The Pennsylvania State University

The Graduate School

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THE DEVELOPMENT AND VALIDATION OF THE SELF-EFFICACY BELIEFS ABOUT EQUITABLE SCIENCE TEACHING AND LEARNING INSTRUMENT FOR PROSPECTIVE ELEMENTARY TEACHERS

A Thesis in

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by

Jennifer M. Ritter

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We approve the thesis of Jennifer M. Ritter.

Date of Signature

_____ _____

Peter A. Rubba
Professor of Education
Thesis Advisor

_____ _____

Thomas M. Dana
Associate Professor of Education
Chair of Committee

_____ _____

Jeanne Brady
Assistant Professor of Education

_____ _____

Rustum Roy
Evan Pugh Professor Emeritus of Material Science

_____ _____

Carla Zembal-Saul
Assistant Professor of Education

_____ _____

J. Daniel Marshall
Associate Professor of Education
Coordinator for Graduate Studies in Curriculum and Instruction

ABSTRACT

The purpose of this study was to develop, validate and establish the reliability of an instrument to assess the self-efficacy beliefs of prospective elementary teachers with regards to science teaching and learning for diverse learners. The study used Bandura's theoretical framework, in that the instrument would use the self-efficacy construct to explore the beliefs of prospective elementary science teachers with regards to science teaching and learning to diverse learners: specifically the two dimensions of self-efficacy beliefs defined by Bandura (1977): personal self-efficacy and outcome expectancy. A seven step plan was designed and followed in the process of developing the instrument, which was titled the Self-Efficacy Beliefs about Equitable Science Teaching or SEBEST. Diverse learners as recognized by *Science for All Americans* (1989) are "those who in the past who have largely been bypassed in science and mathematics education: ethnic and language minorities and girls" (p. xviii). That definition was extended by this researcher to include children from low socioeconomic backgrounds based on the research by Gomez and Tabachnick (1992).

First, the researcher defined the self-efficacy construct to be measured and a content matrix for the instrument that identifies the two dimensions of self-efficacy: personal self-efficacy and outcome expectancy and the four diverse learner groups: ethnic, gender, language minorities and socioeconomic status. Second, one hundred ninety-five draft Likert type items, modeled after those composing the STEBI A (Riggs, 1988) and STEBI-B (Enochs & Riggs, 1990) were prepared with at least six representatives for each cell in the content matrix. Third, the draft items were reviewed independently for clarity and comprehension by ten graduate students in science education. Fourth, a panel composed of eight faculty members representing science education, multicultural education, and self-efficacy research independently judged the content validity of the revised items.

Fifth, the 48 remaining items were organized as a draft SEBEST instrument. The draft instrument was administered to 226 prospective elementary teachers in the

Elementary-Kindergarten Education Program (EK ED) at Penn State in the Fall of 1998. The item analysis was performed with the following goal:

> What is the most reliable and valid combination of items to compose the SEBEST for the purposes of assessing prospective elementary teachers self-efficacy beliefs for teaching science to diverse learners, and the two dimensions of self-efficacy: personal self-efficacy and outcome expectancy?

Sixth, using the results from factor analyses, Coefficient Alpha, and Chi-Square a 34 item instrument was found to achieve the greatest balance across the construct validity, reliability and item balance with the content matrix. The 34 item SEBEST was found to load purely on four factors across the content matrix thus providing evidence construct validity. The Coefficient Alpha reliability for the 34 item SEBEST was .90 and .82 for the PSE sub-scale and .78 for the OE sub-scale. A Chi-Square test ($X^2 = 2.71$, $df = 7$, $p > .05$)was used to confirm that the 34 items were balanced across the Personal Self-Efficacy/Outcome Expectancy and Ethnicity/Language Minority/Gender/Socioeconomic Status/ dimensions of the content matrix.

In the seventh step the SEBEST was to administered to 102 prospective elementary teachers in the Elementary-Kindergarten Education Program (EK ED) and 23 prospective elementary teachers in the Urban Early and Middle Childhood Education Program (URBED) at Penn State at mid-term, in the Spring of 1999, and administered again to the EK ED prospective elementary teachers at the end of the semester, to gather further information regarding the construct validity and reliability, particularly test-retest reliability. The reliability for the of the SEBEST for the URBED student teachers was .90 for the entire instrument, .81 for the PSE sub-scale and .88 for the OE sub-scale. The reliability for the SEBEST for the EK ED group was .88 for the entire instrument, .83 for the PSE sub-scale and .85 for the OE sub-scale. ANOVA was performed on mid-semester data to determine if the SEBEST could differentiate between prospective teachers prepared to teach diverse populations (i.e., the URBED sample) and those in a contemporary teacher

education program that appeared not to have a particular emphasis on teaching diverse populations (i.e., the EK ED sample). The ANOVA results showed no difference between the two groups. While this finding did not provide further evidence of construct validity, it did not distract from the instrument's construct validity. The non-significant ANOVA results were attributed to no difference in self-efficacy beliefs between the two samples, due to the EK ED program having diversity elements throughout the program. Also, one or both samples could have had inflated self-efficacy perceptions regarding science teaching and learning for diverse learners.

Test-retest reliability was calculated by applying a Person-Product-Moment to the EK ED data collected at mid-semester and at the end of the semester. SEBEST test-retest reliability was .70. The PSE sub-scale test-retest reliability was .70 and the OE sub-scale test-retest reliability was .67.

Based on the standardized development procedures used and the associated evidence, the SEBEST appears to be a content and construct valid instrument, with high internal reliability and moderate test-retest reliability qualities, for use with prospective elementary teachers to assess self-efficacy beliefs for teaching and learning science for diverse learners. Further study of the instruments construct validity is recommended. Norming the SEBEST may provide some insights concerning the test-retest results and will provide additional information on the SEBEST that will be useful to users. Additionally, development of a form of the SEBEST for practicing elementary teachers should be pursued.

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I would like to thank my family. Scripture says that "You should honor your mother and father." I always smile when I see this because this is an easy commandment for me to follow. It has been a privilege to have my parents in my life and I am most grateful to both them for all of their support. They are the greatest teachers I have ever had. My dad taught me to work hard and not to be afraid of a challenge. He encourages me to dream and I love him for this. My mom taught me to love without counting the cost. I grew up seeing how much she loved the children in her classroom and knew that I wanted to teach in the same way. They provided me with financial assistance to complete this project but most of all they were always there with a listening ear. I dedicate this work to them.

To my Benedictine family: The community continues to provide the inspiration in how I want to live my life. I chose a study that would look at how to include diverse learners in science education because of the community's commitment to social justice. The greatest honor they can give me is to call me their sister.

Their are also many friends that I have been blessed with that I would like to thank. I would like to thank the Poorbaugh family: Dick, Nancy, Holly, and Brenda, for their support. Their friendship has meant a great deal to me, and I consider myself fortunate to have been included in their family. I would like to thank Uhmmahan and Berk for sharing their precious time with Erdat. I would like to thank Erdat for his statistical as well as computer help in completing my study. I would like to thank Donna and Russell for their help in listening to me over the years. I would also like to thank all my elementary and college students. I have learned more about the art of teaching from them and they continue to help me improve my own practice.

St. Benedict says before you begin any good work you should pray that God brings it to perfection. When I first came here I prayed that prayer. I know that this work is not prefect but my hope is in some small way it lives up to the Benedictine motto:

Ut in omnia glorificetur Deus.

CHAPTER 1

The Problem

The *National Science Education Standards* (1996) and *Science for All Americans* (1989) advocate that all students attain scientific literacy.[1] The *National Science Education Standards* (NSES) state that "Scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity" (p. 22). As stated in *Science for All Americans* (SAA), scientific literacy can lead to the development of students' individual lives as well as their participation in society:

> Education has no higher purpose than preparing people to lead personally fulfilling and responsible lives. For its part, science education--meaning education in science, mathematics and technology--should help students to develop the understandings and habits of mind they need to become compassionate human beings able to think for themselves and to face life head on. It should equip them also to participate thoughtfully with fellow citizens in building and protecting a society that is open, decent, and vital. (p. 3)

These goals of providing meaningful science education for personal and social decision making are admirable, and their optimistic vision for reforming science education are to be celebrated. The reason, however, that these were posed is that our K-12 education system has failed to develop a scientifically literate populace. Science educators are being challenged to reconceptualize science curriculum, teaching, learning and evaluation. No where is the challenge more critical than at the elementary school level

[1] The National Science Education Standards (1996) and Science for All Americans (1989) are documents that work for scientific literacy based primarily on a Western science philosophy. The author wishes to note that this will be the position in this paper but acknowledges that other sciences can an do contribute to our understanding of our surroundings and that these philosophies need to recognized as contributing agents.

where children are introduced to science but some do not pursue science courses and careers in high school.[2]

This challenge may not be seen as critical by some given the Third International Mathematics and Science Study (TIMSS, 1997) results. "In science content areas, our fourth graders' performance exceeds the international average in all four of the areas assessed. In three of these content areas--earth science, life science, and environmental issues and the nature of science --U.S. fourth grade students are significantly outperformed by only one or two other nations. In physical science, only five other nations perform significantly better than the U.S." (Pursuing Excellence: A study of U.S. Fourth and Eighth Grade Mathematics and Science Achievement in International Context, 1997 ht.//nces.ed.gov/TIMSS/). However, while the TIMSS data for grade four suggests that we are moving toward achievement of goal of being "first in the world in mathematics and science achievement by the year 2000," these data do not indicate whether all groups of elementary students performed equally well. By contrast, the most recent National Assessment of Educational Progress (1996) (NAEP) results for 9-year-olds (fourth grade) shows differences in science proficiency assessment by race, ethnicity and gender. The NAEP 1995 found that for the 9 year-old group, males out performed females; that White, non -Hispanic children scored higher then Black and Hispanic children; with Hispanic children scoring the lowest. The NAEP 1995 results also show that 13 year-old males did better then females, that White non-Hispanic children scored higher then Hispanic children and that Black children scored the lowest.

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[2] A critical question can be raised regarding why scientific literacy is deemed important when 95% of our population is not scientifically literate and are highly functioning. First, this researcher believes that if we accept the premise of the argument that "education has no higher purpose then preparing people to lead personally fulfilling and responsible lives" the likelihood is that the lives of those who are not scientifically literate would be more fulfilled if they would have a great understanding of the world around them. Second, diverse students must be equally exposed to some form of scientific literacy in order to have any possibility of future careers in a scientific endeavor. By finding ways to better achieve this goal, which is the purpose of this study, the paradigm of who is included in the science widens.

Studies have shown gender inequity by higher academic achievement for boys than girls. Classroom interactions between teacher and students that favor boys, sexual stereotyping, and gender bias in curricular materials. (AAUW, 1992; Kahle & Meese, 1994; Kelly, 1985; Tobin, K., & Garnett, P. 1987) Several studies have documented that teachers interact with male students more then females (Brophy & Good, 1970; Datta, Schaefer, & Davis, 1968; Dweck & Bush, 1976; Martin, 1972; Sadker & Sadker, 1985; American Association of University Women, 1992), especially White males (Irvine, 1990; Sadker & Sadker, 1981). Jackson and Cosca (1974) and Sadker and Sadker (1981) found that teachers interact with, call on with greater frequency, praise more highly, and intellectually challenge students who are middle class, male, and White.

Additionally, teachers have been found to lack knowledge about the history, ethnicity and culture of their children (Pearson, 1986). Allen and Seumptewa (1988) found that many of the non-Native American teachers who teach Native American students are in a quandary with the difference in the way that the children learn. These teachers often leave the reservation because they do not feel that they connect with the students. Stegemiller (1989) concluded from an analysis of 31 studies that teacher expectations of students' are based on four factors: social class, attractiveness, ethnicity and perhaps gender. Thus, a white boy who comes from a middle or high socioeconomic class and is academically average to above average, has multiple advantages with the teacher over a minority girl or a student who comes from a low socioeconomic home or is academically challenged.

The inequality in interaction between teachers and students who are from low socioeconomic homes, ethnically and culturally diverse and girls is compounded by the curriculum of science, which has been neglected in the elementary classroom (Tilgner, 1990; Westerback, 1982). This neglect is evident in the limited time teachers spend on teaching science, teachers lack of confidence in their ability to understand science content and to be able to teach that content effectively and their negative attitude toward the science curriculum.

The teachers' attitude and interaction are critical elements in the success of scientific literacy for all students. Elementary teachers have been known to have negative attitudes toward science (Shrigley, 1974), do not care for science (Tilgner, 1990), and do not have confidence in their ability to teach science (DeTure, Gregory, & Ramsey, 1990; Sunal, 1980 as cited in Park, 1996). This in turn causes elementary teachers to avoid teaching science to children (Czerniak & Chiarelott, 1990; Westerback, 1982, 1984) or spend less time teaching science as compared to other subjects (Good & Tom, 1985; Weiss, 1987; Westerback, 1984). Czerniak & Chiarelott, (1990) found that the negative attitudes of teachers can be correlated to students negative attitudes about science. An attitude according to Enochs and Riggs (1990) "is a general positive or negative feeling toward something" (p. 625). A belief as defined by Koballa and Crawley (1985) is "information that a person accepts to be true" (p.223). Both, however influence behavior. Thus, teachers' attitudes, beliefs and interaction are critical elements in the success of scientific literacy for all students.

Currently, 25 of the 50 largest school districts in the United States have children of color as the majority student population (Banks, 1991). In states such as New Mexico, Texas and California children of color comprise 70 percent of the total student population (Quality Education for Minorities Project, 1990). Children of color make up 30 percent of the students in the country overall and the growth rate of the minority population segment is expected to increase to 40 percent by the year 2020 (Pallas, Natriell, & McDill, 1989). By contrast, when the demographics of the prospective elementary teacher population is examined it is found to be predominately white, middle class and female (Banks, 1991). The elementary teacher population continues to be Caucasian, monolingual, and female with backgrounds different from those they will teach while, the face of the school population in the United States is becoming more diverse (American Association of Colleges of Teacher Education, 1987; Banks, 1991; Ducharmen and Agne, 1989; Haberman, 1987; Hodgknison, 1985).

Science for All Americans (1989) recognizes these inequalities and proposes that scientific literacy needs to be a goal of school science education for all young people, "those who in the past who have largely been bypassed in science and mathematics education: ethnic and language minorities and girls" (p. xviii). Questions concerning how scientific literacy can be achieved given inequality in interaction due to race, class and gender differences and teacher attitudes concerning the science curriculum are vital.

To ensure scientific literacy for all, it is important for elementary teachers to understand student diversity and be able to teach science for a diverse student population. Part of the solution may be in understanding the behaviors of prospective elementary teachers. Teacher beliefs appear to be good predicators of behavior (Ashton & Webb, 1986a, 1986b; Bandura, 1986; Riggs, 1988; Riggs & Enochs, 1990). Teacher self-efficacy beliefs, in particular, have been found to be valid predictors of practicing and prospective elementary teachers' behavior regarding science teaching and learning (Ashton & Webb, 1986a, 1986b; Bandura, 1986; Riggs, 1988; Riggs & Enochs, 1990). This study builds upon the work of Ashton and Webb (1986a, 1986b) Bandura (1977, 1986) Riggs (1988) and Riggs and Enochs, (1990) and apply it to prospective elementary teachers' beliefs about science teaching and learning for diverse learners.

Purpose of the Study

The purpose of this study is to develop, validate and establish the reliability on an instrument to assess the self-efficacy beliefs of prospective elementary teachers with regards to science teaching and learning for diverse learners. The instrument will be modeled after Riggs (1988) Science Teaching Efficacy Belief Instrument (STEBI) and Enochs and Riggs (1990) Science Teaching Efficacy Belief Instrument for Prospective Teachers (STEBI-B) and will be titled Self-Efficacy Beliefs about Equitable Science Teaching (SEBEST), .

As described in *Science for All Americans* (1989) diverse learners include those students "who in the past have largely been bypassed in science and mathematics education: ethnic and language minorities and girls" (p. xviii). For this study the definition is being extended to include children from low socioeconomic backgrounds. Grant and Tate (1995) agree "educational research becomes problematic when it does not include race, *class*, and gender, and/or when these constructs are not rigorously interrogated" (p. 147). The issue of successful teaching and learning of science is compounded by the issue of class because science requires that teachers and students engage the curriculum through the use of materials and supplies in order to fully understand the concepts being taught. School districts in the poorest parts of our country, who also serve the lowest socioeconomic class lack the necessary textbooks and supplies to be able to create active learners. (Kozol, 1991) Thus, a diverse learner to science education is a person who has been identified by science education research (NSES, 1996; NSTA Pathways, 1997 & SAA, 1989) as one who has not achieved the success in science education as compared to their peers for reasons that may be attributed to but are not limited to race, class, ethnic, cultural backgrounds and gender. Realizing that some groups of people have been bypassed by science education, attention needs to be directed to the educators who can influence a change in this pattern. By studying the self-efficacy beliefs of prospective teachers researchers may be able to understand and influence the educational curriculum of prospective teachers and reverse stereotypes concerning peoples ability to learn and do science.

According to Bandura (1986) the construct of self-efficacy beliefs consist of the two dimensions: personal self-efficacy and outcome expectancy. Personal self-efficacy "is a judgment of one's ability to organize and execute given types of performances, whereas an outcome expectation is a judgment of the likely consequence such performances will produce" (Bandura, 1997 p.21).

Significance of the Study

The study will extend the self-efficacy theory base. The proposed instrument to be named Self-Efficacy Beliefs about Equitable Science Teaching (SEBEST), will be built on the theoretical framework explicated by Bandura (1977, 1986), and extended by Gibson and Dembo (1984), Riggs (1988) and Enochs and Riggs (1990). This study will use Bandura's theoretical framework, in that, the SEBEST will use the self-efficacy construct to explore the beliefs of prospective elementary science teachers with regards to science teaching and learning to diverse learners.

Development of an instrument to measure the self-efficacy beliefs of prospective elementary teachers will provide the means to fill a gap in the literature and our understanding of prospective elementary science teachers' self-efficacy beliefs about science teaching and learning for diverse learners. A review of the literature conducted by the author showed a number of studies dealing with self-efficacy beliefs (Bandura 1977, 1986), teacher self-efficacy beliefs (Ashton and Webb 1986a, 1986b), the science self-efficacy beliefs of inservice teachers (Riggs, 1988), and science self-efficacy beliefs of prospective teachers (Enochs & Riggs, 1990). However, there have been no studies on prospective elementary teachers' self-efficacy beliefs about science teaching and learning with regard to diverse learners. The SEBEST instrument, should have great value to science teacher educators and researchers. The National Council for Research notes in *Science Education Standards* the need for science to be taught in an equitable fashion. (NSES, 1996) The 1996 NAEP data on the science performance of diverse students as cited above, reinforces the need for a better understanding of prospective elementary teachers beliefs about science teaching and learning for diverse learners.

The target population for the SEBEST, prospective elementary science teachers, could be in the teaching profession for thirty or more years over a time span when current minority student population will increase nationwide and become the majority in most school districts. These teachers are an influential population in the educational success of

the generations of children to follow, which adds significance to the development of SEBEST and this study.

Assumptions

This study will be based on the following assumptions:

1. Prospective elementary teachers honestly responded to the items in the SEBEST instrument.
2. Development of a quality, reliable measurement instrument, to some degree must be based on judgment, given that validity and reliability are never proven.

Limitations

This study will have the following limitations:

1. The samples of prospective elementary teachers used in this study may not be representative of the total population of prospective elementary teachers in the United States.
2. Error, which is impossible to totally detect and remove, will have an effect on the data collected and used in this study.

Definition of Terms

The following terms are defined as they will be used in this study**:**

Belief - Koballa and Crawley (1985) defined belief as “information that a person accepts to be true” (p. 223)

SEBEST(Self-Efficacy Beliefs about Equitable Science Teaching) -The instrument developed and validated in this study to measure prospective elementary teachers self-efficacy beliefs about science teaching and learning for diverse learners.

Content Validity - "refers to the degree to which the sample of items, tasks, or questions on a test are representative of some defined universe or domain of content" (Standard for Educational and Psychological Testing, 1985, p. 10).

Construct Validity - "focuses primarily on the test score as a measure of the psychological characteristic of interest" (Standard for Education and Psychological Testing, 1985, p.9). In this study the constructs are identified as personal self-efficacy beliefs and outcome expectancy beliefs with regards to teaching science to diverse learners.

Class -"refers to the economic, social, and political relationships that govern life in a given social order. Class relationships reflect the constraints and limitations individuals and groups experience in the areas of income level, occupation, place of residence and other indicators of status and social rank" (Grant & Ladson-Billings, 1997, p. 44).

Diversity - "diversity refers to differences among people" (Grant & Ladson-Billings, 1997, p. 93).

Diverse learner - A person who has been identified by science education research (NSES, 1996; NSTA Pathways, 1997; SAA, 1989) who has not achieved the success in science education as compared to their peers for reasons that may be attributed to but are not limited to race, class, ethnic, cultural backgrounds and gender.

Elementary Science Education -The science teaching and learning that occurs in grades K-6 or in grades K-8 if the seventh and eighth grade are located in an elementary school building.

English as a Second Language - "the field of teaching English to speakers of other languages" (Teachers of English to Speakers of Other Languages, 1976, p.76).

Outcome Expectancy - "a person's estimate that a given behavior will lead to certain outcomes" (Bandura, 1997, p. 193).

People of Color - Historically used in the 1960's the term people of color has returned to the scholarly literature t to refer those people other then the white population.

Personal Science Teaching Efficacy Beliefs - "This dimension of elementary science teachers' self-efficacy refers to the teachers' belief in their ability to perform teaching behaviors in science." (Riggs, 1988, p. 20)

Personal Self-Efficacy - "People's judgments of their capabilities to organize and execute courses of action required to attain designated type of performances" (Bandura, 1986, p. 391).

Prospective Elementary Educator -The student who is in the last two semesters of their elementary teacher education program preparing to become a certified elementary educator.

Self-Efficacy Beliefs - Consist of two cognitive components, personal self-efficacy and outcome expectancy, to influence people's choice of behavior (Bandura, 1977, 1986 as cited in Park, 1996, p. 5)

Science Teaching Efficacy Beliefs - "Those beliefs of elementary teachers which include both outcome expectancies and self-efficacy beliefs in the area of science teaching. (Riggs, 1988, p. 20)

Science Teaching Outcome Expectancy - "This dimension of elementary science teachers' self-efficacy belief reflects that degree to which elementary teachers believe students can be taught science given external factors such as their family background, socioeconomic status (SES), or school conditions." (Riggs, 1988, p. 21)

STEBI (Science Teaching Efficacy Belief Instrument) - the instrument developed and validated by Riggs (1988) to measure elementary teachers' personal science teaching efficacy beliefs and science teaching outcome expectancy.

STEBI-B (Science Teaching Efficacy Belief Instrument for prospective teachers) - The instrument developed and validated by Enochs and Riggs (1990) to measure prospective elementary teachers' personal science teaching efficacy beliefs and science teaching outcome expectancy.

Socioeconomic Status - is a term used by the U.S. Bureau of Census to measures the economic condition of individual with a criterion called socioeconomic status (SES). (Grant and Ladson-Billings, 1997, p. 248)

Reliability - "refers to the degree to which test scores are free from errors of measurement" (Standard for Educational and Psychological Testing, 1985, p. 19).

Validity - "the appropriateness, meaningfulness, and usefulness of the specific inferences made from test scores. Traditionally, validity evidence categories content, criterion, and construct validity. An ideal validation includes all three of the traditional categories" (Standard for Educational and Psychological Testing, 1985, p. 9).

CHAPTER 2

Review of Literature

Knowledge of science empowers the knower to ask questions and seek answers. Science education, as a means of developing such knowledge, continues to grow in its importance as we embark on the next millennium. Science and technology are growing at an expeditious rate. Science research is being completed and disseminated faster than at any other time in history. Technology is having greater impact upon our lives at home, work and play. We live in a science and technology dependent world. Citizens need to be able to deal with science and technology as it impacts all aspects of their lives. The continuous reform of science education is, therefore, important in empowering future citizens with the knowledge, skills and disposition needed to live in a science and technology dependent world. As part of this reform, the vision is for a future in which science education provides the means for all students to achieve scientific literacy.

A pivotal event in the development of science education reform in the U.S. was the launch of Sputnik I by the Soviet Union in the late fifties, which prompted reassessment of the quality and quantity of science offered in American schools. Although research on the reform of science education for American schools had been ongoing since the time of Jefferson and Franklin (Montgomery, 1994), the space race, beginning in the sixties, gave a new priority to examining how science had been taught in school in order to increase student achievement in science on a national scale. Therefore, during the sixties, science instruction for developing the next generation of scientists, especially for space exploration, became a national goal. To maintain its position as the leading world power, American government and business found it economically and politically imperative to lead the Soviet Union and other nations in science education and scientific progress.

Historically, science education has been a way to create scientists (Montgomery, 1994). The programs and the curriculums have been aimed at students who chose science careers. Today, America still aspires to be first in science and scientific discoveries,

although it realizes that directing the teaching of science to the top 10% of the students in its classrooms, as in the past, has failed to create a scientifically literate population (Roy, 1997). However, the current state of education reform of science education in the U.S. includes efforts to discover how our present teaching of science affects those who are learning it and to find the appropriate methods to teach all students science so that they can become scientifically literate.

Scientific Literacy for All

America can no longer afford to direct science education to mainly those who will become scientists. Instead, it must teach all children to be consumers of scientific and technological data to function in their daily lives. Everyone must be able to understand scientific information as the basis for making decisions that affect their lives and the lives of others. "Scientific literacy also is of increasing importance in the workplace. More and more jobs demand advanced skills, requiring that people be able to learn, reason, think creatively, make decisions, and solve problems" (National Science Education Standards, 1996 p. 1) Scientific literacy is critical to daily life for everyone. Yet, we are not reaching the goal of scientific literacy for all persons (NEAP, 1996)

According to global studies (NEAP, 1996) on educational performance, U.S. students rank near the bottom of all students tested internationally in science and mathematics. The National Assessment of Education Progress found that U.S. graduates in 1986, on average, scored considerably lower overall than U.S. graduates in 1969. Knowing that a shift was needed in the direction of science education towards scientific literacy for all, The National Science Teachers Association proposed the writing of national science education standards. Hundreds of people, including teachers, parents, scientists, and government officials, developed the standards, and thousands reviewed drafts of the standards, which were developed into the document, *National Science Education*

Standards, published in 1996, to guide education in achieving scientific literacy for all students.

According to the NSES (1996), scientific literacy "is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity" (p. 22). The overview to the NSES suggests three primary reasons that scientific literacy is important for all persons: 1) "everyone needs to use scientific information to make choices that arise every day;" 2) "everyone deserves to share in the excitement and personal fulfillment that can come from understanding and learning about the natural world;" and 3) "to keep pace in global markets, the United States needs to have an equally capable citizenry" (pp. 1-2). In particular, persons need to be scientifically literate to participate in public debate and discussion about the science issues that affect them personally and publicly. Decisions regarding cloning, for example, need to be made by an informed society that understands both what this scientific discovery has to offer and what the undesirable consequences of it may be. As another example, U.S. citizens are faced with decisions in their lives related to important environmental issues such as auto emissions, pesticide use and water pollution.

Support for the goal of creating a scientifically literate population has received considerable attention in other academic publications. The American Association for the Advancement of Science (AAAS), in its *Science for all Americans: Project 2061* (1989), outlines what all high school graduate need to achieve scientific literacy, and why:

> Education has no higher purpose than preparing the people to lead personally fulfilling and responsible lives. For it part, science education--meaning education in science, mathematics, and technology--should help students to develop the understandings and habits of mind they need to become compassionate human beings able to think for themselves and to face life head

> on. It should equip them also to participate thoughtfully with fellow citizens in building and protecting a society that is open, decent, and vital. (p. xiii)

The National Science Teachers Association, in their *NSTA Pathways to Science Standards* (1997), encouraged educators to recognize the importance of elementary years as a period in which curiosity, motivation, and exploration for discovery are at a peak for both boys and girls. Thus, science education reform needs to concentrate its efforts on elementary science to ensure scientific literacy for all, which includes providing an equitable opportunity to all students to learn science. This document states:

> Every school program must ensure equity for every child regardless of gender, background, learning style, or ability. Equal opportunity to learn often requires unequal distribution of time and personnel. Minority students may need role models; at risk students may need extra attention; and students from language-deprived or non-English speaking backgrounds will need additional time and/or staff in order to participate equally in science classroom experiences. (p.114)

Equal verses Equitable Education

The NSES (1996) advocate that all students obtain scientific literacy, emphasizing both "excellence and equity" (p. 2). Each child must be ensured an equal opportunity to succeed in science regardless of their gender, class, or ethnic background. Streitmatter (1994) examines the issues of equal and equitable in regard to providing a science curriculum for all students. His idea of "equal" is that each student has the same opportunity to learn science and receives the same treatment. Secada (1989) states "educational equality in education often gets defined in terms of inequality its opposite. Commonly, groups are defined along some demographic characteristic: social class, race,

gender, ethnicity, language background, Aggregate difference along the groups are then explored using some educationally important index. Group differences are interpreted to demonstrate the existence of inequality. Equality, therefore is defined implicitly as the absence of these differences." However, Streitmatter believes that to be equitable, teachers need to recognize that there are differences among the students and that their diversity needs must be considered when teaching them. Thus, not only do the inputs of the teacher, the curriculum, and the prior knowledge of the students need to be calibrated into the learning equation, but all the outputs, meaning the achievements of the students, regardless of their life experience (Subrahmanyan & Bozonie, 1996).

Secada (1994, cited in Atwater, 1995) also discusses equitable education, stating, "Equity is an appeal to justice beyond the letter of a law;" it is "an effort to codify what a society believes is just....Equity in education refers to the scrutiny of social arrangements that undergird schooling to judge whether or not those arrangements are consistent with standards of justice" (pp. 22-23). The essence of equity is, therefore, not that everyone be given the same measure, but each child receives the measure she or he needs to achieve understanding.

Recognizing from the research that the needs of the student are critical is the beginning of the process of achieving equity in education. According to the definition provide by Grant and Ladson-Billings (1997), education equity, in contrast, would not only get the children "in the door", but also would address children's cultural and individual differences in curriculum and instruction. In an equitable classroom, activities would be adapted to meet the learning challenges of children with developmental differences and teachers would not make assumptions that all children had similar middle-class, dominant culture background experiences and would not make academic success dependent on these experiences. In other words, equal opportunity is the first step toward educational equity. Sonia Nieto (1996) supports this notion in her understanding that multicultural education cannot be understood in a vacuum but that it concerns raising the

achievement of all students and thus providing them with an equitable and high quality education" and providing an apprenticeship in the opportunity to become critical productive members of a democratic society" (p. 9). However, we also must examine the role that the teacher plays in managing the classroom and creating an equitable environment for helping students to achieve scientific literacy.

Rosser (1986) explores equity issues, that impinge on the science classroom, "what questions are asked, who is allowed to do the asking, what information is collected, and who interprets that information creates a particular vantage point from which knowledge is perceived " (p. 544). In order to create equity in science education, students need to be involved in asking and answering the questions and in helping to determine what data is important to collect or to learn, whereas traditionally the teacher has asked the questions and directed the learning. Results of this classroom inquiry must be discussed and understood through collaboration among the students and the teacher.

Research on Science Education and Equity

Equity in science education is an issue mainly because of the low numbers of women and minorities currently in and entering science fields. Kelly (1985) asks: who teaches science, who studies science, and how is science presented? Her conclusion is that science has a masculine image. As shown by a meta-analysis of 300 studies on achievement in elementary science, boys scored slightly better then girls; however, by middle school, the difference in achievement by gender had increased considerably in favor of the males (Malone & Fleming, 1983). Atwater (1994, citing Rakow, 1985) noted that the National Assessment in Science data for 1981-1982 report that 9-year-old white males had the most positive attitudes toward science, while 9-year-old African-American females had the least positive attitudes toward science. When data were collected for all ages, Hispanic females had the least positive attitudes toward science, and white males had the most positive attitudes toward science of any of the groups (p. 564).

Rakow (1985) believes that this assessment was gender based rather then ethnic based. Kahle (1994) writes that a "summary of analysis of the research on mathematics and science achievement reveals several important discrepancies. The gender gap in science achievement increases from ages 9 to 13, although most boys and girls are enrolled in similar courses during those years. Boys and girls also have vastly different science-related experiences outside school that contribute to the gender gap in science achievement" (p. 544). These conclusions are exemplified by Kahle and Lakes (1983) and Linn (1990). For example, in our society, boys are more likely to have experience with equipment such as electrical circuits or engines than girls. Therefore, when boys go into classrooms where they will study these topics, they have more prior knowledge than those who have not had these experiences, which usually means girls. These assertions are by Steinkamp and Maher's (1984) study which reported that gender differences in science are greatest in middle school. In a meta-analysis on why females and males performed differently in science, Linn and Hyde (1989) reported that the discrepancy in achievement between males and females is related to issues of society rather than to those of a biological nature (Shakeshaft, 1995). Thus, girls also may not be achieving in science as well as boys because of the social structure, not necessarily because of their biological make up.

Also at issue in regard to equity in science education is the number of women and men in science in proportion to the population. The current world demographics have the total female/male population distribution at 51% and 49%, respectively. Among the number of scientists employed in 1990, only 33% of the population were women, and as few as 2.5 were minorities (National Science Foundation, 1990). Consider that in the year 2000, some 66% of those seeking employment will be women and 30% will be minorities (Southern Growth Policies Board, 1988). Both women and minorities need to be provided with equitable opportunities to enter fields of science and compete for positions in these fields.

In addition, as the racial and gender makeup of the world population changes, science education needs to adapt its instruction to the learning styles of the culturally and geographically diverse peoples, such as Native Americans, African Americans, and those living in rural areas. By knowing the learner, particularly from a cultural perspective, teachers of science education can begin to provide them with what they need in order to achieve scientific literacy.

Teacher's Role in Equity in Science Education

The person with the power to create an equitable environment for science learning, and to encourage gender and cultural equity in science is the classroom teacher. The teacher is the curriculum maker and controls the instructional setting. In many cases, the teacher spends more time with the child than the parents, especially in the elementary years. However, the teacher may be inadequately prepared to teach elementary science for lack of content and pedagogical knowledge. Richards (1995) states, "Too many young people of all backgrounds receive inadequate science teaching in grades K-9. These are the crucial years when children are interested in a variety of subjects" (p. 16).

The role of the teacher is critical in the promotion of scientific literacy. Two areas that teachers can control are their expectations for students and their interactions between and with students. The expectations of teachers, as well as those of parents, show a positive correlation with students' achievement in science courses. When students are stereotyped by the teacher's low expectations, their achievement is lower than anticipated (Lowery, 1997). Fraser (1994) writes that exemplary teachers have high expectations for students. His research found that the expectations of a teacher affect students' attitudes toward the learning environment. Stegemiller (1989) found that expectations are based on four elements: social class, attractiveness, ethnicity, and gender. Students' perception of inequity in their teachers' attitudes or behaviors may be accurate: students in the classroom are treated differently.

Studies by Jones and Wheatly (1990), Kahle (1990), Morse and Handley (1985), and Tobin and Garnett (1987) provide data that support the idea that children are not treated equally. Kahle and Meece (1994) found that :

> Compared with girls, boys are more likely to initiate teacher interactions, to volunteer to answer teacher questions, to call out answers, and to receive praise, criticism, or feedback to prolong teacher interactions. These classroom interaction patterns result in greater opportunities for boys than girls to learn in science and may reflect favorable achievement expectations for boys. (p. 550).

Teachers are often unaware of hidden bias (Lowery, 1997: Morrison, 1990). This is evident in the different expectations teachers, as well as parents, have of children, the kinds of questions that are asked by the teacher and who is called on to answer, the type of activities that are chosen, and the meaning they have for children.

The second area in which teachers are able to promote scientific literacy is in the interaction among and between students and the teacher. By creating a science environment in which one's prior knowledge, experience, and understanding are appreciated by all, the teacher enables the child to achieve better self-esteem and is likely to be more successful in science. Thus, teachers play a critical role in providing an equitable environment in science education. But first they must receive quality instruction in content and pedagogical practice for teaching science. Second, they must identify and confront any hidden bias they may have regarding gender, race, and class. In the identification of these biases, teachers must strive to maintain high expectations for all children. They must, in turn, model acceptance and appreciation for all children's prior knowledge and experience. In considering the critical role the teacher plays in the achievement of students, the question arises: How can

prospective elementary teachers beliefs about teaching equitable science to diverse students be assessed?

Self-Efficacy Beliefs

In research with phobics and heart attack patients Albert Bandura (1977) conceptualized the theory of self-efficacy beliefs. Bandura's self-efficacy theory was based on a relationship that he proposed existed between personal self-efficacy and the actions and behaviors of these patients. Bandura postulated that "self-efficacy beliefs influence the course of action people choose to pursue, how much effort they put forth in given endeavors, how long they would persevere in the face of obstacles and failures, their resilience to adversity, whether their thought patterns are self-hindering or self-aiding, how much stress and depression they experience in coping with taxing environmental demands, and the level of accomplishments they realize" (p. 3).

Bandura (1995) contrasts people with different senses of efficacy as follows:

> People who have a low sense of efficacy in given domains shy away from difficult tasks, which they view as personal threats. They have low aspirations and weak commitment to the goals they choose to pursue. When faced with difficult tasks, they dwell on their personal deficiencies, the obstacles they will encounter, and all kinds of adverse outcomes rather than concentrate on how to perform successfully. They slacken their efforts and give up quickly in the face of difficulties. They are slow to recover their sense of efficacy following failure or setbacks. Because they view insufficient performance as deficient aptitude, it does not require much failure for them to lose faith in their capabilities. They fall easy victim to stress and depression (p. 11).

On the other hand:

> People who have strong beliefs in their capabilities approach difficult tasks as challenges to be mastered rather than as threats to be avoided. Such an affirmative orientation fosters interest and engrossing involvement in activities. They set themselves challenging goals and maintain strong commitment to them. They invest a high level of effort in what they do and heighten their effort in the face of failures and setbacks. They remain task-focused and think strategically in the face of difficulties. They attribute failure to insufficient effort, which supports a success orientation. They approach potential stressors or threats with the confidence that they can exercise some control over them. Such an efficacious outlook enhances performance accomplishments, reduces stress, and lowers vulnerability to depression (Bandura, 1995, p. 39).

Bandura's philosophy of the self-efficacy construct included his theory that self-efficacy beliefs affect how people think, act, feel and motivate themselves concerning all aspects of their lives. He interpreted, however, efficacy beliefs as having varying levels of importance. The most fundamental beliefs are those around which people structure their lives (Bandura, 1997, p. 43). Such beliefs have predictive value because these types of beliefs guide which activities are undertaken and how well they are performed. Bandura found this predictive value to be of the utmost importance because it gave way to the fact that if the self-efficacy beliefs of people could be influenced, people could achieve at levels they once thought they were incapable.

The self-efficacy construct, as described by Bandura, consists of two cognitive dimensions: personal self-efficacy and outcome expectancy. Bandura (1977, 1981, 1986, 1995, & 1997) defined personal self-efficacy as "judgments about how well one can

organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements" (p. 201). Bandura (1977) portrays outcome expectancy as "a person's estimate that a given behavior will lead to certain outcomes. An efficacy expectation is the conviction that one can successfully execute the behavior required to produce the outcomes. Outcome and efficacy expectations are differentiated, because individuals can believe that a particular course of action will produce certain outcomes, but if they entertain serious doubts about whether they can perform the necessary activities such information does not influence their behavior" (p. 193). Bandura (1997) also noted that people who believe that their behavior can influence the outcome of a situation act more assertively then those who believe that outcomes cannot be influenced by their behavior.

The construct of self-efficacy beliefs is grounded in social learning theory and is the product of a complex process of self-persuasion that relies on cognitive processing of diverse sources of efficacy information. These include performance accomplishments, vicarious experience, verbal persuasion and emotional and physiological arousal.

Performance accomplishments or mastery experiences are considered the most influential sources of information for affecting self-efficacy beliefs because they are based on authentic experience in which the participant performs the action (Bandura, Adams, & Beyer, 1977 as cited in Bandura, 1981). Success in mastery experiences is dependent on the participants preconceptions of their abilities, the degree of difficulty of the activity, the effort that they expended, their physical and emotional state, and the degree of external support they receive (Bandura, 1995). The greater the personal self-efficacy the greater the performance accomplishments. The greater the self-efficacy the more likely the participant is to persist in their effort until they succeed. Thus, the greater the self-efficacy belief the greater the influence on the behavior. Success in mastery experiences increases efficacy appraisals whereas repeated failures will lower self-efficacy beliefs. This is especially true

if the failures come before success and does not reflect a lack of effort on the part of the participant.

Vicarious experiences are actions that participants watch others perform in the hope that, by having the desired behavior modeled in a successful manner the participants will be able to repeat the action and also be successful. Brown and Inouye (1978) studied the affects of vicarious experiences and found that "observers who believed themselves to be superior to a failing model maintained high efficacy expectations and did not at all slacken their efforts despite repeated failure. In contrast, modeled failure had a devastating effect on observers' self-judged efficacy when they perceived themselves of comparable ability to the model" (as cited in Bandura, 1997 p. 207). For example, when a prospective teacher identifies with another prospective teacher in ability and who models a performance and fails, it highly influences their own self-efficacy beliefs. Likewise, when a prospective teacher identifies in ability with another prospective teacher who models a performance and is successful this action will positively affect their self-efficacy beliefs. Thus, identification in ability with the person who models the performance the more influential the successes and failures. Participants persuade themselves, that if others can do it, they should be able to achieve at least some improvement in performance.

The third source of information for self-efficacy beliefs is verbal persuasion. In this method participants are verbally told that they possess the capabilities to successfully perform the action. Chambliss and Murray (1979a, 1979b) found that " although social (verbal) persuasion alone may be limited in its power to create enduring increases in self-efficacy, it can contribute to successful performance if the heightened appraisal is within realistic bounds. Persuasive efficacy influences, therefore, have their greatest impact on people who have some reason to believe that they can produce effects though their actions (as cited in Bandura, 1982, p. 127). Verbal persuasion is widely used because of its convenience and accessibility. The success of verbal persuasion is also dependent on the credibility of those who are giving the verbal persuasion. If the participants see them as

credible they are more likely to exert greater effort and sustain it longer than those who harbor self-doubts and dwell on their deficiencies when problems arise (Litt, 1988 Schunk, 1989 as cited in Bandura, 1995, p. 4).

The fourth component of information for self-efficacy beliefs is physiological and emotional states. This source of self-knowledge informs people about their state of being concerning the amount of stress or vulnerability regarding their capabilities for a certain action to be achieved successfully. Individuals with a high sense of self-efficacy can find a heightened sense of arousal as motivating, while those with a lower sense of self-efficacy may experience fear or anxiety that prevents them from attempting the performance.

The four sources of information for self-efficacy beliefs described above are environmental events, however, it is the cognitive realization of these events that must be internalized, processed and transformed to create a persons sense of self-efficacy. The processes that regulate the formation of a persons beliefs are: cognitive, motivational, affective and selection process (Bandura, 1977, 1982, 1989, 1995, 1997). These processes work in collaboration together in the development of the persons self-efficacy beliefs. The relationship Bandura proposes existing between these elements is presented in Figure 1.1 and further described below.

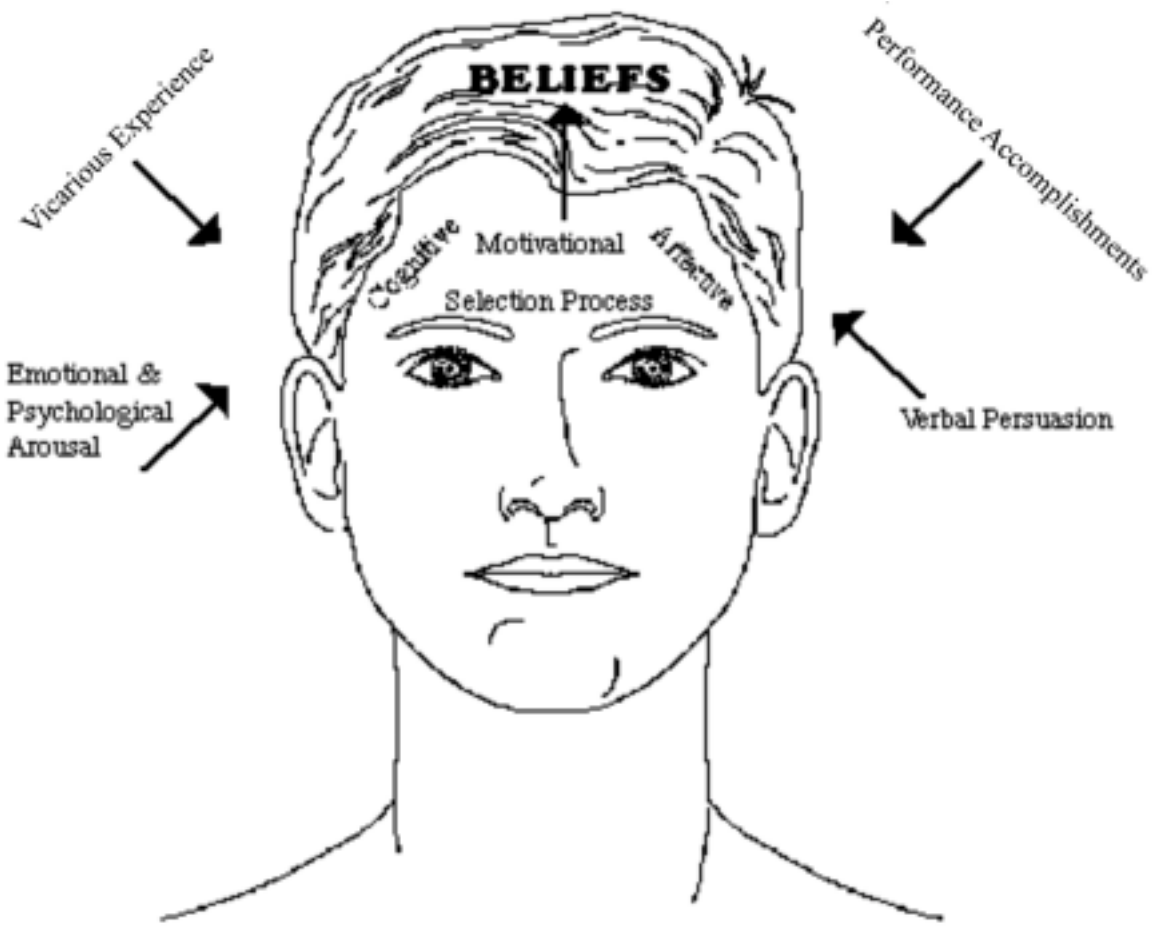

Figure 1.1 Relationship between environmental sources of information and cognitive processing in discerning self-efficacy beliefs.

According to Bandura (1997) “cognitive processes in efficacy judgment have two separable aspects: The first concerns what types of cues people use as indicators of personal efficacy; the second concerns the inference rules or heuristics they employ for integrating efficacy information from different sources in arriving at their self-efficacy judgments (p. 205). Once the cues are observed a successful performance is processed into their existing self-efficacy belief system. A successful performance, however, may not alter a persons existing belief system if their existing self-efficacy beliefs are founded in failure experiences or if they have evidence that the successful performance was associated with luck and not their effort.

The second internal process that determines one’s self-efficacy beliefs is motivation. There are three forms of cognitive motivations: attribution theory, expectancy-value theory, and goal theory. Attribution theory is concerned with how individuals are motivated, behave and emote. The expectancy-value theory is concerned with how a person is motivated to perform a certain behavior to produce a certain outcome. An example of this theory is a student working for a good grade in order to be rewarded by her/his parents. The behavior of doing well in school produces the outcome of a reward. The third theory concerning motivation as an influence in self-efficacy beliefs is goal theory. Locke and Latham (1990) found a large body of evidence that supports that challenging goals enhance and sustain motivation.(as cited in Bandura, 1995) Here an individual forms goals and persists in order to achieve the goals. If the goals are achieved in a successful manner the individuals self-efficacy is enhanced. If the goals are not met, the individual with high self-efficacy will increase their effort, those with a lowered sense of self-efficacy will change the goals.

Affective processes are involved in self-efficacy beliefs by the fact that emotions of individuals direct the individuals actions. Fear, anxiety and depression in those with lowered self-efficacy beliefs will cause these individual’s to protect themselves from future

failure whereas those with high self-efficacy belief will engage in proactive measures to change their emotional state.

The last internal process associated with self-efficacy belief development is selection. In this process the individual chooses activities based on what they are capable of successfully completing, and avoiding activities they feel will make them vulnerable. (Bandura, 1995, 1997).

In summary self-efficacy beliefs are considered to influence the course of action people choose to pursue, how much effort they put forth in given endeavors and how long they would persevere in the face of obstacles and failures. People with a low sense of efficacy shy away from difficult tasks, which they may view has threatening. People with a high sense of efficacy approach difficult tasks as challenges to be mastered rather than as threats to be avoided. Self-efficacy beliefs have been found to have predictive value concerning peoples behavior in relationship to fundamental beliefs around which people structure their lives.

The construct of self-efficacy consists of two cognitive dimensions: personal self-efficacy and outcome expectancy. Personal self-efficacy is concerned with the judgments individuals make in organizing and executing courses of action to deal with situations that are ambiguous, unpredictable and stressful. Outcome expectancy is the estimation that a given behavior will lead to certain outcomes. The construct of self-efficacy is delineated by these two dimensions because an individual may believe that a certain action will produce an outcome but may not have the self-efficacy belief that they can successfully perform the action.

The construct of self-efficacy is grounded in social learning theory and the expectations of personal self-efficacy stem from four main sources of information: Performance accomplishments, vicarious experience, verbal persuasion and emotional and physiological arousal. Performance accomplishments are considered the most influential sources of information for affecting self-efficacy beliefs because they are based on

authentic experience in which the participant performs the action. The second source of efficacy information is vicarious experiences which are actions that participants watch others perform in the hope that by having the desired behavior modeled in a successful manner, the participants will be able to repeat the action and also be successful. The higher the degree of identification that the participant believes exists between themselves and the model, the higher the affective ability with regards to whether the modeled behavior is successful or unsuccessful. Verbal persuasion is the third source of information and is the telling of the participants that they possess the capabilities to successfully perform the action. This process has greater affective value if the persuader is seen by the participant as being credible. This method is used most often because of its availability and ease. It is, however, less effective if the persuasion is considered unrealistic to the participant. The fourth component is physiological and emotional states. In this element the heighten sense of fear and anxiety that a new experience brings to participants will cause those with low self-efficacy to retreat and those with high self-efficacy to become more determined to meet the challenge.

The environmental elements of performance accomplishments, vicarious experiences, verbal persuasion and emotional and physiological states are identified as information sources of efficacy beliefs, however, a distinction must be made between these elements and the cognitive processes that are undertaken by a participant that informs the belief system. The cognitive processes are recognized as cognitive, motivational, affective and selection. The cognitive process deals with the integrating of the self-efficacy information from the external cues and the other processes. Motivation deal with attribution theory, expectancy-value an goal theory. Research has showed that the more challenging the goals the more enhanced and sustained will be the motivation. The affective process deals with the emotions that an individual feels. Emotions such as anxiety, fear and depression will affect the behavior of an individual. Selection is the

process in which an individual chooses activities based on what they are capable of successfully completing and avoiding activities they perceive beyond their ability.

Self-Efficacy Beliefs Compared to Other Theories of Self

It is important to differentiate and distinguish between self-efficacy and other related self-knowledge theories that may have been mingled together in the past but are clearly different constructs when analyzed.

Bandura (1986) distinguishes between the self-referent theory of self-concept by stating that "for the most part, self theories are concerned with global self-images. However, a global self image does not do justice to the complexity of self-efficacy precepts, which vary across different activities, different levels of the same activity, and different circumstances. A composite self-image may yield some modest correlations, but it is not equal to the task of predicting with any degree of accuracy and the intraindividual variability in performance. Self theories have had difficulty explaining how the same self-concept can give rise to diverse types of behavior" (p. 410). Bandura (1986) identifies the self-referent theory of self-esteem as the concern with the degree of self-worth a person perceives of their attributes, whereas self-efficacy is concerned with the capabilities of an individual. These constructs are also differentiated because there is no direct correlation between people having a high sense of self-efficacy and having a high sense of self-esteem. Thus, an individual could have a high sense of self-esteem but a low sense of self-efficacy for a particular activity. The last self-referent theory to be contrasted with self-efficacy is self- confidence. Self-confidence as defined by Schunk (1991) is " people's belief that they have the ability to produce results, accomplish goals, or perform tasks competently" (p. 211). As compared to self-efficacy, self-confidence does not differentiate between the action and the outcome that one produces where self-efficacy sees this as separate dimensions.

The most famous outcome expectancy theory is Rotter's (1966) locus of control. In this theory there is internal and external aspect of locus of control. Internal locus of control is associated with peoples belief that their behavior will affect the outcome of a situation. External locus of control is the belief that life's events are controlled by such factors as luck, destiny or accident. Bandura (1986) distinguished between these constructs by stating "it should be noted, however, that Rotter's (1966) conceptual scheme is primarily concerned with causal beliefs about the relation between actions and outcomes rather than with personal efficacy. Perceived self-efficacy and beliefs about the locus of outcome causality must be distinguished. Convictions that outcomes are determined by one's own actions can be either demoralizing or heartening, depending on the level of self-judge efficacy (p. 413). Bandura (1997) reiterates this by stating, "beliefs about whether one can produce certain action (perceived self-efficacy) cannot, by any stretch of the imagination, be considered the same as beliefs about whether actions affect outcomes (locus of control)" (p. 20).

Self-efficacy as compared to attribution theory is the next area to explore. The attribution construct places emphasis on what causes outcomes. Thus, attributions are people's perceptions about causes of outcomes and influence expectation of future successes and failures (Park, 1996 p. 40). An example of this would be teachers who believe that their success is due to their hard work, their ability to teach effectively, or the home backgrounds of their students. According to Bandura (1986) self-efficacy regulates attributional factors which in turn sways behavior. Thus, human behavior is regulated by attributions and attributions are regulated by self-efficacy beliefs.

Historical Development of Teacher Self-Efficacy Beliefs Instrumentation

The Rand Corporation developed the first instrument for teacher self-efficacy beliefs in the mid-1970's. This instrument was administered by Armor (1976) and Berman and McLaughlin (1977) and consisted of two Likert Scale items:

1) "When it comes right down to it, a teacher really can't do much because most of a student's motivation and performance depends on his or her home environment."
2) "If I really try hard, I can get through to even the most difficult or unmotivated students." (p. 159-160).

Both research groups defined teacher self-efficacy as "the extent to which the teacher believed he or she had the capacity to affect student performance" (Berman & McLauglin, 1977, p. 137). Armor (1976) concluded that there was a positive relationship between positive teacher self-efficacy and student achievement in reading. Barman and McLaughlin (1977) also found that teachers' self-efficacy beliefs were positively correlated to improved student performance, the number of project goals and the amount of teacher change. Researchers such as Denhman and Michael (1981), Ashton and Webb (1982) and Gibson and Dembo (1984) were critical of the Rand studies because they believed the questions where based on Rotter's (1966) locus of control and not on Bandura's efficacy belief. They were also critical that neither of the items correlated with each other.

Denhan and Michael (1981) and Ashton and Webb (1982) each developed a multidimensional model of teacher efficacy beliefs based on Bandura's (1977) conception of self-efficacy. The Denhan and Michael (1981) study used twenty teachers and "defined teacher's sense of self-efficacy as an intervening variable that mediates the relationship between antecedents (teacher training, teaching experiences, system variables, and personal variables and consequences (teacher behavior and student outcomes)" (as cited in Riggs, 1988 p. 29). Their conclusion was that teacher's sense of efficacy may be both a causal and resulting factor meaning that a relationship existed that teacher's sense of self-efficacy affected student outcomes and student outcomes affected teacher's sense of self-efficacy. Ashton and Webb's (1982) work focused on providing support for the two dimension of Bandura's self-efficacy construct, which in turn fueled future work to define a conceptual framework for teacher self-efficacy research. (Ashton and Webb's 1983). Later Ashton,

Webb and Doda (1983) determined that there was a positive relationship between teachers' sense of self-efficacy and student outcomes.

Gibson and Dembo (1984) used Bandura (1977) self-efficacy construct and the work of Ashton and Webb (1982) to further define the self-efficacy construct by developing and validating an instrument to measure teachers' self-efficacy beliefs. After administering an instrument to 208 teachers and completing factor analysis on the data, they concluded that the construct of teacher efficacy did in fact have two distinct dimensions: personal self-efficacy and outcome expectancy. Later, however, this study was criticized for not clearly delineating, according to Bandura's definition of the self-efficacy construct, the personal efficacy dimension in the instrument.

Riggs (1988) studied the self-efficacy construct and cited Bandura (1981) in which he believed the self-efficacy construct is situation specific. Following this theory Riggs (1988) used the work of Gibson and Dembo (1984) to develop and validated an instrument to measure teachers' personal self-efficacy and outcome expectancy beliefs for science teaching and learning. The instrument was entitled Science Teaching Beliefs Instrument (STEBI) and the dimensions were *personal science teaching efficacy belief* and dealt with a teachers' ability to teach science and *science teaching outcome expectancy* and refers to a teachers' belief in their ability to influence students science learning. Enochs and Riggs (1990) then developed and validated an instrument entitled Science Teaching Efficacy Beliefs Instrument (STEBI-B) for prospective teachers. The STEBI-A and STEBI-B have become widely used in science education to inform teacher educators about the science beliefs of prospective teachers. STEBI-B has similarly been used to inform practicing teachers about their science beliefs. Both instruments have been re-written in other languages because the importance of science self-efficacy beliefs has been realized in other countries as a critical role in teaching effectively.

Instruments also have been developed to study the self-efficacy construct with referent to other areas. This dissertation is an effort to develop, validate and establish the

reliability of an instrument to measure self-efficacy beliefs of prospective elementary teachers with regards to science teaching and learning for diverse learners.

CHAPTER 3

Methodology

Purpose and Guiding Questions

The purpose of this study was to develop, validate and establish the reliability of an instrument to measure self-efficacy beliefs of prospective elementary teachers with regards to science teaching and learning for diverse learners. The instrument, to be titled the Self-Efficacy Beliefs about Equitable Science Teaching (SEBEST), was based upon the work of Bandura (1977, 1986), Riggs, (1988) Enochs & Riggs (1990).

Instrument Reliability and Validity

The development of a valid and reliable instrument is a complex and difficult process. The process begins with the definition of the construct to be assessed and continues through, item pool preparation, item refinement, and selection based upon field test data, and study of the instrument's reliability and validity. (Borg & Gall, 1989; Nunnally, 1970; Rubba & Andersen, 1978).

Validity

"Validity is the degree to which a instrument measures what it purports to measure" (Borg and Gall, 1989, p. 258). The Standards for Educational and Psychological Testing (AERA-APA-NCME, 1985) states that validity "refers to the appropriateness, meaningfulness, and usefulness of the specific inferences made from test [instrument] scores" (p. 9). The critical importance of validity is echoed throughout research. According to the Standards for Educational and Psychological Testing "validity is the most important consideration in test evaluation" (p. 9). Nunnally (1970) states that determination of validity is a crucially important phase in the development of a measuring instrument to determine if it is useful for any purpose (p. 132). Validity should be a primary concern during instrument development. It is there that the measurement objective is transformed

into items. The content of the instrument must be strategically planned, developed, checked and rechecked to ensure the highest possible degree of correspondence between content and intent (Nunnally, 1967 as cited in Rubba, 1977, p. 51-52).

The American Psychological Association has defined the guidelines for determining instrument validity and has identified the four types of instrument validity to be: content, concurrent, predictive and construct. (Borg and Gall, 1989) The SEBEST instrument will purport to measure the self-efficacy beliefs of prospective elementary teachers with regard to teaching and learning science for diverse learners. Evidence of construct and content validities will need to be established in developing the SEBEST.

Construct validity is the extent to which a particular test can be shown to measure a hypothetical construct, that is, "a theoretical construction about the nature of human behavior" (Standards for Educational and Psychological Testing: AERA-APA-NCME, 1985 as cited in Borg and Gall, 1989, p. 255). Self-efficacy according to Bandura (1977) is a construct that can be broken down into two dimensions: personal self-efficacy and outcome expectancy. Personal self-efficacy beliefs are a people's judgment of their capabilities to organize and execute courses of action required to attain designated types of performances. Outcome expectancy is the degree to which people believed the environment could be controlled. In the case of the SEBEST instrument, personal self-efficacy is to be associated with prospective science teachers' judgment of their ability to teach science to diverse learners and the degree to which prospective science teachers believe that the teaching/learning environment can be controlled such that learners of diverse backgrounds can learn science.

Content validity is the degree to which the sample of test items represents the content that the test is designed to measure (Borg & Gall, 1989 p. 258). In the development of the SEBEST, the items need to be representative with regard to the two dimensions of the self-efficacy construct i.e. personal self-efficacy and outcome expectancy and dimensions of diversity. As discussed earlier in Chapter 2, a diverse learner to science

education is a person who has been identified by science education research (NSES, 1996; NSTA Pathways, 1997 & SAA, 1989) as one who has not achieved the success in science education as compared to their peers for reasons that may be attributed to but are not limited to race, class, ethnic, cultural backgrounds and gender. Additionally, the Likert-type items that will compose the SEBEST can be phrased in a positive or negative stance. Figure 2,2 presents the combinations of these content domains with each cell denoting content that the researcher aimed to represent in the SEBEST.

Reliability

Reliability, as applies to educational measurements, may be defined as the level of internal consistency or stability of the measuring device within each application and over time (Borg & Gall, 1989 p. 257; Nunnally, 1970). Error in a instrument results in unreliable measurement. The goal in determining reliability of an instrument is to assure that the errors in measurement are at a minimum. Nunnally (1970) cites eight sources of error which can threaten instrument reliability and organizes instrument error into two categories. The first category deals with random error sources embedded within the instrument that cause deviation in performance within the items of the instrument. These "internal" sources of error include item ambiguity, item sampling, participant guessing, and subjective scoring. The second category of errors can occur between administrations of a instrument. These "external" sources of error include differences in instrument content between administrations, subjective scoring and differences in participants over time. (Rubba, 1977)

Cronbach's Coefficient Alpha, which examines internal consistency or internal sources of error, is often employed in educational and psychological instruments that do not use dichotomous items. It is, in fact, the most recommended method of assessing reliability because of the high degree of sensitivity this method offers over its alternatives (Suen, 1999). (Nunnally, 1970) The test-retest method is the technique for assessing

external error sources in an instrument. By this method, scores on one test administration of an instrument are correlated with scores from another test administration to the same subjects at another point in time at least six weeks later. (Gall, Borg & Gall, 1996 p. 772). Cronbach's Coefficient Alpha and the test-retest method were used to examine the reliability of the SEBEST. Reliability coefficients above .90 are considered necessary to make individual decisions with instrument results; above .80 are considered for research; and above .70 for initial group decisions that will be tested through additional means. (Nunnally, 1970).

Development of the SEBEST

The seven step plan described below was used in developing and building validity and high reliability into the SEBEST. Details on Steps 6 and 7 of the instrument development, including supporting data, are provided in Chapter 4.

Step 1: Defining the Constructs to be Measured

A construct, according to Borg and Gall (1989), "is a concept that is inferred from commonalties among observed phenomena and that can be used to explain those phenomena. In theory development, a concept that refers to a structure or process is hypothesized to underlie particular observable phenomena" (p. 756). In this study the researcher proposes to develop an instrument that assessed the self-efficacy beliefs of prospective elementary teachers concerning the teaching and learning of science for diverse learners, specifically the two dimensions of self-efficacy belief defined by Bandura (1977): personal self-efficacy and outcome expectancy.

Diverse learners as recognized by *Science for All Americans* (1989) are "those who in the past who have largely been bypassed in science and mathematics education: ethnic and language minorities and girls" (p. xviii). That definition was extended by this researcher to include children from low socioeconomic backgrounds based on the research

by Gomez and Tabachnick (1992). They found "that the views of prospective teachers in their sample toward minority children and children from low-income families would limit the children's opportunities to learn and prosper from schooling." Similarly, the work of Grant and Tate (1995) that acknowledges " educational research becomes problematic when it does not include race, *class*, and gender, and/or when these constructs are not rigorously interrogated" (p. 147*)*. For example, *The IEA study of Science II: Science Achievement in Twenty-three Countries*, found that family economics factors were related to achievement in science, for example the educational level of the parents, the size of the family, and the amount of reading material in the home. (Postlethwaite & Wiley 1992). Baker (1998) proposes that "parental attitudes and economic condition of the family could be the major determinant of whether a girl will receive an education" (p. 879). Figure 3.1 presents the Content matrix that was used in this study to define the content for the SEBEST in terms of the self-efficacy construct (i.e., personal self-efficacy and outcome expectancy dimensions), the definition of diverse learners developed by the researcher, and the positive verse negative phrasing of Likert items. The researcher aimed to have each of the dimensions of self-efficacy beliefs of prospective elementary teachers toward teaching learning science for divers learners represented as sub-scale in the SEBEST.

Step 2: Draft Item Preparation

The research presented in Chapter 2, above, in the area of science education and multicultural education, (for example, AAUW, 1992; Kahle & Meese, 1995; Kelly, 1985; Tobin, 1996, Atwater, 1994; Brickhouse, 1994; Gomez, 1996; Hodson, 1993; Rakow, 1985; Spurlin, 1995) informed the researcher about practices that are effective for teaching science to diverse student populations as she prepared draft items for the SEBEST. One hundred ninety-five Likert type items, modeled after those composing the STEBI A (Riggs, 1988) and STEBI-B (Enochs & Riggs, 1990) were drafted with at least six representatives for each cell in the Content matrix presented in Figure 3.1.

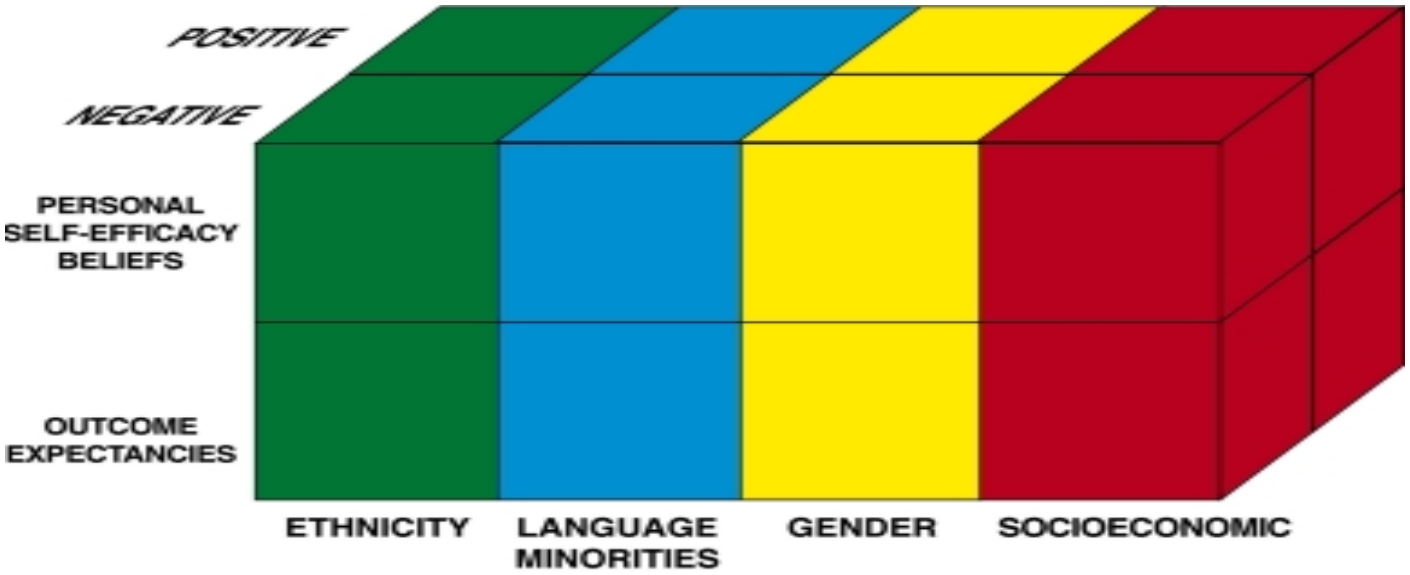

Figure 2.2 Content Matrix for the Self-Efficacy Beliefs about Equitable Science Teaching(SEBEST)

Figure 3.1 Content Matrix for the Self-Efficacy Beliefs about Equitable Science Teaching (SEBEST)

The researcher also referred to Edwards (1957) fourteen points for item clarity as draft items where written to reduce item error due to ambiguity. These are as follows: (1) use items that refer to the present verses the past, (2) avoid factual statements, (3) not using items that can be interpreted in several ways, (4) use items that only deal with the construct, (5) avoid items that are endorsed by all or none in the target population, (6) use items that encompass the entire construct, (7) use simple, clear and direct language, (8) use items that are short and less then twenty words, (9) items should be one complete thought, (10) items should not use "all," "always," "none" or "never," (11) use care in using only, "just" and "merely," (12) items should be in simple sentences as verse to compound, (13) do not use words that may not be understood by the reader, (14) avoid double negatives. (p. 13-14)

Step 3: Draft Item Review

A letter that explained the review process and the 195 draft items were submitted to ten graduate student in Science Education at Penn State University. Edward's criteria and the definitions of self-efficacy beliefs, personal self-efficacy, outcome expectancy, ethnicity, language minorities and gender also were included. The graduate students independently reviewed each of the draft items for clarity and comprehension by prospective elementary teachers. Comments for improvement were recorded directly on the draft items. The feedback was collected by the researcher and used in revising the items. The revised items were resubmitted to the graduate students and subsequently revised until all ten graduate students judged that clarity and comprehension was achieved for at least five items in each cell of the matrix. Eighty items were identified within two rounds of review by the graduate students. Appendix A contains the list of graduate students who acted as reviewers, the letters sent to the graduate students and the forms for the collection of their responses to the draft items.

Step 4: Revised Item Content Validity

A panel composed of eight faculty members representing science education, multicultural education, and self-efficacy research were constituted for the purpose of judging the content validity of the revised items. These faculty members were given a letter of explanation, the revised items, the definitions of terms used within the instrument and Edwards criteria. The panel member's independent feedback was collected from the panel and used to revise the items. Appendix B contains a list of the faculty content validity reviewers for the items, the letter sent to the faculty and the form for the collection of their input on the items. The items were to be resubmitted to the faculty members until at least four items in each cell of the content matrix (Figure 3.1) were judged content valid by three of the five judges. However, this proved unnecessary given that a sufficient number of the items, 48 with at least 6 items representing each cell in the content matrix, were judged content valid after one review. These 48 content valid items constituted the "first draft" instrument. (See materials in Appendix C)

Step 5: First Draft Instrument Try Out

The "first draft" instrument was administered to the 136 prospective elementary teachers in the five sections of SCIED 458--Teaching Elementary School Science and the 100 prospective elementary teachers in the nine sections of Student Teaching at Penn State University during the week of November 9, 1999. These groups represented the intended population for the final instrument. The resulting data were used in formulating the SEBEST as described in Step 6, below.

Step 6: SEBEST Formulation

The data obtained from administering the 48 item "first draft" instrument to the SCIED 458 classes and student teachers were used to identify the items to be included in the SEBEST. The following guiding question was developed for this purpose:

What is the most reliable and valid combination of items to compose the SEBEST for the purposes of assessing prospective elementary teachers self-efficacy beliefs for teaching science to diverse learner, and the two dimensions of personal self-efficacy and outcome expectancy?

The question implied the need for the researcher to examine the construct validity of the items and the contributions items made to reliability, using data from the "first draft" instrument try out (Step 5). That is, data from the first draft item try out were factor analyzed, and the factor properties examined for evidence of construct validity. Ideally, two major factors would emerge: (1) personal self-efficacy about science teaching and learning for diverse learners, and (2) outcome expectancy for science learning by diverse learners. Item score to total test score correlation and item contribution to total test reliability were used to identify the strongest items. Item balance across the categories of the content matrix (Figure 3.1) also was examined using Chi-Square. Coefficient Alpha, a measure of internal consistency, was used to examine the reliability of the instrument. The strongest combination of construct valid and reliable items that had balanced representation from the content matrix, were identified using these procedures in combination and arranged to form the Self-Efficacy Beliefs about Equitable Science Teaching (SEBEST). Details on this process are provided in Chapter 4.

Step 7: Further Study of Construct Validity and Reliability

A second construct validity and reliability study was conducted on of the SEBEST in the Spring of 1999. This was done to develop further evidence of the instrument's construct validity and to collect data on the internal reliability and test-retest reliability of the instrument. Following a method proposed by Cronbach (1956), it was assumed that the self-efficacy beliefs about science teaching and learning would differ between a class of

prospective elementary teachers enrolled in the Penn State Urban Teacher Education Program (Commonwealth College, Delaware Campus) and prospective elementary teachers enrolled in the Elementary-Kindergarten Teacher Education Program also at Penn State (College of Education, University Park).

Penn State teacher preparation programs, including the Elementary-Kindergarten Education Program (EK ED) and the Urban Early and Middle Childhood Education Program (URBED), are accredited by the National Council for Accreditation Education (NCATE) and approved by the Pennsylvania Department of Education. The EK ED program is a contemporary elementary teacher education program that prepares kindergarten through grade six teachers to work in a wide variety of elementary school settings, e.g., public/private, rural/suburban/urban. It is situated in a conceptual framework, that consists of five nodes: 1) Educators are lifelong learner's; 2) Educators understand how students develop and learn; 3) Educators possess discipline knowledge, and pedagogical understanding; 4) Educators manage and monitor learning and development; 5) Educators are members of the learning communities. A copy of the EK ED conceptual framework is presented in Appendix D.

The URBED program was designed to prepare prospective teachers to teach in kindergarten through middle school urban settings. The mission of the program "is to give you [prospective teachers] an understanding of the unique realities that the urban individual, family, and community face" (Program Brochue, 1999). The theoretical emphasis of the programmed is grounded in research by Weiner (1993):

> Aside from meeting the requirements that apply to quality programs to educate teachers, the preparation of teachers of at-risk students in urban schools needs to take into account the social context of urban schools and the characteristics of prospective teachers. What is critical in formulation programs to prepare teachers of at-risk students in urban schools is matching the program to the teacher-candidates' abilities and values so that they enter urban schools

> prepared to teach students with an unlimited variety of needs, many of them beyond schooling's purview, under pressures for both teacher and student to conform to standardized procedures (p. 135).

The course requirements for the URBED and the EK ED program are shown in Figure 3.2.

EK ED Program	URBED Program
Entry Requirements	
1. GPA of at least 3.0 for guaranteed admission 2. GPA of at least 2.50 for consideration 3. PRAXIS: Communication Skills 4. Penn State Mathematics Test 5. 80 hours of volunteer or paid education work experience with learners of the age groups they plan to teach, including 40 hours of these age-appropriate 80 hours with learners whose cultural, social or ethnic background differ from the candidate's own. 6. Must earn a C or higher in education courses	1. GPA of at least 2.50 2. Must earn a C or higher in education courses 3. PRAXIS: Communication Skills 4. Penn State Mathematics Test 5. 80 hours of volunteer or paid education work experience with learners of the age groups they plan to teach, including 40 hours these age-appropriate 80 hours with learners of whose cultural, social or ethnic background differ from the candidate's own.
Courses for Major and Option[3]	
1. Psychology - PSY 2 GS 2. Introduction to Developmental Psychology - PSY 213 GS 2. Learning and Instruction - EDPSY 14 3. Education in American Society - EDTHP 115 4. Problem Solving in Mathematics - MATH 200 GQ 5. The Visual Arts in the Elementary School - A ED 303 6. English Language Analysis - ENGL 100 7. The Health Program for the Elementary School Child - KINES 126 8. Problem Solving in Mathematics - MATH 200 GQ 9. Teaching Exceptional Students in General Education Settings - SPLED 400 10. Teaching Reading in the Elementary School - LL ED 400 11. Teaching Language Arts In Elementary School - LL Ed 401 12. Teaching Children's Literature - LL ED 402 13. Teaching Mathematics in the Elementary Schools - METHED 420 14. Teaching Social Studies in the Elementary Grades - SS ED 430W 15. Teaching Science in the Elementary School - SCIED 458 16. Practicum in Student Teaching - CI 495D 17. Professional Development Practicum - CI 495F 18. Clinical Application of Instruction-Elementary and Kindergarten Education - C I 495B 19. Music for Classroom Teachers - MUSIC 241 20. Elementary School Activities - KINES 380 21 Learning and Instruction - EDPSY 14	1. Introductory Field Experience for Teacher Preparation - CI 295 3. Education in American Society - EDTHP 115 4. Introductory Field Experience for Teacher Preparation - CI 295 5. Introduction to Algorithmic Processes - CMPSC 101 6. The Visual Arts in the Elementary School - A ED 303 7. Elementary School Activities - KINES 380 8. Field Experience for Urban Teacher Preparation - URBED 395W (6 credits) 9. Urban Schools and Family and Community Systems URBED 400 10. Using Literacy And Communication (Social) Knowledge and Assessment in Urban Environments - URBED 401 11. Early to Middle Childhood Teaching and Assessment for Urban Settings URBED 402 12. Science and Mathematics Knowledge and Assessment in Urban Settings URBED 403 13. Ethnic Minorities and Schools in the United States EDTHP 411 14. Sociology of Education - EDTHP 416 15. Inclusive Education and Assessment - SPLED 444 16. Practicum in Student Teaching - CI 495D 17. Professional Development Practicum - CI 495F 18. Music for Classroom Teachers - MUSIC 241

Figure 3.2 Comparison of Course Requirements for the URBED and the EK ED Programs

[3] Additionally, EK ED and URBED students must fulfill Penn State General Studies Requirements of 46 credits

EK ED Program	URBED Program
	Courses for Major and Option
Additional Courses (6 credits)	Additional Courses (28 credits)
(Each class is a 3 credit course)	(Each class is a 3 credit course-pick 3 credits in a, b & c)
1. Introductory Microeconomics Analysis and Policy - ECON 2	a. Introductory Biological Anthropology - ANTH 21
2. Introductory Macroeconomics Analysis and Policy - ECON 4	a. Structure and Function of Organisms - BI SC 1
3. Principles of Economics - ECON 14	a. Genetics, Ecology and Evolution - BI SC 2
4. Economics Freshman Seminar - ECON 187	a. Environmental Science - BI SC 3
5. Human Geography: An Introduction - GEOG 20	a. Human Body: Form and Function -BI SC 4
6. Geographic Perspectives on Human -Environment Relations- GEOG 30	b. Molecular Science - CHEM 1
7. Economic Geography - GEOG 100	b. Introductory Chemistry - CHEM 11
8. The American Scene - GEOG 102	b. Chemical Principles - CHEM 12
9. Geography of Developing World - GEOG 103	b. Introductory and General Chemistry - CHEM 17
10. Urban Geography - GEOG 120	b. Materials in Today's World - MATSC 81
11. Elements of Cultural Geography - GEOG 124	b. The Science of Physics - PHYS 1
12. Geography of International Affairs - GEOG 128	c. The Earth System - EARTH 2
13. Geography of Pennsylvania - GEOG 200	c. Out of the Fiery Furnace - EM SC (STS) 150
	c. Planet Earth - GEOSCE 20
Supporting Courses & Related Areas (6-9 Credits)	c. Physical Geography: An Introduction - GEOG 10
1. EDTHP 400 Level Section	c. Energy and the Environment - MATSC 101
2. United States History Selection	c. Introductory Meteorology - METEO 3
3. FYS	Select 3 credits each from a and b
	a. Survey of Eastern Art - ART H 120
Additional Courses (3 Credits)	a. Chinese Art - ART H 320
1. American Civilization to 1877 - HIST 20	a. The Arts - INART 1
2. American Civilization since 1877 - HIST 21	a. Performing Arts - INART 5
	a. The Popular Arts in American: Mass Media Arts -INART 10
Academic Concentration (12 Credits)	b. The Art of Cinema -COMM 150
Selected with departmental recommendation from one of the following areas of academic emphasis: Bilingual Education, Communications, Arts & Humanities, Social Sciences, Science & Mathematics, Music, Health & Physical Activity.	b. Introduction to Creative Writing - ENGL 50
	b. Introduction to Creative Writing - ENGL 50
	b. The Art of the Theater - THEA 100
	b. Fundamentals of Acting - THEA 102

Figure 3.2 (cont.) Comparison of Course Requirements for the URBED and the EK ED Programs

EK ED Program	URBED Program
	Courses for Major and Option
	Select 6 credits from Introduction to American Studies - AM ST 100 American Popular Culture and Folklife - AM ST 105 Black American Literature - ENGL 139 American Civilization since 1877 - HIST 21 History of Welfare and Poverty in the United States - HIST 154
	Select 6 credits from: The Art of the Cinema - COMM 100 Introduction to Human Development - HD FS 129 Infant and Child Development - HD FS 229 Social Problems - SOC 5 Urban Sociology - SOC 15 Race and Ethnic Relations - SOC 119
	Select 1 credits from: Health and Disease - BB H 19 Drugs in Society - BB H 43 Introduction to Health aspects of Human Sexuality BB H 46 Consumer Health - HPA 57 Standard First Aid, Personal Safety and CPR -KINES 13 Lifestyles for Health - KINES 15 Emergency Care - KINES 303
	Exit Requirements
1. PRAXIS Tests a. General Knowledge b. Principles of Learning and Teaching c. Specialty Area Test- Elementary Education 2. Clearances as required by the Pennsylvania Department of Education	1. PRAXIS Tests a. General Knowledge b. Principles of Learning and Teaching c. Specialty Area Test- Elementary Education 2. Clearances as required by the Pennsylvania Department of Education

Figure 3.2 (cont.) Comparison of Course Requirements for the URBED and the EK ED Programs

As shown in Figure 3.2 in both programs entry requirements are a GPA of 2.5 for consideration, passing the PRAXIS - Communication Skills test and the Penn State mathematics test. Fulfillment of Penn State General Studies requirements states taking 46 credits in both programs. Prescribed courses are those that are deemed necessary for the major. Additional courses are those that support that major. The exit requirements for both programs require passing the PRAXIS - General Knowledge; Principles of Learning and Teaching; Specialty Area Test - Elementary Education and obtaining the clearances from the Pennsylvania Department of Education (PDE).

The SEBEST was administered to prospective EK ED and URBED elementary teacher samples during the week of March 15, 1999. In the case of the EK ED program these included the 102 students in the five section of SCIED 458. The participants in the URBED program were the 22 students enrolled in student teaching. Demographic data also were collected in order to allow comparison between the two groups based on ethnicity, gender, GPA and year of study. Scores on the SEBEST were compared across the URBED and five EK ED SCIED 458 groups using ANOVA. The .05 level for statistical significance would be used as a matter of the SEBEST between the two classes at level. Coefficient Alpha reliability was calculated. The SEBEST was readministered to the same five sections of SCIED 458 during the week of April 26, 1999 to allow test-retest reliability to be calculated. Details on these analyses are provided in Chapter 4.

CHAPTER 4

Data Analysis Details and Results

This chapter presents details on the data collection and analysis associated with selected steps in the development of the SEBEST as described in Chapter 3. In particular, details and results are given on the data collection and analysis associated with Step 6: Formation of the SEBEST and for Step 7: Further Study of Construct Validity and Reliability.

SEBEST Formulation Results

The "first draft" of the SEBEST consisted of 48 items that had been judged to be content valid for the purposes of assessing prospective elementary teachers self-efficacy beliefs with regards to the science teaching and learning for diverse learners. The task in Step 6 of the SEBEST development process (see Chapter 3), was three-fold: to identify a subset of the 48 items that : a) was construct valid, b) had high internal consistency reliability, and c) was representative of the content matrix presented in Figure 3.1. Factor analysis was used to help identify a construct valid subset of items. Coefficient Alpha reliability, a measure of internal consistency, was used to examine the internal consistency of the groups of items, and Chi Square was used to check item representation against the content matrix presented in Figure 3.1. Because the three qualities can be antithetical to one another -- that is, the most construct valid and reliable set of items might not be representative of the content matrix -- these statistical techniques were applied multiple times and in combination to help select items for the SEBEST that gave the instrument the strongest profile across all three qualities.

Data for these analyses were collected by administering the 48 item "first draft" instrument to 226 prospective elementary teachers in the Penn State University Elementary/Kindergarten Education (EK ED) program. These included the students in the five sections of SCIED 458--Teaching Science in the Elementary School (n = 124) and in

the nine sections of Student Teaching (n = 102) during the Fall semester of 1998. Usable data were secured from 217 of these prospective elementary teachers -- 120 of the students in SCIED 458 and 97 of the students in student teaching. The mean score on the 48 items among the 217 prospective elementary teachers was 151.45 with a standard deviation of 10.97 (scores on the 48 item instrument could range between 48 and 240). The data analyses are described below.

Initial Factor Analysis Results

The data secured from the 217 prospective elementary teachers on the 48 item draft instrument were subjected to Principal Component Factor Analysis using Varimax Rotation. The analysis generated 14 factors with an Eigenvalue of 1.00 or greater, that accounted for 64% of the variance in the instrument results. Table 4.1 shows the item loading across the 14 factors, the variance accounted for by each factor and cumulatively across them, and the content matrix category for each item. Because the researcher desired to select the smallest subset of the items that were construct valid, had high reliability and were representative, a Scree Plot was used to visually examine the number of factors and determine the number of significant factors. The Scree plot for the analysis is presented in Figure 4.1.

A Scree plot is a plot of factor Eigenvalues in the order in which the factors account for variance in the data. According to William and Goldstein (1984) the number of significant factors, or number of component factors to be retained, is visually indicated by the change in the slope of the plot -- the point at which the Scree plot curve breaks and forms a relatively straight line by a series of smaller, non-significant, Eigenvalues. For Figure 4.1, the point at which the contour of the curve changes is marked with an arrow -- at an Eigenvalue of 1.7. Four factors were identified as significant using this method. Twenty-eight items loaded on these four factors. From a factor analysis perspective alone, the instrument might include 28 items.

Table 4.1

Factor Analysis of “First Draft” of SEBEST

Content Matrix	Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10	Factor 11	Factor 12	Factor 13	Factor 14
PSE :LM	1		.661												
PSE :SES	2	.517													
OE: G	3										.786				
OE: E	4				.794										
PSE: E	5	.510													
PSE :LM	6		.593												
PSE: G	7	.498													
OE :E	8				.781										
PSE:LM	9		.796												
PSE: G	10	.444													
PSE :E	11				.494										
OE :E	12							.651							
OE :LM	13							.658							
OE: LM	14								.794						
OE: G	15					.625									
OE :E	16				.404										
PSE :LM	17		.689												
PSE: G	18						.713								
OE :SES	19										.459				
OE :LM	20								.637						
OE: G	21													.721	
PSE: E	22	.740													
OE :SES	23									.830					
PSE: E	24						.352								
OE :G	25					.681									
PSE :SES	26	.651													
PSE: G	27					.640									
OE :SES	28											.655			
PSE: E	29	.724													

Table 4.1(cont.)

Factor Analysis of “First Draft” of SEBEST

Content Matrix	Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10	Factor 11	Factor 12	Factor 13	Factor 14
OE:G	30			.412											
PSE :LM	31		.578												
OE :G	32	.495													
OE :SES	33											.608			
PSE: E	34	.693													
OE :LM	35			.541											
PSE :SES	36	.424		.414											
OE: E	37			.535											
PSE :SES	38									.771					
PSE: G	39														.588
OE :SES	40			.569											
OE :LM	41			.464											
OE: E	42										.470				
OE :SES	43			.529											
PSE: G	44						.673								
PSE :LM	45		.703												
PSE :SES	46														
PSE :SES	47						.579						.701		
PSE :LM	48			.692											
% of Variance		19.5	6.2	5.7	4.4	3.6	3.4	3.4	3.1	2.7	2.6	2.4	2.4	2.3	2.2
% Cumulative Variance		19.5	25.7	31.4	35.8	39.4	42.9	46.3	49.4	52.1	54.8	57.2	59.5	61.8	64

PSE = Personal Self Efficacy; OE = Outcome Expectancy
E = Ethnicity; G = Gender; LM = Language Minority; SES = Socioeconomic Status

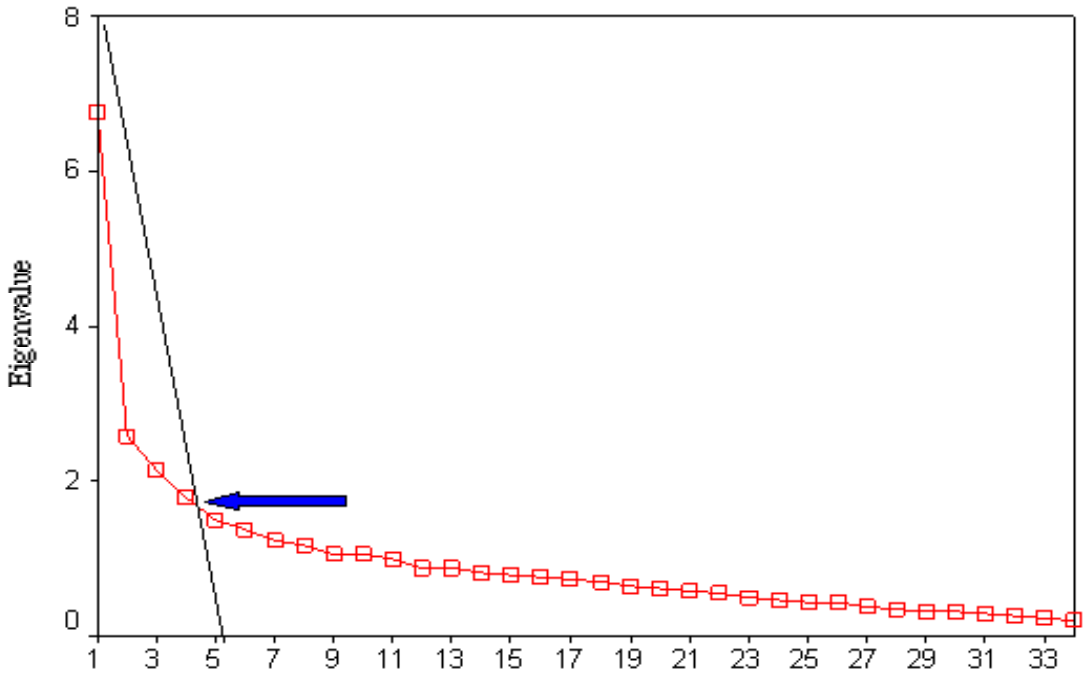

Figure 4.1 Scree Plot.

Item Reliability Results

The contribution each of the 48 items made to total instrument scores and reliability also was examined to determine the possible composition of the instrument from a reliability perspective. Thirty-four items were judged to be appropriate for inclusion in the instrument based on this perspective. That is, the 34 items that had the highest item to total instrument score correlations generated the highest Coefficient Alpha reliability for the total instrument and two sub-scales. Appendix E – Item Contribution to 48 item "First Draft SEBEST" presents the item means, item variances, item to total scale correlations and reliability results. From a reliability perspective, the instrument would include 34 items.

Second Factor Analysis Results

The data secured from the 217 prospective elementary teachers on the 34 items were subjected to Principal Component Factor Analysis using Varimax Rotation. Table 4.2 presents these factor analysis results. The 34 items loaded across four factors, as identified using the Scree Plot method, which accounted for 39.2% of the variance in the data. As is noted in Table 4.2, Factor 1 accounted for 11.6% of the variance in the instrument results, Factor 2 for 9.5% Factor 3 for 9.3%, and Factor 4 for 8.9%. These percentages showed balanced variance across the four factors.

Additionally, the item factor loading for the four factors were pure with each factor, being associated with either the Personal Self-Efficacy (PSE) or Outcome Expectancy (OE) dimension of Self-Efficacy Perception. Eleven items loaded on Factor 1, all associated with Personal Self-Efficacy (PSE), particularly socioeconomic status, gender and ethnicity. Factor 1, therefore, was identified with PSE. Ten items, all of which were associated with Outcome Expectancy (OE), loaded on Factor 2. These items were associated with language minorities, socioeconomic status, gender and ethnicity. Six items identified with PSE loaded on Factor 3, all associated with Language Minorities. Eight items associated with OE, but from across the content matrix, loaded on Factor 4. The reliability of the items loading on the PSE items that loaded on Factor 1 was .82 and on Factor 3 was .80. The reliability for the OE items that loaded on Factor 2 was .72 and on Factor 4 was .75. Appendix E contains three tables that show the contribution for each of the 34 items toward the reliabilities for the instrument as a whole and associated with PSE and OE.

Table 4.2

Factor Analysis Results for 34 Items

Items	Factor 1	Factor 2	Factor 3	Factor 4	Matrix Cell(s)
1			0.71		PSE:LM
2	0.49				PSE:SES
3				0.47	OE:G
4		0.54			OE:E
5	0.63				PSE:E
6			0.65		PSE:LM
7	0.56				PSE:G
8		0.64			OE:E
9			0.76		PSE:LM
10	0.49				PSE:G
12				0.65	OE:E
14		0.50			OE:LM
15		0.63			OE:G
16		0.68			OE:E
17			0.65		PSE:LM
18	0.30				PSE:G
19				0.61	OE:SES
21				0.64	OE:G
22	0.69				PSE:E
24	0.38				PSE:E
25		0.42			OE:G
26	0.67				PSE:SES
28		0.45			OE:SES
29	0.79				PSE:E
30				0.49	OE:G
31			0.60		PSE:LM
34	0.67				PSE:E
40		0.42		0.29	OE:SES
41		0.53			OE:LM
42				0.64	OE:E
43		0.36		0.55	OE:SES
44	0.38				PSE:G
45		0.72			PSE:LM
48				0.39	OE:LM
% of Variance	11.6	9.5	9.3	8.9	
% Cumulative Variance	11.6	21.1	30.3	39.2	

PSE = Personal Self Efficacy; OE = Outcome Expectancy
E = Ethnicity; G = Gender; LM = Language Minority; SES = Socioeconomic Status

Chi Square Results

Table 4.3 shows the distribution for the 34 items across the content matrix presented in Figure 3.1. A Chi-Square test was used to determine whether the 34 items were balanced across Personal Self-Efficacy/Outcome Expectancy and Ethnicity/Language Minority/ Gender/Socioeconomic Status for the PSE and OE dimensions of the content matrix. The resulting statistic, $X^2 = 2.71$, $df = 7$, was not significant at the .05 level of probability. This was interpreted as evidence that each of the two dimensions of the self-efficacy construct and each of the four diverse groups identified by the researcher were represented in a 34 item instrument with no significant difference.

Table 4.3

Distribution of 34 Items Across the Content Matrix

Dimensions/ Items	Ethnicity	Language Minority	Gender	Socioeconomic
Personal Self Efficacy	#7,#19,#27 #29,#33	#1.#5,#9,#13 #21,#25	#11,#15,#23 #31	#3,#17
Outcome Expectancy	#4,#12,#16 #22,#32	#18,#30, #34	#2,#8,#20, #26,#28	#6,#10, #14,#24

The SEBEST Instrument

The task in Step 6 was to identify a subset of the tryout items that was construct valid, had high internal consistency reliability, and was representative of the content matrix presented in Figure 3.1. Factor analysis, Coefficient Alpha reliability, and Chi Square data were applied multiple times and in combination to help select items for the SEBEST that gave the instrument the strongest profile across all three qualities. Thirty-four items achieved this goal, and were used to compose the Self-Efficacy Beliefs about Equitable Science Teaching or SEBEST instrument.

Table 4.4 presents the 34 item SEBEST. The even items compose the Personal Self-Efficacy or PSE Sub-Scale, and the odd items compose the Outcome Expectancy Sub-Scale.

Table 4.4

Self-**E**fficacy **B**eliefs about **E**quitable **S**cience **T**eaching **(SEBEST)**

****

Please indicate the degree to which you agree or disagree with each statement below by shaping in the appropriate letters on the scan sheet.

5 = Strongly Agree 4 = Agree 3 = Uncertain 2 = Disagree 1 = Strongly Disagree

****

		Strongly Agree		Uncertain		Strongly Disagree
1.	I will be able to effectively teach science to children whose first language is not English.	5	4	3	2	1
2.	Girls can learn science if they receive effective science instruction.	5	4	3	2	1
3.	I do not have the ability to teach science to children from economically disadvantaged backgrounds.	5	4	3	2	1
4.	Even when teachers use the most effective science techniques in teaching science, some Native American children cannot achieve in science.	5	4	3	2	1
5.	I can do a great deal as a teacher to increase the science achievement of children who do not speak English as their first language.	5	4	3	2	1
6.	Good teaching cannot help children from low socioeconomic backgrounds achieve in science.	5	4	3	2	1
7.	I will be able to meet the learning needs of children of color when I teach science.	5	4	3	2	1
8.	Girls are not as capable as boys in learning science even when effective instruction is provided.	5	4	3	2	1
9.	I do not know teaching strategies that will help children who are English Language Learners achieve in science.	5	4	3	2	1
10.	Effective science teaching can help children from low socioeconomic backgrounds overcome hurdles to become good science learners.	5	4	3	2	1
11.	I can help girls learn science at the same level as boys.	5	4	3	2	1
12.	Even when teachers use the most effective science techniques in teaching science, some children of color cannot achieve in science.	5	4	3	2	1
13.	I do not know how to teach science concepts to children who speak English as a second language.	5	4	3	2	1
14.	Effective science teaching cannot improve the science achievement of children from impoverished backgrounds.	5	4	3	2	1
15.	I will be effective in teaching science in a meaningful way to girls.	5	4	3	2	1

		Strongly Agree		Uncertain		Strongly Disagree
16.	Children of color can succeed in science when proven science teaching strategies are employed.	5	4	3	2	1
17.	I will have the ability to help children from low socioeconomic backgrounds be successful in science.	5	4	3	2	1
18.	Children who speak English as a second language are not able to achieve in science even when the instruction is effective.	5	4	3	2	1
19.	I will be able to successfully teach science to Native American children.	5	4	3	2	1
20.	Girls have the ability to compete academically with boys in science when they receive quality science instruction.	5	4	3	2	1
21.	I will not be able to teach science to children who speak English as a second language as effectively as I will to children who speak English as their first language.	5	4	3	2	1
22.	Children of color cannot learn science as well as other children even when effective science teaching instruction is provided.	5	4	3	2	1
23.	I cannot help girls learn science at the same level as boys.	5	4	3	2	1
24.	A good science teacher can help children from impoverished backgrounds achieve in science at the same level as children from higher socioeconomic backgrounds.	5	4	3	2	1
25.	I will be able to effectively monitor the science understanding of children who are English Language Learners.	5	4	3	2	1
26.	Girls can develop in science at the same level as boys if they receive science instruction that is effective.	5	4	3	2	1
27.	I will not be able to successfully teach science to Asian children.	5	4	3	2	1
28.	Girls do not have the ability to learn science as well as boys, even when effective teaching techniques are used.	5	4	3	2	1
29.	I will be able to successfully teach science to children of color.	5	4	3	2	1
30.	Children who are English Language Learners do not have the ability to be successful in science even when the science instruction is effective.	5	4	3	2	1
31.	I will be able to help girls learn science.	5	4	3	2	1
32.	White children can learn science as well as other children when effective science teaching is employed.	5	4	3	2	1
33.	I will not be able to teach science successfully to White children.	5	4	3	2	1
34.	Children who are English Language Learners can be successful in learning science if the teaching is effective	5	4	3	2	1

Coefficient Alpha Reliability Results

Coefficient Alpha was used to assess the reliability of the 34 item SEBEST and its sub-scales using data secured from the 217 prospective elementary teachers from the EK ED programs. The reliability of the entire instrument was found to be .87. The reliability was .83 for the 17 PSE items or sub-scale and .78 for the 17 OE items or sub-scale. A reliability of .87 indicates that 76% of a respondent's score is true score variance and 24% due to error. Similarly, a reliability of .83 indicates 69% true score while 31% is error, and a reliability of .78 indicates that 61% is true score and 39% is due to error.

According to standards presented by Helton, Workman and Matuszchk (1982), a reliability coefficient of .90 or higher is desired for classroom classification decisions, although this benchmark is rarely met. Remmers, Gage and Rummel (1965) support a reliability coefficient of .80 or higher for school tests and .70 or higher for research tests, especially if group performance is only at issue. Additionally, Reliability coefficients above .90 are considered necessary to make individual decisions with instrument results; above .80 are considered for research; and above .70 for initial group decisions that will be tested through additional means. (Nunnally, 1970). The reliability coefficients of .87 on the 34 item SEBEST, and .83 and .78 on its sub-scales, was interpreted as being well within the acceptable reliability range for a research instrument.

Further Study of Construct Validity and Reliability Results

A second construct study was undertaken to test further the construct validity of the SEBEST and to gather additional data on its reliability, particularly internal consistency and test-retest reliability. The study was designed around the availability of two samples of prospective elementary teachers (samples of convenience). One consisted of 23 prospective teachers enrolled in the Urban Early and Middle Childhood Education Program (URBED) at the Penn State Delaware Campus, a teacher education program with an urban education focus (described in Chapter 3). These prospective elementary teachers were at

the mid-point of their student teaching experience in a urban elementary school. They had completed all of the required coursework, including URBED 403--Using Science and Mathematics Knowledge and Assessment in Urban Settings --the prior semester along with an associated in-school (urban) clinical experience. The other sample consisted of 102 prospective teachers enrolled in the Elementary Kindergarten Teacher Education Program (EK ED) at the Penn State University Park Campus (described in Chapter 3). These prospective elementary teacher were at the mid-point of completing SCIED 458--Teaching Science in the Elementary School, along with mathematics and social studies teaching and learning courses and an associated in-school clinical experience. The vast majority would be student teaching the next semester.

Construct Validity Results

The construct validity of an instrument is never fully proven because, according to Borg and Gall (1989), a construct "is a concept that is inferred from commonalties among observed phenomena and that can be used to explain those phenomena" (p. 756). Thus, we never prove that an instrument measures a construct, but instead collect and accumulate evidence that supports the assertion that the construct in question is being measured. As described above in this chapter, factor analysis initially was used to provide evidence of the construct validity of the SEBEST. An additional method for developing evidence of an instrument's construct validity is to test for an anticipated difference on the instrument (the construct) between two groups. (Nunnally, 1970)

For this additional construct validity study, the researcher hypothesized that the prospective elementary teachers in a teacher education program that focuses on preparing elementary teachers for the urban setting (e.g., the URBED student teachers) would have significantly higher self-efficacy beliefs with regarding to teaching science and learning for diverse learners, as measured particularly by the SEBEST, then would prospective

elementary teachers in a teacher education that did not have that focus (e.g., the EK ED SCIED 458 students). Hence, the following null hypothesis was posed for testing:

> H_O: There will not exist a statistically significant difference in the self-efficacy beliefs with regards to science teaching and learning for diverse learners as measured by the SEBEST, between URBED Program prospective elementary teachers in student teaching, and EK ED Program prospective elementary teachers in SCIED 458.

The SEBEST was administered by the researcher to the 23 URBED Program student teachers, at mid point of the Spring 1999 semester during the time allotted for a seminar meeting. The 102 EK ED prospective elementary teachers enrolled in the five sections of SCIED 458 completed the SEBEST during class time at mid-spring semester 1999. Demographic data were collected from the prospective elementary teachers using the questionnaire presented in Appendix F.

The demographic data are summarized in Table 4.5 for the URBED student teachers and each of the five sections of EK ED SCIED 458 and the five sections combined. They showed little difference between the two samples. The majority of students in both samples were seniors (8th semester standing) seeking a Bachelor of Science degree and initial Pennsylvania elementary teacher certification. The GPA's for the samples also were not significantly different. The preponderance of students in both samples were white females who spoke English as their first language.

Table 4.5

Demographic Data on URBED and EK ED Samples

Program	URBED Student Teachers	EK ED SCIED 458	EK ED	EK ED	EK ED	EK ED	Means for EK ED Sections
Section/Group	001	001	002	003	004	005	001-005
Status:							
BS and Cert.	23	27	18	19	18	19	101
Certification Only	*	2	*	*	5	*	7
Other	*	*	*	*	2	*	2
Semester Standing:							
5	*	*	1	*	*	*	1
6	1	3	1	*	*	2	6
7	*	2	4	2	2	2	12
8	18	24	10	17	22	15	88
9	2	*	*	*	*	*	*
10	2	*	2	*	*	*	2
11	*	*	*	*	1	*	1
GPA (Average)	3.51	3.41	3.55	3.53	3.49	3.4	3.48
Gender:							
Female	21	24	15	14	18	16	87
Male	2	5	3	5	8	4	25
Ethnicity:							
American Indian	*	*	*	*	*	1	1
Asian	*	*	*	*	1	*	1
Black	1	1	*	*	*	*	1
Hispanic	1/2	1	*	*	*	*	1
White	19 1/2	26	18	19	25	17	105
Primary Language:							
English	23	27	*	19	26	18	90
Spanish	*	1	1	*	*	*	2
French	*	*	*	*	*	*	*
Other	*	*	*	*	1 Cantonese	*	1
Second Language							
English	*	1	*	2	1	*	4
Spanish	3	1	*	2	2	1	6
French	*	*	*	1	*	*	1
Other	1 German 1 Hebrew 1 Sign	*	*	1 German	*	*	1

Table 4.6 shows the means and standard deviations on the SEBEST and its sub-scales for each of the six groups (i.e., one URBED and five EK ED). The URBED prospective elementary teachers' SEBEST scores ranged between 115 and 167 for the entire instrument (possible rang = 34 - 170), and between 58 and 83 for PSE and between 57 and 85 for OE (possible range on each sub-scale = 17 - 85). The EK ED prospective elementary teachers' SEBEST scores ranged between 107 and 166 for the entire instrument, and between 48 and 82 for PSE and between 58 and 85 for OE.

Table 4.6

Descriptive Statistics on Mid-Semester SEBEST Results

Groups		Means	Standard Deviation
URBED Student Teachers	001	148.41	13.34
EK ED	001	151.62	10.77
SCIED 458	002	150.47	13.6
	003	146.68	11.7
	004	147.10	11.2
	005	153.05	7.18

Analysis of Variance (ANOVA) was used to test for differences across the six sections or groups of URBED and EK ED prospective elementary teachers on the entire SEBEST, and the PSE and OE sub-scale scores. Table 4.7, 4.8 and 4.9, below, present the respective ANOVA results. No statistically significant difference was found across the six groups on the total SEBEST and SEBEST PSE and OE sub-scale. That is, the ANOVA results were consistent with the null hypothesis, and so it was not rejected.

Table 4.7

One-way Analysis of Variance: on Total SEBEST

Source	DF	SS	MS	*F*	*P*
Group	5	669	134	1.02	0.409
Error	118	15495	131		
Total	123	16164			

* p≤.05

Table 4.8

One-way Analysis of Variance: on SEBEST PSE Sub-Scale

Source	DF	SS	MS	*F*	*P*
Group	5	259.1	51.8	1.05	0.394
Error	118	5844.4	49.5		
Total	123	6103.4			

* p≤.05

Table 4.9

One-way Analysis of Variance: on SEBEST OE Sub-Scale

Source	DF	SS	MS	*F*	*P*
Group	5	141.2	28.2	0.78	0.570
Error	118	4299.0	36.4		
Total	123	4440.2			

* p≤.05

The URBED and EK ED comparison of SEBEST total instrument and sub-scale scores using ANOVA did not provide further evidence of the construct validity of the instrument. But the researcher does not believe that the ANOVA results bring into question the construct validity of the SEBEST. In the process of reviewing the demographic data on the URBED and EK ED prospective elementary teachers, the researcher began to question

the original basis for the null hypothesis. There may not have been a difference in the quality of the teacher preparation for science teaching and learning for diverse learners between the EK ED and URBED programs. Students in the EK ED program must fulfill a diversity requirement in the General Studies portion of the bachelor's degree and they complete two courses in Educational Theory and Policy that deal with diversity issues. Also, recognizing each child as an individual learner and understanding his/her prior knowledge are pedagogical emphases throughout the EK ED program. And, because they had limited teaching experience, the possibility exists that the prospective EK ED elementary teachers had inflated self-efficacy perceptions with regard to science teaching and learning for diverse learners. The data presented in Table 4.6 supports this inference in that the mean SEBEST scores for the five section of SCIED 458 range near the top of the scale, between 147.10 and 153.05, wherein the highest possible score was 170. (Data to be presented later in the chapter in Table 4.11 is similarly supportive.)

Reliability Results

Coefficient Alpha was employed to assess the reliability of the 34 items SEBEST with the URBED and EK ED data obtained at mid-semester (Spring 1999) and on SEBEST data collected at the end of the semester (Spring 1999) from the EK ED prospective elementary teachers in the five sections of SCIED 458. Table 4.10 summarizes the reliability statistics for both groups at mid-semester. The Coefficient Alpha reliability of the SEBEST at mid-semester with the URBED student teachers was .90. It was .81 for the PSE sub-scale and .88 for OE sub-scale. The reliability of the SEBEST with the EK ED SCIED 458 students was .88 at mid-semester across the five sections. For the PSE sub-scale was .83 and for the OE sub-scale was .85. Table 4.11 summarizes the descriptive statistics on the EK ED group (five sections of SCIED 458) at the end of the semester. Table 4.12 summarizes the SEBEST reliability data for that administration. These data yielded a Coefficient Alpha of 0.92 for the SEBEST the Alphas of .87 and .86 for the PSE

and OE sub-scales, respectively. Appendix G contains nine tables, that show the contribution for each of the 34 items toward the reliabilities for the instrument as a whole, and each of the sub-scales for the URBED group at mid-semester and the EK ED group at mid-semester and end of the semester.

Table 4.10

Coefficient Alpha Reliability of SEBEST: Mid-Semester

Group	Entire Instrument	PSE Sub-scale	OE Sub-scale
URBED	.90	.81	.88
EK ED	.88	.83	.85

Table 4.11

Descriptive Statistics for End-of-Semester SEBEST Results

Group	Section	Mean	Standard Deviation
EK ED	001	151.19	13.41
	002	155.50	9.35
	003	148.55	15.59
	004	150.15	14.68
	005	144.36	13.46

Table 4.12

Coefficient Alpha Reliability of SEBEST: End of the Semester

Group	Entire Instrument	PSE Sub-scale	OE Sub-scale
EK ED	.92	.87	.86

Test-Rest Reliability

The test-retest reliability of the SEBEST was determined using the mid-semester and end-of-semester EK ED data collected from the five sections of SCIED 458. A

Pearson Product-Moment correlation coefficient was calculated between the mid-semester and end-of-semester SEBEST scores for the 90 SCIED 458 student who completed both administrations. The test-retest reliability for the total SEBEST was determined to be .70. For the PSE sub-scale the test-retest reliability was .70 and for the OE sub-scale was .67.

CHAPTER 5

Summary, Conclusion, Implication, and Recommendations

Summary

Currently, 25 of the 50 largest school districts in the United States have children of color as the majority student population (Banks, 1991). In states such as New Mexico, Texas and California children of color comprise 70 percent of the total student population (Quality Education for Minorities Project, 1990). Children of color make up 30 percent of the students in the country overall and the growth rate of the minority population segment is expected to increase to 40 percent by the year 2020 (Pallas, Natriell, & McDill, 1989). By contrast, when the demographics of the prospective elementary teacher population is examined it is found to be predominately white, middle class and female (Banks, 1991). Thus, it is important for elementary teachers to understand student diversity and be able to teach science for a diverse student population. Part of the solution may be in understanding the behaviors of prospective elementary teachers. Teacher beliefs appear to be good predicators of behavior (Ashton & Webb, 1986a, 1986b; Bandura, 1986; Riggs, 1988; Riggs & Enochs, 1990). Teacher self-efficacy beliefs, in particular, have been found to be valid predictors of practicing and prospective elementary teachers' behavior regarding science teaching and learning (Ashton & Webb, 1986a, 1986b; Bandura, 1986; Riggs, 1988; Riggs & Enochs, 1990). This study builds upon the work of Ashton and Webb (1986a, 1986b) Bandura (1977, 1986) Riggs (1988) and Riggs and Enochs, (1990) and apply it to prospective elementary teachers' beliefs about science teaching and learning for diverse learners.

The purpose of this study was to develop, validate and establish the reliability of an instrument to assess the self-efficacy beliefs of prospective elementary teachers with regards to science teaching and learning for diverse learners. The study is significant for four reasons. First, it would fill a gap in the literature and our understanding of prospective elementary teachers' self-efficacy beliefs about science teaching and learning

for diverse learners. Second, this study would extend the self-efficacy theory base to include prospective elementary teachers' self-efficacy beliefs about science teaching and learning for diverse learners. Third, an instrument that measured prospective elementary teachers self-efficacy beliefs toward science teaching and learning for diverse learners would have value for science teacher educators and researchers. Fourth, the proposed instrument would assess a target population, prospective elementary teachers, who could be in the teaching profession for thirty or more years. A seven step plan was designed and followed in the process of developing the instrument, which was titled the Self-Efficacy Beliefs about Equitable Science Teaching or SEBEST. Diverse learners as recognized by *Science for All Americans* (1989) are "those who in the past who have largely been bypassed in science and mathematics education: ethnic and language minorities and girls" (p. xviii). That definition was extended by this researcher to include children from low socioeconomic backgrounds based on the research by Gomez and Tabachnick (1992).

First, the researcher defined the self-efficacy construct to be measured and identified the diverse learners for the study. Second,.one hundred ninety-five draft Likert type items, modeled after those composing the STEBI A (Riggs, 1988) and STEBI-B (Enochs & Riggs, 1990) were prepared with at least six representatives for each cell in a content matrix that identifies the two dimensions of self-efficacy: personal self-efficacy and outcome expectancy and the four diverse learner groups: ethnic, gender, language minorities and socioeconomic status. Third, the draft items were reviewed independently for clarity and comprehension by ten graduate students in science education. Fourth, a panel composed of eight faculty members representing science education, multicultural education, and self-efficacy research independently judged the content validity of the revised items.

Fifth, the 48 remaining items were organized as a draft SEBEST instrument and the instrument was administered to 226 prospective elementary teachers in the Elementary-

Kindergarten Education Program (EK ED) at Penn State in the Fall of 1998. The item analysis was performed with the following goal:

> What is the most reliable and valid combination of items to compose the SEBEST for the purposes of assessing prospective elementary teachers self-efficacy beliefs for teaching science to diverse learner, and the two dimensions of personal self-efficacy and outcome expectancy?

Using factor analysis, Coefficient Alpha, and Chi-Square a 34 item instrument was found to achieve the greatest balance between the construct validity, reliability. The 34 item SEBEST was found to load purely on four factors across the content matrix thus providing evidence that the construct validity. The Coefficient Alpha reliability for the 34 item SEBEST was .90 and .82 for the PSE sub-scale .78 and for the OE sub-scale. A Chi-Square test was used to determine whether the 34 items were balanced across the Personal Self-Efficacy/Outcome Expectancy and Ethnicity/Language Minority/Gender/ Socioeconomic Status/ dimensions of the content matrix. The resulting statistic, X^2 = 2.71, $df = 7$, was not significant at the .05 level of probability.

In the seventh step the SEBEST was to administered to 102 prospective elementary teachers in the Elementary-Kindergarten Education Program (EK ED) and 23 prospective elementary teachers in the Urban Early and Middle Childhood Education Program (URBED) at Penn State in the Spring of 1999, at mid-term and then administered again to the EK ED prospective elementary teachers at the end of the semester to gather further information regarding the construct validity and reliability, particularly test-retest. The reliability for the of the SEBEST for the URBED student teachers was .90 for the entire instrument, .81 for the PSE sub-scale and .88 for the OE sub-scale. The reliability for the SEBEST for the EK ED group was .88 for the entire instrument, .83 for the PSE sub-scale and .85 for the OE sub-scale. The ANOVA was performed on mid-semester data to determine if the SEBEST could differentiate between prospective teachers prepared to teach diverse populations (i.e., the URBED sample) and those in a contemporary teacher

education program which appeared not to have a particular emphasis on teaching diverse populations (i.e., the EK ED sample). The ANOVA results showed no difference between the two groups. While this finding does not provide further evidence of construct validity, it did not distract from the instrument's construct validity. The non-significant ANOVA results were attributed to no difference in self-efficacy beliefs due to the fact the EK ED students have diversity elements running throughout the program. Also, one or both groups could have had inflated self-efficacy perceptions regarding science teaching and learning for diverse learners. There is research that questions the theory that beliefs and actions are linked as described earlier. For example Borko and Putman (1996) state that teachers' knowledge and beliefs play a large role in determining actions in the classroom, however, teachers' prior knowledge and beliefs are resistant to change even after instruction. Knowledge and beliefs serve as filters through which learnering takes place. Bullough and Knowles (1991) suggest that teachers beliefs and actions are not always congruent. In their study of a teacher, for example, her beliefs of being a nurturer and parent as a teacher were non-existent in her classroom instruction. Instead her practices were dictated by her needs and expectations for the students.

Test-retest reliability was calculated using the EK ED data collected at mid-semester and the end of the semester. SEBEST test-retest reliability was .70. The PSE sub-scale test-retest reliability was .70 and the OE sub-scale test-retest reliability was .67

Conclusion and Implication

Based on the standardized development procedures used and the associated evidence, the SEBEST appears to be a content and construct valid instrument, with high internal reliability and moderate test-retest reliability qualities, for use with prospective elementary teachers to assess self-efficacy beliefs for teaching and learning science for diverse learners.

The SEBEST could be a valuable tool for science teacher educators working in practical and research settings to assess the self-efficacy beliefs of prospective elementary teachers with regards to science teaching and learning for diverse learners. The SEBEST could be used singularly or in combination with other data collection techniques, such as first-hand observations of teachers engaged in science teaching with diverse learners. Similarly, the SEBEST could be useful to multicultural teacher educators. For example, the instrument could be used to help identify if a particular course or program is achieving what it purports with regard to prospective elementary teacher preparation for science teaching and learning for diverse learner groups.

Recommendations

The construct validity of an instrument is never fully established (Nunnally, 1970), thus, the construct validity of the SEBEST will continue to need to be studied. In the process, the reliability of the SEBEST, including test-retest reliability, should be re-examined. The question raised in Chapter 4 associated with prospective elementary teachers' inflated self-efficacy perceptions with regard to science teaching and learning for diverse learners needs to be examined. Norming the SEBEST may provide some insights here and will provide additional information on the instrument that will be useful to users. This also could help determine if prospective elementary teachers have inflated self-efficacy beliefs with regards to teaching science to diverse learners. Additionally, development of a form of the SEBEST for practicing elementary teachers should be pursued, as was done with the STEBI-B.

References

Allen & Seumptewa (1988).

American Association of Colleges for Teacher Education. (1987). Teaching teachers: Facts and figures, research about a teacher education project. Washington, DC: Author.

American Association of University Women. (1992). *The AAUW Report: How schools shortchange girls*, Washington, DC: The AAUW Educational Foundation.

Atwater, M. M. (1994). Research on cultural diversity in the classroom. In D. Gabel (Ed.), *Handbook of research on science teaching and learning*. New York: Macmillan.

Armor, D., Conroy-Osequera, P., Cox, M., King, N., McDonnel, L., Pascal, A., Pauley, E., & Zellman, G. (1976). Analysis of the school preferred reading programs in selected Los Angels minority school. (R-2007-LAUSD). Santa Monica, CA: Rand Corp.

Ashton, P., & Webb, R. (March, 1982). Teachers' sense of efficacy: Toward and ecological model. Paper presented at the annual meeting of the American Educational Research Association, New York.

Ashton, P., & Webb, R. (1986a). Teacher efficacy attitudes, classroom behavior, and maintaining professional self-esteem. In P. Ashton, & R. Webb (Eds.). *Making a difference: Teachers' sense of efficacy and student achievement*. (pp. 55-89). New York: Longman Inc.

Ashton, P., & Webb, R. (1986b). Teachers' sense of efficacy, classroom behavior, and student achievement. In P. Ashton, & R. Webb (Eds.). *Making a difference: teachers' sense of efficacy and student achievement*. (pp. 125-144). New York: Longman Inc.

Baker, D. (1998). Equity issues in science education. In B. Fraser & K. Tobin (Eds.) International Handbook of Science Education Part Two (pp. 869-895). Netherlands: Kluwer Academic.

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. Psychological Review, 84(2), 191-215.

Bandura, A. (1981). Self-referent thought: A developmental analysis of self-efficacy. In J. H. Flavelll & L. Ross (Eds.). *Social cognitive development frontiers and possible futures*. Melbourne, Australia: Cambridge.

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

Bandura, A. (1986). Social foundations of thought and action. Englewood Cliffs, New Jersey: Prentice-Hall.

Bandura, A. (1989). Regulation of cognitive processes through perceived self-efficacy. *Developmental Psychology*, 25(5), 729-735.

Bandura, A. (1995). Exercise of personal and collective efficacy in changing societies. In A. Bandura (Ed.), *Self-efficacy in changing societies*. Melbourne, Australia: Cambridge.

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

Banks, J. (1991). Teaching multicultural literacy to teachers. *Teaching Education*, 4(1), 135-144.

Berman, P., McLaughlin, M. (1977). Federal programs supporting educational change: Vole. 7. Factors affecting implementation and continuation. Santa Monica, CA: Rand Corp.

Borg, W. R., & Gall, M. D. (1989). Educational Research: An Introduction-Fifth Edition. White Plains, New York: Longman.

Borko, H. & Putnam, R. (1996). Learning to teach. In D. Berliner and R. Calfee (Eds.), Handbook of Educational Psychology (pp. 673-708). Macmillan: New York.

Brickhouse, N. (1994). Bringing in the outsides: Reshaping the sciences of the future. *Journal of Curriculum Studies* 26(4), 401-416.

Brophy, J., & Good, T. (1970). Teachers' communication of differential expectations for children's classroom performance: Some behavioral data. *Journal of Educational Psychology*, 61, 356-374.

Bullough, R. U., & Knowles, J. G., (1991). Teaching and nurturing changing conceptions of self as teacher in a case study of becoming a teacher. Qualitative Studies in Education, 2, 121-140.

Campbell, J.R., Voelkl, K.E., & Donahue, P.L. (1997). *NAEP 1996 trends in academic progress*, Washington, DC: National Center for Education Statistics.

Czerniak, C. & Chiarelott, L. (1990). Teacher education for effective science instruction-a social cognitive perspective. *Journal of Teacher Education*, 41(1), 49-58.

Datta, L., Schaefer, E., Davis, M. (1968). Sex and scholastic aptitude as variables on teachers' rating of the adjustment and classroom behavior of Negro and other seventh-grade students. *Journal of Education Psychology*, 59, 94-101.

Denham, C. H. & Michael, J. J. (1981). Teacher sense of efficacy: A definition of the construct and a model for further research. *Education Research Quarterly*, 5, 39-63.

DeTure, Gregory, & Ramsey. (1990, April). The science preparation of elementary teachers. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Atlanta, GA.

Dweck, C. S., & Bush, E. S. (1976). Sex differences in learned helplessness: Differential debilitation with peer and adult evaluators. *Developmental Psychology*, 12, 147-156.

Ducharme, E., & Agne, R. (1989). Professors of education: Uneasy residents of academe. In R. Wisniewski & E. Ducharme (Eds.), The professors of teaching (pp. 67-86). Albany, New York: SUNY Press.

Edwards, A. (1957). Techniques of attitude scale construction. New York, New York. Appleton-Century-Crofts.

Enochs, L. G. & Riggs, I. M. (1990). Further development of an elementary science teaching efficacy belief instrument: preservice elementary scale. *School Science and Mathematics,* 90(8), 694-706.

Fraser, B. J. (1994). Research on classroom and school climate. In D. Gabel (Ed.), *Handbook of research on science teaching and learning.* New York: Macmillan.

Gall, M. D., Borg, W. R., & Gall, J. P. (1996). Education Research: An Introduction-Sixth Edition. White Plains, New York: Longman.

Gibson, S. & Dembo, M. H. (1984). Teacher efficacy: A construct validation. *Journal of Educational Psychology*, 76(4), 569-582.

Gomez, M. L. (1996). Telling stories of our teaching, reflecting on our practices. *Action in Teacher Education*, 18(3), 1-12.

Good, T. L, & Tom, D.Y. H. (1985). Self-regulation, efficacy, expectations, and social orientation: teacher and classroom perspectives. In C. Ames & R. Ames (Eds.). Research on Motivation in Education: Vol., 2. The Classroom Milieu. (pp. 307-326). Orlando, Fl: Academic Press.

Grant, C. A., & Ladson -Billings, G. (Eds.). (1997). Dictionary of multicultural education. Phoenix: Oryx.

Grant, C.A. & Tate, W.F. (1995). Multicultural education through the lens of the multicultural education research literature. In J. Banks (Ed), Handbook of research on multicultural education: New York: Macmillan.

Haberman, M. (1987). Recruiting and selecting teachers for urban schools. New York: ERIC Clearinghouse on Urban Education, Institute for Urban and Minority Education.

Helton, G.B., Workman, E.A., & Matuszck, P.N. (1982) Psycoeducational Assessment: Integrating concepts and techniques. Florida: Grune & Stratton.

Hodgknison (1985).

Hodson, D. (1993). In search of a rationale for multicultural science education. *Science Education,* 77(6), 685-711.

Irvine, J.J. (1990). Black students and school failure. New York: Greenwood Press.

Jackson, G., & Cosca, C. (1974). The inequality of educational opportunity in the Southwest: An observational study of ethnically mixed classrooms. *American Educational Research Journal*, 11, 219-229.

Jones, G., & Wheatley, J. (1990). Gender differences in teacher-student interactions in science classrooms. *Journal of Research in Science Teaching,* 27(9), 861-874.

Kahle, J. B. (1990). Real students take chemistry and physics: gender issues. In K. Tobin, J. B. Kahle, & B. J. Fraser (Eds.), Windows into science classrooms; Problems associated with higher-level cognitive learning (pp. 92-134). New York: Falmer.

Kahle, J. B., (1994). Retention of girls in science: case studies of secondary teachers. In J. B. Kahle (Ed.), Women in science; a report form the field. Philadelphia: Falmer.

Kahle, J. B., & Lakes, M. K. (1983). The myth of equality in science classrooms. *Journal of Research in Science Teaching, 20* (2), 131-140.

Kahle, J. B., & Meece, J. (1994). Research on gender issues in the classroom. In D. Gabel (Ed.), *Handbook of research on science teaching and learning.* New York: Macmillan.

Kelly, A., (1985). The construction of masculine science. *British Journal of sociology of education,* 6(2), 133-153.

Koballa, T. R. & Crawley, F.E. (1985). The influence of attitude of science teaching and learning. *School Science and Mathematics,* 85, 222-232.

Kozol, J (1991). Savage inequalities. New York: Crown Publishers, Inc.

Linn, M. C. (1990, July). Gender, mathematics and science: Trends and recommendations. Paper prepared for the Council of Chief State Officers Summer Institute, Mystic, CT.

Linn, M. C., & Hyde, J. S. (1989). Gender, mathematics and science, *Educational Researcher, 18* (8), 17-19; 22-27.

Lowery, L. F. (1997). *NSTA pathways to the science standards: Guidelines for moving the vision into practice.* (Elementary school ed.). Arlington, VA: National Science Teachers Association.

Malone, M., & Fleming, L. (1983). The relationship of student characteristics and student performance as viewed by meta-analysis research. *Journal of Research in Science Teaching 20,* 481-496.

Martin, R. (1972). Student sex and behavior as determinants of the type of frequency of teacher-student contacts. *Journal of School Psychology,* 10, 339-347.

Montogomery, S. L. (1994). Minds for the making: the role of science in American education, 1750-1990. New York: Guilford Press.

Morrison, J. W. (1990). *Compensatory preschool teachers' interaction patterns with the classroom minority*. (Report No PS 018 650). New York: Syracuse University. (ERIC Document Reproduction Service No. ED 317 271).

Morse, L. W., & Handley, H. M. (1985). Listening to adolescents: Gender differences in science classroom interaction. In L. C. Wilkinson & C.B. Marrett (Eds.), *Gender influences in classroom interactions.* New York: Academic.

National Science Education Standards. (1996). Washington, DC: National Academy.

National Science Foundation. (1990). *Women and minorities in science and engineering* . (Report No. 90-301). Washington, DC: Author.

Nieto, S. (1996). Affirming diversity: The sociopolitical context of multicultural education (2nd ed.). Chicago: University of Chicago Press.

Nunnally, J. C. (1967). Psychometric Theory. New York: McGraw-Hill.

Nunnally, J. C. (1970). Introduction to psychological measurement. New York. McGraw-Hill.

Pallas, A., Natriell, G., & McDill, E. (1989). The changing nature of the disadvantaged population. *Educational Researcher,* 18(5), 16-22.

Park, S. (1996). Development and validation of the Korean science teaching efficacy beliefs instrument (K-STEBI) for prospective elementary school teachers. *Dissertation Abstract International.*

Pearson (1986).

Postlethwaite, T. & Wiley, D. (1992). The IEA study of science II: Science achievement in twenty-three countries. New York: Pergamon.

Pursuing Excellence: A study of U.S. Fourth and Eighth Grade Mathematics and Science Achievement in International Context (1997) ht.//nces.ed.gov/TIMSS/

Quality Education for Minorities Project. (1990). Education that works: An action plan for the education of minorities. Cambridge, MA: Author.

Rakow, S. J. (1985). Minority students in science: Perspectives from the 1981-1982 National Assessment in Science. *Urban Education, 20* (1), 103-113.

Remmers, H.H., Gage, N.L., & Rummel, J. F. (1965) A practical introduction to measurement and evaluation. New York: Harper & Row.

Richards, M. (1995). Underrepresented groups in astronomy. *Mercury, 24,* (3), 16.

Riggs, I. M. (1988). The development of an elementary teachers' science teaching efficacy belief instrument. Dissertation Abstract International.

Rotter, J. B (1966). Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs, 80, Whole No. 604.

Rosser, S. (1986). A practical guide: Teaching science and health from a feminist perspective. New York: Pergamon Press.

Roy, R. (1997). Unpublished Interview

Rubba, P. A. (1977). The development, field testing and validation of an instrument to assess secondary school students' understanding of the nature of scientific knowledge. Dissertation Abstract International.

Rubba, P. A., & Andersen, H. O. (1978). Development of an instrument of assess secondary school students' understanding of the Nature of scientific knowledge. *Science Education*, 62(4): 449-458.

Sadker, D., & Sadker, M. (1981). The development and field trial of a non-sexist teacher education curriculum. *High School Journal*, 64, 331-336.

Sadker, D., & Sadker, M. (1985). Is the o.k. classroom o.k.? *Phi Delta Kappan*, 66(5), 358-361.

Science for all Americans. (1989). Washington, DC: American Association for the Advancement of Science.

Schunk, D. H. (1991). Self-efficacy and academic motivation. *Educational Psychologist*, 26(3&4), 207-231.

Secada, W. G. (1989). Educational equity versus equality of education: An alternative conception. In W. G. Secada (Ed.) *Equity in Education* (pp. 86-88). London: Framer Press.

Secada, W. (1994). Equity and the teaching of mathematics. In M. M. Atwater, K., Radzik-Marsh, & M. Strutches (Eds.), *Multicultural education: Inclusion of all.*

Shakeshaft, C. (1995). Reforming science education to include girls. *Theory into Practice,* 34 (1), 74-79.

Shrigley, R.L. (1974). The attitude of preservice elementary teachers toward science. *School Science and Mathematics*, 74(3), 437-446.

Southern Growth Policies Board. (1988). *Halfway home and a long way to go.* Little Rock: Bell South.

Spurlin, Q. (1995). Making science comprehensible for language minority students. *Journal of Science Teacher Education* , 6(2), 71-78.

Standards for educational and psychological testing (1985). Washington, D. C: American Educational Research Association, American Psychological Association, & National Council on Measurement in Education.

Stegemiller, H. A. (1989). *An annotated bibliography of the literature dealing with the contributing factors of teacher expectations on student performance.* (Report No. SP 031 604). South Bend: Indiana University at South Bend. (ERIC Document Reproduction No. ED 313 323).

Steinkamp, M., & Maehr, M. (1984). Gender differences in motivational orientations toward achievement in school science: A quantitative synthesis. *American Educational Research Journal 21,* 39-59.

Streitmatter, J. (1994). *Toward gender equity in the classroom.* Albany, NY: SUNY.

Subrahmanyan, L., & Bozonie, H. (1996). Gender equity in middle school science teaching: Being "equitable" should be the goal. *Middle School Journal,* 27(5), 3-10.

Suen, H. (1999). Unpublished Interview

Sunal, D. W. (1980). Effect of field experience during elementary methods courses on preservice teacher behavior. *Journal of Research in Science Teaching,* 17(1), 17-23.

Teachers of English to Speakers of Other Languages (TESOL). (1976). Position paper on the role of English as a second language in bilingual education. Washington, DC: Georgetown University.

Tilgner, P. J. (1990). Avoiding science in the elementary school. *Science Education,* 74(4), 421-431.

Tobin, K., & Garnett, P. (1987). Gender related differences in science activities. *Science Education,* 71, 91-103.

Tobin, K. (1996).

Weiner, L. (1993). Preparing teachers for urban schools. 135-136.

Weiss, I. R. (1987). Report on the 1985-1986 national survey of science and mathematics education. Research Triangle Park, North Carolina: Center for Educational Research and evaluation, Research Triangle Institute.

Westerback, M. (1982). Studies on attitude toward teaching science and anxiety about teaching science in preservice teachers. *Journal of Research in Science Teaching.* 19(7), 603-616.

Westerback, M.(1984). Studies on anxiety about teaching science in preservice elementary teachers. *Journal of Research in Science Teaching,* 21(9), 937-950.

William, R. & Goldstein, M. (1984) Multivariate analysis: Methods and applications. New York: Wiley and Sons.

Appendix A

LIST OF GRADUATE REVIEWERS, LETTERS TO GRADUATE STUDENT REVIEWERS AND EVALUATION FORMS FOR THE SELF-EFFICACY BELIEFS ABOUT EQUITABLE SCIENCE TEACHING (SEBEST) ITEMS

Science Education Graduate Student Reviewers for the *Self-Efficacy Beliefs for Equitable Science Teaching* (SEBEST) Instrument

Leigh Ann Boardman	Ph.D. Program
James Bolinger	Ph.D. Program
Erdat Cataloglu	Ph.D. Program
Tonjua Freeman	Ph.D. Program
Patricia Friedrichsen	Ph.D. Program
Marla Jones	D.Ed. Program
Robert Kuech	Ph.D. Program
Eric McConnell	M.S. Program
Rachel Parson	M.S. Program
Joseph Taylor	Ph.D. Program

September 18, 1998

Dear ,

Thank you for agreeing to participate as a reviewer of the Self-Efficacy Beliefs about Equitable Science Teaching (SEBEST) instrument. The goal of the instrument is to measure self-efficacy beliefs and outcome expectancies of prospective elementary teachers with regards to science teaching for diverse learners.

Your task is to review the items that you have been assigned for clarity and comprehension by prospective elementary teachers, and to record your comments directly on the draft items. Your feedback will be collected and used in revising the items. The revised items will be resubmitted to you and subsequently revised until clarity is achieved. Therefore, it will be necessary that you write your name on your packet when you turn it in. I am asking that you return the packet to my mailbox outside the science education office by Monday September 28, 1998.

In order to complete this task you will need to be familiar with the following points in the construction of this instrument. First, Edwards (1957) criteria for item clarity was used a to reduce item ambiguity. Even though Edward's criteria were used in drafting the items, as a reviewer you will need to examine each question to ensure it meets these criteria. They are as follows:

1. Use items that refer to present verses the past
2. Avoid factual statements
3. Does not use items that can be interpreted in several ways
4. Use items that only deal with the construct
5. Avoid items that are endorsed by all or none in the target population
6. Use items that encompass the entire construct
7. Use simple, clear and direct language
8. Use items that are short and less then twenty words
9. Items should be one complete thought
10. Items should not Use "all," "always," "none," or "never,"
11. Use care in using only, "just" and "merely,"
12. Items should be in simple sentences as verse to compound
13. Do not use words that may not be understood by the reader,
14. Avoid double negative.

You will also need to familiarize yourself with the definitions of the terms used in the instrument. They are *self-efficacy beliefs, personal self-efficacy, outcome expectancy, ethnicity, language minorities, socioeconomic and gender.*

Self-efficacy beliefs as defined by Bandura (1977) are "beliefs that people have that influence the course of action people choose to pursue, how much effort they put forth in given endeavors, how long they would persevere in the face of obstacles and failures, their resilience to adversity, whether their thought patterns are self-hindering or self-aiding, how much stress and depression they experience in coping with taking environmental demands, and the level of accomplishments they realize" (p. 3).

Personal self-efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." The focus is upon the individual believing he/she has the capability (or will have the capability, in the case of a prospective teacher) to act.

Outcome expectancy as portrayed by Bandura (1977) is " a person's estimate that a given behavior will lead to certain outcomes. An efficacy expectation is the conviction that one can successfully execute the behavior required to produce the outcomes. Outcome and efficacy expectations are differentiated, because individuals can believe that a particular course of action will produce certain outcomes, but it they entertain serious doubts about whether they can perform the necessary activities such information does not influence their behavior" (p. 193).

Science for All Americans (1989) identifies diverse learners to science education as those who have been by-passed, namely ethnic, language minorities and gender. Socioeconomic is a group that has been added as a dimension of diverse learners by the researcher due to her belief that children from low socioeconomic backgrounds are by-passed by science education. Ethnicity according to the American Heritage College Dictionary and this instrument is the race, background, or affiliation of a person. Language minorities as defined by Science for All Americans (1989) are those who speak English as a second language. Gender is the sexual identity, especially in relation to society or culture. The Socioeconomic Status of a person is determined by both social and economic factors of a in the person's life.

With these definitions in mind I am now asking you to review the items assigned to you for their clarity and comprehension.

If you have any questions regarding this process please feel free to call me at 814-867-3325 or email me at jmr214@psu.edu.

Once again I want to thank you for your time and expertise. I am grateful.

Peace,

Jennifer Ritter

Task: You are asked to review the items for clarity and comprehension. Please note a + or - under each area and suggest item revisions as needed.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act**.

Language Minorities as defined by Science for All Americans (1989) are those who speak English as a second language.

Positively Stated Item one that has an affirmative element or characteristic.

Clarity is clearness of thought and style.

Comprehension is the ability of prospective elementary teachers (e.g. those in SCIED 458) to read and understand the item.

Draft Items		Clarity		Comprehension	
		+	-	+	-
LPP 1. I will be able to teach science to children whose first language is not English.	SA A UN D SD				
LPP 2. I will be able to effectively monitor the science understanding of children whose first language is not English.	SA A UN D SD				
LPP 3. When children in my classroom who speak English as a second language achieve in science, it will be attributed to my teaching.	SA A UN D SD				
LPP 4. The science achievement of children in my classroom whose first language is not English is directly related to my teaching effectiveness.	SA A UN D SD				
LPP 5. Children whose first language is not English are capable of learning the science I will teach.	SA A UN D SD				
LPP 6. I will be able to help children whose first language is not English overcome their limitations to learn science.	SA A UN D SD				
LPP 7. I can do a great deal as a teacher to increase the science achievement of children who do not speak English as their first language.	SA A UN D SD				

Task: You are asked to review the items for clarity and comprehension. Please note a + or - under each area and suggest item revisions as needed.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act.**

Language Minorities as defined by Science for All Americans (1989) are those who speak English as a second language.

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Clarity is clearness of thought and style.

Comprehension is the ability of prospective elementary teachers (e.g. those in SCIED 458) to read and understand the item.

Draft Items	Clarity + -	Comprehension + -
LPN 1. I will not be able to teach science to children who speak English as their second language as effectively as I will be able to teach children who speak English as their first language. SA A UN D SD		
LPN 2. No amount of effort on my part will be able to influence the success in my science class of children who speak English as their second language. SA A UN D SD		
LPN 3. My ability to teach science will be limited if children do not speak English at home. SA A UN D SD		
LPN 4. I do not know how to teach science concepts to children who speak English as a second language. SA A UN D SD		
LPN 5. I do not know the strategies for teaching science to increase the achievement for children who speak English as a second language. SA A UN D SD		
LPN 6. I will not be as responsible for the science achievement of children who speak English has a second language. SA A UN D SD		

Task: You are asked to review the items for clarity and comprehension. Please note a + or - under each area and suggest item revisions as needed.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act.**

Gender is the sexual identity, especially in relation to society or culture.

Positively Stated Item one that has an affirmative element or characteristic.

Clarity is clearness of thought and style.

Comprehension is the ability of prospective elementary teachers (e.g. those in SCIED 458) to read and understand the item.

Draft Items		Clarity		Comprehension	
		+	-	+	-
GPP 1. I will have the skills to teach science to girls to improve their achievement.	SA A UN D SD				
GPP 2. I will be able to motivate girls to learn science.	SA A UN D SD				
GPP 3. As a teacher, I will influence girls achievement in science.	SA A UN D SD				
GPP 4. I will have the ability to teach science so girls can achieve.	SA A UN D SD				
GPP 5. I can help girls achieve in science at the same level as boys.	SA A UN D SD				
GPP 6. What I will do as a teacher in the classroom can equalize the science achievement level of girls with that of boys.	SA A UN D SD				
GPP 7. I will be effective in teaching science in a meaningful way to girls.	SA A UN D SD				
GPP 8. As a teacher, I will be in a position to equalize the science achievement of girls with that of boys.	SA A UN D SD				

Task: You are asked to review the items for clarity and comprehension. Please note a + or - under each area and suggest item revisions as needed.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act.**

Gender is the sexual identity, especially in relation to society or culture.

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Clarity is clearness of thought and style.

Comprehension is the ability of prospective elementary teachers (e.g. those in SCIED 458) to read and understand the item.

Draft Items		Clarity	Comprehension
		+ -	+ -
GPN 1. My teaching cannot make up for the lack of science experiences girls have.	SA A UN D SD		
GPN 2. I do not know how to turn girls on to science.	SA A UN D SD		
GPN 3. As a teacher, I will not be responsible for the success of girls in my science classroom.	SA A UN D SD		
GPN 4. Extra effort on my part as a teacher, will not help girls do well in science.	SA A UN D SD		
GPN 5. Effective science teaching on my part cannot improve the science understanding of girls.	SA A UN D SD		

Task: You are asked to review the items for clarity and comprehension. Please note a + or - under each area and suggest item revisions as needed.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act.**

Socioeconomic Status of a person is determined by both social and economic factors of a in the person's life.

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Clarity is clearness of thought and style.

Comprehension is the ability of prospective elementary teachers (e.g. those in SCIED 458) to read and understand the item.

Draft Items	Clarity + -	Comprehension + -
SPN 1. I will not have the ability to help children from low socioeconomic backgrounds be successful in learning science. SA A UN D SD		
SPN 2. I do not have the ability to overcome the science learning limitations of children from economically disadvantaged backgrounds. SA A UN D SD		
SPN 3. Increased effort on my part in teaching science will produce little change in the science achievement of children from low socioeconomic backgrounds. SA A UN D SD		
SPN 4. The success in science of children from low socioeconomic backgrounds will not be directly related to my teaching effectiveness. SA A UN D SD		
SPN 5. Extra effort in science teaching on my part will not improve the success of children from low socioeconomic backgrounds. SA A UN D SD		
SPN 6. I will not have the science teaching ability to overcome the limitations of children from low socioeconomic backgrounds. SA A UN D SD		

Task: You are asked to review the items for clarity and comprehension. Please note a + or - under each area and suggest item revisions as needed.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act.**

Socioeconomic Status of a person is determined by both social and economic factors of a in the person's life.

Positively Stated Item one that has an affirmative element or characteristic.

Clarity is clearness of thought and style.

Comprehension is the ability of prospective elementary teachers (e.g. those in SCIED 458) to read and understand the item.

Draft Items	Clarity	Comprehension
	+ -	+ -
SPP 1. I will have the ability to excite children from impoverished backgrounds about science and be successful science learners. SA A UN D SD		
SPP 2. When the science grades of children from low socioeconomic backgrounds improve, it will be because I put extra effort into my science teaching. SA A UN D SD		
SPP 3. I will have the ability to help children from low socioeconomic backgrounds be successful in science. SA A UN D SD		
SPP 4. I will be responsible if children in my classroom from impoverished backgrounds do not learn science at the level of their counter parts. SA A UN D SD		
SPP 5. Extra effort on my part as a teacher will improve the success in science of children from low socioeconomic backgrounds. SA A UN D SD		

Task: You are asked to review the items for clarity and comprehension. Please note a + or - under each area and suggest item revisions as needed.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act.**

Ethnicity is the race, background, or affiliation of a person

Positively Stated Item one that has an affirmative element or characteristic.

Clarity is clearness of thought and style.

Comprehension is the ability of prospective elementary teachers (e.g. those in SCIED 458) to read and understand the item.

Draft Items		Clarity + -	Comprehension + -
EPP 1. I will be able to successfully teach science to Native American children.	SA A UN D SD		
EPP 2. I will be able to make science culturally relevant for Hispanic children.	SA A UN D SD		
EPP 3. I will be able to successfully teach science to children of color.	SA A UN D SD		
EPP 4. I will be able to teach science in a meaningful manner to White children.	SA A UN D SD		
EPP 5. If Native American children are successful in learning science it will be attributed to my teaching.	SA A UN D SD		
EPP 6. If children of color are successful in learning science it will be attributed to my teaching.	SA A UN D SD		
EPP 7. I will be able to meet the needs of children of color when I teach science.	SA A UN D SD		

Task: You are asked to review the items for clarity and comprehension. Please note a + or - under each area and suggest item revisions as needed.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act.**

Ethnicity is the race, background, or affiliation of a person

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Clarity is clearness of thought and style.

Comprehension is the ability of prospective elementary teachers (e.g. those in SCIED 458) to read and understand the item.

Draft Items		Clarity		Comprehension	
		+	-	+	-
EPN 1. I will not be able to teach science in a meaningful manner to Hispanic children.	SA A UN D SD				
EPN 2. If Black children are not successful in learning science it will be attributed to my teaching.	SA A UN D SD				
EPN 3. If Asian children are not successful in learning science it will be attributed to my teaching.	SA A UN D SD				
EPN 4. I will not be able to successfully teach science to Black children.	SA A UN D SD				
EPN 5. I will not be able to successfully teach science to Asian children.	SA A UN D SD				
EPN 6. I will not be able to make science culturally relevant for White children.	SA A UN D SD				

Task: You are asked to review the items for clarity and comprehension. Please note a + or - under each area and suggest item revisions as needed.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Language Minorities as defined by Science for All Americans (1989) are those who speak English as a second language.

Positively Stated Item one that has an affirmative element or characteristic.

Clarity is clearness of thought and style.

Comprehension is the ability of prospective elementary teachers (e.g. those in SCIED 458) to read and understand the item.

Draft Items		Clarity		Comprehension	
		+	-	+	-
LOP 1. Effective science teaching will enable children who speak English as a second language to overcome obstacles and be successful in science.	SA A UN D SD				
LOP 2. With effective science teaching, children who speak English as a second language can achieve in science as well as their peers.	SA A UN D SD				
LOP 3. Children who speak English as a second language can be successful in learning science if the teaching is effective.	SA A UN D SD				
LOP 4. With effective science teaching, children who speak English as a second language are capable of competing in science with children who speak English as their first language.	SA A UN D SD				

Task: You are asked to review the items for clarity and comprehension. Please note a + or - under each area and suggest item revisions as needed.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Language Minorities as defined by Science for All Americans (1989) are those who speak English as a second language.

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Clarity is clearness of thought and style.

Comprehension is the ability of prospective elementary teachers (e.g. those in SCIED 458) to read and understand the item.

Draft Items	Clarity	Comprehension	
	+	-	+ -
LON 1. Children who speak English as a second language are not able to learn science as well as their counter parts, even with effective science teaching.			SA A UN D SD
LON 2. Children whose first language is not English have a difficult time learning science, even when proven science teaching techniques are used by the teacher.			SA A UN D SD
LON 3. Children who speak English as a second language are not able to achieve in science even when the instruction is effective.			SA A UN D SD
LON 4. Children who speak English as their second language do not have the ability to be successful in science even when the science instruction is effective.			SA A UN D SD

Task: You are asked to review the items for clarity and comprehension. Please note a + or - under each area and suggest item revisions as needed.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Gender is the sexual identity, especially in relation to society or culture.

Positively Stated Item one that has an affirmative element or characteristic.

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Comprehension is the ability of prospective elementary teachers (e.g. those in SCIED 458) to read and understand the item.

Draft Items		Clarity		Comprehension	
		+	-	+	-
GOP 1. Girls will aspire to become scientists if they receive effective science instruction.	SA A UN D SD				
GOP 2. Girls can develop in science at the same level as boys when they receive science instruction that is meaningful to them.	SA A UN D SD				
GOP 3. Girls have the ability to compete with boys in science when they receive quality science instruction.	SA A UN D SD				
GOP 4. Teachers should expect girls and boys to achieve equally in science.	SA A UN D SD				
GOP 5. Girls will learn science if they receive effective science instruction.	SA A UN D SD				

Task: You are asked to review the items for clarity and comprehension. Please note a + or - under each area and suggest item revisions as needed.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

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Comprehension is the ability of prospective elementary teachers (e.g. those in SCIED 458) to read and understand the item.

Draft Items		Clarity	Comprehension
		+ -	+ -
GPN 1. My teaching cannot make up for the lack of science experiences girls have.	SA A UN D SD		
GPN 2. I do not know how to turn girls on to science.	SA A UN D SD		
GPN 3. As a teacher, I will not be responsible for the success of girls in my science classroom.	SA A UN D SD		
GPN 4. Extra effort on my part as a teacher, will not help girls do well in science.	SA A UN D SD		
GPN 5. Effective science teaching on my part cannot improve the science understanding of girls.	SA A UN D SD		

Task: You are asked to review the items for clarity and comprehension. Please note a + or - under each area and suggest item revisions as needed.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Socioeconomic Status of a person is determined by both social and economic factors of a in the person's life.

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Clarity is clearness of thought and style.

Comprehension is the ability of prospective elementary teachers (e.g. those in SCIED 458) to read and understand the item.

Draft Items		Clarity		Comprehension	
		+	-	+	-
SPN 1. I will not have the ability to help children from low socioeconomic backgrounds be successful in learning science.	SA A UN D SD				
SPN 2. I do not have the ability to overcome the science learning limitations of children from economically disadvantaged backgrounds.	SA A UN D SD				
SPN 3. Increased effort on my part in teaching science will produce little change in the science achievement of children from low socioeconomic backgrounds.	SA A UN D SD				
SPN 4. The success in science of children from low socioeconomic backgrounds will not be directly related to my teaching effectiveness.	SA A UN D SD				
SPN 5. Extra effort in science teaching on my part will not improve the success of children from low socioeconomic backgrounds.	SA A UN D SD				
SPN 6. I will not have the science teaching ability to overcome the limitations of children from low socioeconomic backgrounds.	SA A UN D SD				

Task: You are asked to review the items for clarity and comprehension. Please note a + or - under each area and suggest item revisions as needed.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Socioeconomic Status of a person is determined by both social and economic factors of a in the person's life.

Positively Stated Item one that has an affirmative element or characteristic.

Clarity is clearness of thought and style.

Comprehension is the ability of prospective elementary teachers (e.g. those in SCIED 458) to read and understand the item.

Draft Items		Clarity	Comprehension
		+ -	+ -
SOP 1. When children from low socioeconomic homes succeed in science, it can be attributed to good teaching.	SA A UN D SD		
SOP 2. Children from low socioeconomic backgrounds are capable of earning high science grades when science is taught well.	SA A UN D SD		
SOP 3. Extra effort in science teaching can improve the success in science of children from impoverished homes.	SA A UN D SD		
SOP 4. A good science teacher can help impoverished children achieve in science at the level of children from higher socioeconomic backgrounds.	SA A UN D SD		

Task: You are asked to review the items for clarity and comprehension. Please note a + or - under each area and suggest item revisions as needed.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Ethnicity is the race, background, or affiliation of a person

Positively Stated Item one that has an affirmative element or characteristic.

Clarity is clearness of thought and style.

Comprehension is the ability of prospective elementary teachers (e.g. those in SCIED 458) to read and understand the item.

Draft Items		Clarity	Comprehension
		+ -	+ -
EOP 1. Native American children can successfully learn science when effective teaching techniques are employed.	SA A UN D SD		
EOP 2. With effective teaching, Hispanic children can achieve in science.	SA A UN D SD		
EOP 3. Children of color can succeed in science when proven science teaching strategies are employed.	SA A UN D SD		
EOP 4. White children can learn science as well as other children when effective science teaching is employed.	SA A UN D SD		
EOP 5. Effective teaching can help Black children overcome their home background to achieve in science.	SA A UN D SD		
EOP 6. Effective teaching can help Asian children overcome their home background to achieve in science.	SA A UN D SD		

Task: You are asked to review the items for clarity and comprehension. Please note a + or - under each area and suggest item revisions as needed.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

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Comprehension is the ability of prospective elementary teachers (e.g. those in SCIED 458) to read and understand the item.

Draft Items		Clarity		Comprehension	
		+	-	+	-
EON 1. Hispanic children cannot learn science as well as other children even with effective science teaching.	SA A UN D SD				
EON 2. Children of color cannot learn science as well as other children even when effective science teaching instruction is provided.	SA A UN D SD				
EON 3. Even when teachers use the most effective science techniques in teaching science Native American children cannot overcome their home background to achieve in science.	SA A UN D SD				
EON 4. Even when teachers use the most effective science techniques in teaching science children of color cannot over their home background to achieve in science.	SA A UN D SD				
EON 5. Black children cannot successfully learn science even when effective teaching techniques are employed.	SA A UN D S				
EON 6. Asian children cannot successfully learn science even when effective teaching techniques are employed.	SA A UN D SD				
EON 7. White children cannot achieve in science even with effective teaching.	SA A UN D SD				

October 2, 1998

Dear

First, I would like to thank you for your meaningful input on the initial draft of potential items for the Self-Efficacy Beliefs about Equitable Science Teaching (SEBEST) instrument. Both Dr. Rubba and I found your comments very helpful.

We have incorporated the input from the three reviewers who examined each item for clarity and comprehension as we believed it strengthened the respective items. Even if your exact suggestion was not included it was carefully considered, and often times had to be balanced against a different comment from another reviewer.

At this time we need to ask you to complete a second review of the items for both clarity and comprehension. Above each set of items, I have defined the task and related terms to help better articulate the review process.

I would like to ask you to complete this review by **Friday, October 9, 1998** and return them to my science education mailbox. If this time line presents a problem, please tell me and I will see what adjustments can be made.

Once again thank you for your time and effort. I am grateful!

Peace,

Jenny

Item Set Content Domain: You are asked to judge the clarity and comprehension of each of the items in the set below. Each item in the set is intended to assess in combination: the **Personal Self-Efficacy** of prospective elementary teachers with regard to teaching science to students of different **Language Minorities,** and is designed to be **Positively** stated.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act**.
Language Minorities as defined by Science for All Americans (1989) are those who speak English as a second language.
Positively Stated Item one that has an affirmative element or characteristic.

Draft Items	Clarity + -	Comprehension + -	
LPP 1. I will be able to teach science to children whose first language is not English.			SA A UN D SD
LPP 2. I will be able to effectively monitor the science understanding of children whose first language is not English.			SA A UN D SD
LPP 3. When children in my classroom who speak English as a second language achieve in science, it will be attributed to my teaching.			SA A UN D SD
LPP 4. The science achievement of children in my classroom whose first language is not English will be directly related to my teaching effectiveness.			SA A UN D SD
LPP 5. Children whose first language is not English are capable of learning the science I will teach.			SA A UN D SD
LPP 6. I will be able to help children whose first language is not English overcome their limitations to learn science.			SA A UN D SD
LPP 7. I can do a great deal as a teacher to increase the science achievement of children who do not speak English as their first language.			SA A UN D SD

Item Set Content Domain: You are asked to judge the clarity and comprehension of each of the items in the set below. Each item in the set is intended to assess in combination: the **Personal Self-Efficacy** of prospective elementary teachers with regard to teaching science to students of different **Language Minorities,** and is designed to be **Negatively** stated.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act.**

Language Minorities as defined by Science for All Americans (1989) are those who speak English as a second language.
Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Draft Items	Clarity + -	Comprehension + -
LPN 1. I will not be able to teach science to children who speak English as their second language as effectively as I will be able to teach children who speak English as their first language. SA A UN D SD		
LPN 2. No amount of effort on my part will be able to influence the success in my science class of children who speak English as their second language. SA A UN D SD		
LPN 3. My ability to teach science will be limited if children do not speak English at home. SA A UN D SD		
LPN 4. I do not know how to teach science concepts to children who speak English as a second language. SA A UN D SD		
LPN 5. I do not know the strategies for teaching science to increase the achievement for children who speak English as a second language. SA A UN D SD		
LPN 6. I will not be as responsible for the science achievement of children who speak English as a second language. SA A UN D SD		

Item Set Content Domain: You are asked to judge the clarity and comprehension of each of the items in the set below. Each item in the set is intended to assess in combination: the **Personal Self-Efficacy** of prospective elementary teachers with regard to teaching science to students of different **Gender,** and is designed to be **Positively** stated.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act.**

Gender is the sexual identity, especially in relation to society or culture.

Positively Stated Item one that has an affirmative element or characteristic.

Draft Items		Clarity + -	Comprehension + -
GPP 1. I will have the skills to teach science to girls to improve their achievement.	SA A UN D SD		
GPP 2. I will be able to motivate girls to learn science.	SA A UN D SD		
GPP 3. As a teacher, I will influence girls' achievement in science.	SA A UN D SD		
GPP 4. I will have the ability to teach science so girls can achieve.	SA A UN D SD		
GPP 5. I can help girls achieve in science at the same level as boys.	SA A UN D SD		
GPP 6. What I will do as a teacher in the classroom can equalize the science achievement level of girls with that of boys.	SA A UN D SD		
GPP 7. I will be effective in teaching science in a meaningful way to girls.	SA A UN D SD		
GPP 8. As a teacher, I will be in a position to equalize the science achievement of girls with that of boys.	SA A UN D SD		

Item Set Content Domain: You are asked to judge the clarity and comprehension of each of the items in the set below. Each item in the set is intended to assess in combination: the **Personal Self-Efficacy** of prospective elementary teachers with regard to teaching science to students of different **Gender,** and is designed to be **Negatively** stated.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act.**

Gender is the sexual identity, especially in relation to society or culture.

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Draft Items		Clarity		Comprehension	
		+	-	+	-
GPN 1. My teaching cannot make up for the lack of science experiences girls have.	SA A UN D SD				
GPN 2. I do not know how to turn girls on to science.	SA A UN D SD				
GPN 3. As a teacher, I will not be responsible for the success of girls in my science classroom.	SA A UN D SD				
GPN 4. Extra effort on my part as a teacher will not help girls do well in science.	SA A UN D SD				
GPN 5. Effective science teaching on my part cannot improve the science understanding of girls.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the clarity and comprehension of each of the items in the set below. Each item in the set is intended to assess in combination: the **Personal Self-Efficacy** of prospective elementary teachers with regard to teaching science to students of different **Socioeconomic Status,** and is designed to be **Negatively** stated.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act.**

Socioeconomic Status of a person is determined by both social and economic factors of a in the person's life.

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Draft Items	Clarity + -	Comprehension + -
SPN 1. I will not have the ability to help children from low socioeconomic backgrounds be successful in learning science. SA A UN D SD		
SPN 2. I do not have the ability to overcome the science learning limitations of children from economically disadvantaged backgrounds. SA A UN D SD		
SPN 3. Increased effort on my part in teaching science will produce little change in the science achievement of children from low socioeconomic backgrounds. SA A UN D SD		
SPN 4. The success in science of children from low socioeconomic backgrounds will not be directly related to my teaching effectiveness. SA A UN D SD		
SPN 5. Extra effort in science teaching on my part will not improve the success of children from low socioeconomic backgrounds. SA A UN D SD		
SPN 6. I will not have the science teaching ability to overcome the limitations of children from low socioeconomic backgrounds. SA A UN D SD		

Item Set Content Domain: You are asked to judge the clarity and comprehension of each of the items in the set below. Each item in the set is intended to assess in combination: the **Personal Self-Efficacy** of prospective elementary teachers with regard to teaching science to students of different **Socioeconomic Status,** and is designed to be **Positively** stated.

Definitions:

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Socioeconomic Status of a person is determined by both social and economic factors of a in the person's life.

Positively Stated Item one that has an affirmative element or characteristic.

Draft Items		Clarity	Comprehension
		+ -	+ -
SPP 1. I will have the ability to help children from impoverished backgrounds be successful science learners.	SA A UN D SD		
SPP 2. When the science grades of children from low socioeconomic backgrounds improve, it will be because I put extra effort into my science teaching.	SA A UN D SD		
SPP 3. I will have the ability to help children from low socioeconomic backgrounds be successful in science.	SA A UN D SD		
SPP 4. I will be responsible if children in my classroom from impoverished backgrounds do not learn science at the level of their counter parts.	SA A UN D SD		
SPP 5. Extra effort on my part as a teacher will improve the success in science of children from low socioeconomic backgrounds.	SA A UN D SD		

Item Set Content Domain: You are asked to judge the clarity and comprehension of each of the items in the set below. Each item in the set is intended to assess in combination: the **Personal Self-Efficacy** of prospective elementary teachers with regard to teaching science to students of different **Ethnicity,** and is designed to be **Positively** stated.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act.**

Ethnicity is the race, background, or affiliation of a person

Positively Stated Item one that has an affirmative element or characteristic.

Draft Items		Clarity + -	Comprehension + -
EPP 1. I will be able to successfully teach science to Native American children.	SA A UN D SD		
EPP 2. I will be able to make science culturally relevant for Hispanic children.	SA A UN D SD		
EPP 3. I will be able to successfully teach science to children of color.	SA A UN D SD		
EPP 4. I will be able to teach science in a meaningful manner to White children.	SA A UN D SD		
EPP 5. If Native American children are successful in learning science it will be attributed to my teaching.	SA A UN D SD		
EPP 6. If children of color are successful in learning science it will be attributed to my teaching.	SA A UN D SD		
EPP 7. I will be able to meet the needs of children of color when I teach science.	SA A UN D SD		

Item Set Content Domain: You are asked to judge the clarity and comprehension of each of the items in the set below. Each item in the set is intended to assess in combination: the **Personal Self-Efficacy** of prospective elementary teachers with regard to teaching science to students of different **Ethnicity,** and is designed to be **Negatively** stated.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act.**

Ethnicity is the race, background, or affiliation of a person

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Draft Items		Clarity + -	Comprehension + -
EPN 1. I will not be able to teach science in a meaningful manner to Hispanic children.	SA A UN D SD		
EPN 2. If Black children are not successful in learning science it will be attributed to my teaching.	SA A UN D SD		
EPN 3. If Asian children are not successful in learning science it will be attributed to my teaching.	SA A UN D SD		
EPN 4. I will not be able to successfully teach science to Black children.	SA A UN D SD		
EPN 5. I will not be able to successfully teach science to Asian children.	SA A UN D SD		
EPN 6. I will not be able to make science culturally relevant for White children.	SA A UN D SD		

Item Set Content Domain: You are asked to judge the clarity and comprehension of each of the items in the set below. Each item in the set is intended to assess in combination: the **Outcome Expectancy** of prospective elementary teachers with regard to teaching science to students of different **Language Minorities,** and is designed to be **Positively** stated.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Language Minorities as defined by Science for All Americans (1989) are those who speak English as a second language.

Positively Stated Item one that has an affirmative element or characteristic.

Draft Items		Clarity	Comprehension
		+ -	+ -
LOP 1. Effective science teaching will enable children who speak English as a second language to overcome obstacles and be successful in science.	SA A UN D SD		
LOP 2. With effective science teaching, children who speak English as a second language can achieve in science as well as their peers.	SA A UN D SD		
LOP 3. Children who speak English as a second language can be successful in learning science if the teaching is effective.	SA A UN D SD		
LOP 4. With effective science teaching, children who speak English as a second language are capable of competing in science with children who speak English as their first language.	SA A UN D SD		

Item Set Content Domain: You are asked to judge the clarity and comprehension of each of the items in the set below. Each item in the set is intended to assess in combination: the **Outcome Expectancy** of prospective elementary teachers with regard to teaching science to students of different **Language Minorities,** and is designed to be **Negatively** stated.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Language Minorities as defined by Science for All Americans (1989) are those who speak English as a second language.

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Draft Items	Clarity + -	Comprehension + -
LON 1. Children who speak English as a second language are not able to learn science as well as their counterparts, even with effective science teaching. SA A UN D SD		
LON 2. Children whose first language is not English have a difficult time learning science, even when proven science teaching techniques are used by the teacher. SA A UN D SD		
LON 3. Children who speak English as a second language are not able to achieve in science even when the instruction is effective. SA A UN D SD		
LON 4. Children who speak English as their second language do not have the ability to be successful in science even when the science instruction is effective. SA A UN D SD		

Item Set Content Domain: You are asked to judge the clarity and comprehension of each of the items in the set below. Each item in the set is intended to assess in combination: the **Outcome Expectancy** of prospective elementary teachers with regard to teaching science to students of different **Gender,** and is designed to be **Positively** stated.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Gender is the sexual identity, especially in relation to society or culture.

Positively Stated Item one that has an affirmative element or characteristic.

Draft Items		Clarity		Comprehension	
		+	-	+	-
GOP 1. Girls will aspire to become scientists if they receive effective science instruction.	SA A UN D SD				
GOP 2. Girls can develop in science at the same level as boys when they receive science instruction that is meaningful to them.	SA A UN D SD				
GOP 3. Girls have the ability to compete with boys in science when they receive quality science instruction.	SA A UN D SD				
GOP 4. Teachers should expect girls and boys to achieve equally in science.	SA A UN D SD				
GOP 5. Girls will learn science if they receive effective science instruction.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the clarity and comprehension of each of the items in the set below. Each item in the set is intended to assess in combination: the **Outcome Expectancy** of prospective elementary teachers with regard to teaching science to students of different **Gender,** and is designed to be **Negatively** stated.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**
Gender is the sexual identity, especially in relation to society or culture.
Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Draft Items		Clarity		Comprehension	
		+	-	+	-
GON 1. Even good science teachers cannot help girls learn science as well as boys.	SA A UN D SD				
GON 2. Girls' achievement in science is not directly related to their teacher's effectiveness as a science teacher.	SA A UN D SD				
GON 3. Females do not have the ability to learn science as well as their male counter parts, even when effective teaching techniques are used.	SA A UN D SD				
GON 4. Girls are not as capable as boys in learning science even when effective instruction is provided.	SA A UN D SD				
GON 5. Females do not have the ability to achieve good grades in science, even when effective teaching techniques are used.	SA A UN D SD				
GON 6. Teachers should not expect girls and boys to achieve equally in science.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the clarity and comprehension of each of the items in the set below. Each item in the set is intended to assess in combination: the **Outcome Expectancy** of prospective elementary teachers with regard to teaching science to students of different **Socioeconomic Status,** and is designed to be **Negatively** stated.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Socioeconomic Status of a person is determined by both social and economic factors of a in the person's life.
Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Draft Items		Clarity		Comprehension	
		+	-	+	-
SON 1. When children from impoverished homes do not succeed in science it cannot be blamed on the quality of teaching.	SA A UN D SD				
SON 2. The science achievement level of children from low socioeconomic backgrounds is not related to the quality of the science teaching.	SA A UN D SD				
SON 3. A teacher is not responsible for the science achievement of children from low socioeconomic backgrounds.	SA A UN D SD				
SON 4. Good teaching cannot help children from low socioeconomic backgrounds achieve good grades in science class.	SA A UN D SD				
SON 5. Effective science teaching cannot help children from impoverished homes overcome hurdles to become good science students.	SA A UN D SD				
SON 6. Effective science teaching cannot improve the science achievement of children from impoverished background.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the clarity and comprehension of each of the items in the set below. Each item in the set is intended to assess in combination: the **Outcome Expectancy** of prospective elementary teachers with regard to teaching science to students of different **Socioeconomic Status,** and is designed to be **Positively** stated.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Socioeconomic Status of a person is determined by both social and economic factors of a in the person's life.

Positively Stated Item one that has an affirmative element or characteristic.

Draft Items		Clarity + -	Comprehension + -
SOP 1. When children from low socioeconomic backgrounds succeed in science, it can be attributed to good teaching.	SA A UN D SD		
SOP 2. Children from low socioeconomic backgrounds are capable of earning high science grades when science is taught well.	SA A UN D SD		
SOP 3. Extra effort in science teaching can improve the success in science of children from impoverished homes.	SA A UN D SD		
SOP 4. A good science teacher can help impoverished children achieve in science at the level of children from higher socioeconomic backgrounds.	SA A UN D SD		

Item Set Content Domain: You are asked to judge the clarity and comprehension of each of the items in the set below. Each item in the set is intended to assess in combination: the **Outcome Expectancy** of prospective elementary teachers with regard to teaching science to students of different **Ethnicity,** and is designed to be **Positively** stated.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Ethnicity is the race, background, or affiliation of a person

Positively Stated Item one that has an affirmative element or characteristic.

Draft Items		Clarity	Comprehension
		+ -	+ -
EOP 1. Native American children can successfully learn science when effective teaching techniques are employed.	SA A UN D SD		
EOP 2. With effective teaching, Hispanic children can achieve in science.	SA A UN D SD		
EOP 3. Children of color can succeed in science when proven science teaching strategies are employed.	SA A UN D SD		
EOP 4. White children can learn science as well as other children when effective science teaching is employed.	SA A UN D SD		
EOP 5. Effective teaching can help Black children overcome their home background to achieve in science.	SA A UN D SD		
EOP 6. Effective teaching can help Asian children overcome their home background to achieve in science.	SA A UN D SD		

Item Set Content Domain: You are asked to judge the clarity and comprehension of each of the items in the set below. Each item in the set is intended to assess in combination: the **Outcome Expectancy** of prospective elementary teachers with regard to teaching science to students of different **Ethnicity,** and is designed to be **Negatively** stated.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Ethnicity is the race, background, or affiliation of a person
Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Draft Items	Clarity + -	Comprehension + -	
EON 1. Hispanic children cannot learn science as well as other children even with effective science teaching.			SA A UN D SD
EON 2. Children of color cannot learn science as well as other children even when effective science teaching instruction is provided.			SA A UN D SD
EON 3. Even when teachers use the most effective science techniques in teaching science, Native American children cannot overcome their home background to achieve in science.			SA A UN D SD
EON 4. Even when teachers use the most effective science techniques in teaching science, children of color cannot overcome their home background to achieve in science.			SA A UN D SD
EON 5. Black children cannot successfully learn science even when effective teaching techniques are employed.			SA A UN D SD
EON 6. Asian children cannot successfully learn science even when effective teaching techniques are employed.			SA A UN D SD
EON 7. White children cannot achieve in science even with effective teaching.			SA A UN D SD

Appendix B

LIST OF FACULTY REVIEWER, LETTER TO FACULTY REVIEWERS AND EVALUATION FORMS FOR THE SELF-EFFICACY BELIEFS ABOUT EQUITABLE SCIENCE TEACHING (SEBEST) ITEMS

Faculty Reviewers for the *Self-Efficacy Beliefs for Equitable Science Teaching* (SEBEST) Instrument

Thomas M. Dana, Ph.D.	Pennsylvania State University
Jeanne Brady, Ph.D.	Pennsylvania State University
Larry Enochs*, Ph.D.	University of Wisconsin at Milwaukee
Lillian McKeel, Ph.D.	Shippensburg State University
Eric Hagedorn*, Ph.D.	University of Wisconsin at Milwaukee
Iris Riggs, Ph.D.	California State University
Gail Shoyer, Ph.D.	Kansas State University
Carla Zembal-Saul, Ph.D.	Pennsylvania State University

* Analysis of content was sent after the instrument was constructed, however, analysis did support the items chosen by other reviewers.

October 14, 1998

Dear Committee,

Fall greetings! I hope this note finds your semester going well. My Fall semester has been busy with developing items for the Self-Efficacy Beliefs about Equitable Science Teaching (SEBEST) instrument and item reviews. Your initial comments were very beneficial in that they helped me see the need to refocus some of the items. As of today, the draft items in each category (ethnic minorities, language minorities, gender and socioeconomic status) have been reviewed twice by ten Science Education graduate students for clarity and comprehension. After each review Dr. Rubba and I revised the draft items as per the reviewers' comments.

I would now like to request your help in reviewing the draft items for content validity. I am defining content validity as "the extent to which inferences from a test's scores adequately represent the content or conceptual domain that the test is claimed to measure" (Borg & Gall, 1996). The content domain for each draft set of items for the SEBEST is defined by a combination of three factors. One factor is the personal self-efficacy or the outcome expectancy dimension of the self-efficacy beliefs of prospective elementary teachers with regards to science teaching and learning for diverse learners. A second factor is either the ethnicity, language minorities, gender, or socioeconomic status of the learners referred to in the items. The third factor is whether items are phrased positively or negatively.

Directions are provided at the top of each set of draft items under the heading "Task". Also, definitions for relevant terms, as they were used in developing the draft items and in the clarity/comprehension reviews, are provided with each set of draft items.

I am asking that you return the packet to my mailbox outside the science education office no later than **Monday October 26, 1998.** If you have any questions regarding this process, please feel free to call me at 814-867-3325 or email me at jmr214@psu.edu.

Once again, I want to thank you for your time and expertise. I am grateful.

Peace,

Jennifer Ritter

Item Set Content Domain: You are asked to judge the content validity of each of the items in the set below. Each item in the set is intended to assess in combination: the **Personal Self-Efficacy** of prospective elementary teachers with regard to teaching science to students of different **Language Minorities,** and is designed to be **Positively** stated.

Task: Please read each item carefully and assess its content validity. If you judge the item to be content valid, place a check mark in the left most or 1st column labeled "Item is Content Valid." If you find it is not content valid, but would be with some minor modifications, please note the modifications to the item and place a check mark in the 2nd column labeled "Item Content Valid w/ Noted Mod." If you find the item is not content valid and would not be even with modifications, please mark the 3rd column labeled "Item not Content Valid." Finally, please select the strongest four items from among the items you determined to be valid and would recommend be included in the SEBEST. Mark these in the right most column marked "Rank" as "1", "2", "3" and "4" for your top four choices.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act**.

Language Minorities as defined by Science for All Americans (1989) are those who speak English as a second language.

Positively Stated Item one that has an affirmative element or characteristic.

Draft Items		Item is Content Valid	Item Content Valid w/Mod	Item not Content Valid	Rank
LPP 1. I will be able to teach science to children whose first language is not English.	SA A UN D SD				
LPP 2. I will be able to effectively monitor the science understanding of children whose first language is not English.	SA A UN D SD				
LPP 3. When children in my classroom who speak English as a second language achieve in science, it will be attributed to my teaching.	SA A UN D SD				
LPP 4. The science achievement of children in my classroom whose first language is not English will be directly related to my teaching effectiveness.	SA A UN D SD				
LPP 5. Children whose first language is not English are capable of learning the science I will teach.	SA A UN D SD				
LPP 6. I will be able to help children whose first language is not English overcome their limitations to learn science.	SA A UN D SD				
LPP 7. I can do a great deal as a teacher to increase the science achievement of children who do not speak English as their first language.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the content validity of each of the items in the set below. Each item in the set is intended to assess in combination: the **Personal Self-Efficacy** of prospective elementary teachers with regard to teaching science to students of different **Language Minorities,** and is designed to be **Negatively** stated.

Task: Please read each item carefully and assess its content validity. If you judge the item to be content valid, place a check mark in the left most or 1st column labeled "Item is Content Valid." If you find it is not content valid, but would be with some minor modifications, please note the modifications to the item and place a check mark in the 2nd column labeled "Item Content Valid w/ Noted Mod." If you find the item is not content valid and would not be even with modifications, please mark the 3rd column labeled "Item not Content Valid." Finally, please select the strongest four items from among the items you determined to be valid and would recommend be included in the SEBEST. Mark these in the right most column marked "Rank" as "1", "2", "3" and "4" for your top four choices.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act.**

Language Minorities as defined by Science for All Americans (1989) are those who speak English as a second language.

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Draft Items	Item is Content Valid	Item Content Valid w/Mod	Item not Content Valid	Rank
LPN 1. I will not be able to teach science to children who speak English as their second language as effectively as I will be able to teach children who speak English as their first language. SA A UN D SD				
LPN 2. No amount of effort on my part will be able to influence the success in my science class of children who speak English as their second language. SA A UN D SD				
LPN 3. My ability to teach science will be limited if children do not speak English at home. SA A UN D SD				
LPN 4. I do not know how to teach science concepts to children who speak English as a second language. SA A UN D SD				
LPN 5. I do not know the strategies for teaching science to increase the achievement for children who speak English as a second language. SA A UN D SD				
LPN 6. I will not be as responsible for the science achievement of children who speak English as a second language. SA A UN D SD				

Item Set Content Domain: You are asked to judge the content validity of each of the items in the set below. Each item in the set is intended to assess in combination: the **Personal Self-Efficacy** of prospective elementary teachers with regard to teaching science to students of different **Gender,** and is designed to be **Positively** stated.

Task: Please read each item carefully and assess its content validity. If you judge the item to be content valid, place a check mark in the left most or 1st column labeled "Item is Content Valid." If you find it is not content valid, but would be with some minor modifications, please note the modifications to the item and place a check mark in the 2nd column labeled "Item Content Valid w/ Noted Mod." If you find the item is not content valid and would not be even with modifications, please mark the 3rd column labeled "Item not Content Valid." Finally, please select the strongest four items from among the items you determined to be valid and would recommend be included in the SEBEST. Mark these in the right most column marked "Rank" as "1", "2", "3" and "4" for your top four choices.

Definitions:

Personal Self-Efficacy as defined by Bandura (1977, 1981, 1986, 1995 & 1997) is "judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain many ambiguous, unpredictable, and often stressful elements." **The focus in the proposed items (below) is to be upon a prospective elementary teachers belief that he/she will have the capability upon entering teaching to act.**

Gender is the sexual identity, especially in relation to society or culture.

Positively Stated Item one that has an affirmative element or characteristic.

Draft Items		Item is Content Valid	Item Content Valid w/Mod	Item not Content Valid	Rank
GPP 1. I will have the skills to teach science to girls to improve their achievement.	SA A UN D SD				
GPP 2. I will be able to motivate girls to learn science.	SA A UN D SD				
GPP 3. As a teacher, I will influence girls' achievement in science.	SA A UN D SD				
GPP 4. I will have the ability to teach science so girls can achieve.	SA A UN D SD				
GPP 5. I can help girls achieve in science at the same level as boys.	SA A UN D SD				
GPP 6. What I will do as a teacher in the classroom can equalize the science achievement level of girls with that of boys.	SA A UN D SD				
GPP 7. I will be effective in teaching science in a meaningful way to girls.	SA A UN D SD				
GPP 8. As a teacher, I will be in a position to equalize the science achievement of girls with that of boys.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the content validity of each of the items in the set below. Each item in the set is intended to assess in combination: the **Personal Self-Efficacy** of prospective elementary teachers with regard to teaching science to students of different **Gender,** and is designed to be **Negatively** stated.

Task: Please read each item carefully and assess its content validity. If you judge the item to be content valid, place a check mark in the left most or 1st column labeled "Item is Content Valid." If you find it is not content valid, but would be with some minor modifications, please note the modifications to the item and place a check mark in the 2nd column labeled "Item Content Valid w/ Noted Mod." If you find the item is not content valid and would not be even with modifications, please mark the 3rd column labeled "Item not Content Valid." Finally, please select the strongest four items from among the items you determined to be valid and would recommend be included in the SEBEST. Mark these in the right most column marked "Rank" as "1", "2", "3" and "4" for your top four choices.

Definitions:

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Gender is the sexual identity, especially in relation to society or culture.

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Draft Items		Item is Content Valid	Item Content Valid w/Mod	Item not Content Valid	Rank
GPN 1. My teaching cannot make up for the lack of science experiences girls have.	SA A UN D SD				
GPN 2. I do not know how to turn girls on to science.	SA A UN D SD				
GPN 3. As a teacher, I will not be responsible for the success of girls in my science classroom.	SA A UN D SD				
GPN 4. Extra effort on my part as a teacher will not help girls do well in science.	SA A UN D SD				
GPN 5. Effective science teaching on my part cannot improve the science understanding of girls.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the content validity of each of the items in the set below. Each item in the set is intended to assess in combination: the **Personal Self-Efficacy** of prospective elementary teachers with regard to teaching science to students of different **Socioeconomic Status,** and is designed to be **Negatively** stated.

Task: Please read each item carefully and assess its content validity. If you judge the item to be content valid, place a check mark in the left most or 1st column labeled "Item is Content Valid." If you find it is not content valid, but would be with some minor modifications, please note the modifications to the item and place a check mark in the 2nd column labeled "Item Content Valid w/ Noted Mod." If you find the item is not content valid and would not be even with modifications, please mark the 3rd column labeled "Item not Content Valid." Finally, please select the strongest four items from among the items you determined to be valid and would recommend be included in the SEBEST. Mark these in the right most column marked "Rank" as "1", "2", "3" and "4" for your top four choices.

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Socioeconomic Status of a person is determined by both social and economic factors of a in the person's life.

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Draft Items		Item is Content Valid	Item Content Valid w/Mod	Item not Content Valid	Rank
backgrounds be successful in learning science.	SA A UN D SD				
SPN 2. I do not have the ability to overcome the science learning limitations of children from economically disadvantaged backgrounds.	SA A UN D SD				
SPN 3. Increased effort on my part in teaching science will produce little change in the science achievement of children from low socioeconomic backgrounds.	SA A UN D SD				
SPN 4. The success in science of children from low socioeconomic backgrounds will not be directly related to my teaching effectiveness.	SA A UN D SD				
SPN 5. Extra effort in science teaching on my part will not improve the success of children from low socioeconomic backgrounds.	SA A UN D SD				
SPN 6. I will not have the science teaching ability to overcome the limitations of children from low socioeconomic backgrounds.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the content validity of each of the items in the set below. Each item in the set is intended to assess in combination: the **Personal Self-Efficacy** of prospective elementary teachers with regard to teaching science to students of different **Socioeconomic Status,** and is designed to be **Positively** stated.

Task: Please read each item carefully and assess its content validity. If you judge the item to be content valid, place a check mark in the left most or 1st column labeled "Item is Content Valid." If you find it is not content valid, but would be with some minor modifications, please note the modifications to the item and place a check mark in the 2nd column labeled "Item Content Valid w/ Noted Mod." If you find the item is not content valid and would not be even with modifications, please mark the 3rd column labeled "Item not Content Valid." Finally, please select the strongest four items from among the items you determined to be valid and would recommend be included in the SEBEST. Mark these in the right most column marked "Rank" as "1", "2", "3" and "4" for your top four choices.

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Socioeconomic Status of a person is determined by both social and economic factors of a in the person's life.

Positively Stated Item one that has an affirmative element or characteristic.

Draft Items		Item is Content Valid	Item Content Valid w/Mod	Item not Content Valid	Rank
SPP 1. I will have the ability to help children from impoverished backgrounds be successful science learners.	SA A UN D SD				
SPP 2. When the science grades of children from low socioeconomic backgrounds improve, it will be because I put extra effort into my science teaching.	SA A UN D SD				
SPP 3. I will have the ability to help children from low socioeconomic backgrounds be successful in science.	SA A UN D SD				
SPP 4. I will be responsible if children in my classroom from impoverished backgrounds do not learn science at the level of their counter parts.	SA A UN D SD				
SPP 5. Extra effort on my part as a teacher will improve the success in science of children from low socioeconomic backgrounds.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the content validity of each of the items in the set below. Each item in the set is intended to assess in combination: the **Personal Self-Efficacy** of prospective elementary teachers with regard to teaching science to students of different **Ethnicity,** and is designed to be **Positively** stated.

Task: Please read each item carefully and assess its content validity. If you judge the item to be content valid, place a check mark in the left most or 1st column labeled "Item is Content Valid." If you find it is not content valid, but would be with some minor modifications, please note the modifications to the item and place a check mark in the 2nd column labeled "Item Content Valid w/ Noted Mod." If you find the item is not content valid and would not be even with modifications, please mark the 3rd column labeled "Item not Content Valid." Finally, please select the strongest four items from among the items you determined to be valid and would recommend be included in the SEBEST. Mark these in the right most column marked "Rank" as "1", "2", "3" and "4" for your top four choices.

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Ethnicity is the race, background, or affiliation of a person

Positively Stated Item one that has an affirmative element or characteristic.

Draft Items		Item is Content Valid	Item Content Valid w/Mod	Item not Content Valid	Rank
EPP 1. I will be able to successfully teach science to Native American children.	SA A UN D SD				
EPP 2. I will be able to make science culturally relevant for Hispanic children.	SA A UN D SD				
EPP 3. I will be able to successfully teach science to children of color.	SA A UN D SD				
EPP 4. I will be able to teach science in a meaningful manner to White children.	SA A UN D SD				
EPP 5. If Native American children are successful in learning science it will be attributed to my teaching.	SA A UN D SD				
EPP 6. If children of color are successful in learning science it will be attributed to my teaching.	SA A UN D SD				
EPP 7. I will be able to meet the learning needs of children of color when I teach science.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the content validity of each of the items in the set below. Each item in the set is intended to assess in combination: the **Personal Self-Efficacy** of prospective elementary teachers with regard to teaching science to students of different **Ethnicity,** and is designed to be **Negatively** stated.

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Ethnicity is the race, background, or affiliation of a person

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Draft Items		Item is Content Valid	Item Content Valid w/Mod	Item not Content Valid	Rank
EPN 1. I will not be able to teach science in a meaningful manner to Hispanic children.	SA A UN D SD				
EPN 2. If Black children are not successful in learning science it will be attributed to my teaching.	SA A UN D SD				
EPN 3. If Asian children are not successful in learning science it will be attributed to my teaching.	SA A UN D SD				
EPN 4. I will not be able to successfully teach science to Black children.	SA A UN D SD				
EPN 5. I will not be able to successfully teach science to Asian children.	SA A UN D SD				
EPN 6. I will not be able to make science culturally relevant for White children.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the content validity of each of the items in the set below. Each item in the set is intended to assess in combination: the **Outcome Expectancy** of prospective elementary teachers with regard to teaching science to students of different **Language Minorities,** and is designed to be **Positively** stated.

Task: Please read each item carefully and assess its content validity. If you judge the item to be content valid, place a check mark in the left most or 1st column labeled "Item is Content Valid." If you find it is not content valid, but would be with some minor modifications, please note the modifications to the item and place a check mark in the 2nd column labeled "Item Content Valid w/ Noted Mod." If you find the item is not content valid and would not be even with modifications, please mark the 3rd column labeled "Item not Content Valid." Finally, please select the strongest four items from among the items you determined to be valid and would recommend be included in the SEBEST. Mark these in the right most column marked "Rank" as "1", "2", "3" and "4" for your top four choices.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Language Minorities as defined by Science for All Americans (1989) are those who speak English as a second language.

Positively Stated Item one that has an affirmative element or characteristic.

Draft Items		Item is Content Valid	Item Content Valid w/Mod	Item not Content Valid	Rank
LOP 1. Effective science teaching will enable children who speak English as a second language to overcome obstacles and be successful in science.	SA A UN D SD				
LOP 2. With effective science teaching, children who speak English as a second language can achieve in science as well as their peers.	SA A UN D SD				
LOP 3. Children who speak English as a second language can be successful in learning science if the teaching is effective.	SA A UN D SD				
LOP 4. With effective science teaching, children who speak English as a second language are capable of competing in science with children who speak English as their first language.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the content validity of each of the items in the set below. Each item in the set is intended to assess in combination: the **Outcome Expectancy** of prospective elementary teachers with regard to teaching science to students of different **Language Minorities,** and is designed to be **Negatively** stated.

Task: Please read each item carefully and assess its content validity. If you judge the item to be content valid, place a check mark in the left most or 1st column labeled "Item is Content Valid." If you find it is not content valid, but would be with some minor modifications, please note the modifications to the item and place a check mark in the 2nd column labeled "Item Content Valid w/ Noted Mod." If you find the item is not content valid and would not be even with modifications, please mark the 3rd column labeled "Item not Content Valid." Finally, please select the strongest four items from among the items you determined to be valid and would recommend be included in the SEBEST. Mark these in the right most column marked "Rank" as "1", "2", "3" and "4" for your top four choices.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Language Minorities as defined by Science for All Americans (1989) are those who speak English as a second language.

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Draft Items		Item is Content Valid	Item Content Valid w/Mod	Item not Content Valid	Rank
LON 1. Children who speak English as a second language are not able to learn science as well as their counterparts, even with effective science teaching.	SA A UN D SD				
LON 2. Children whose first language is not English have a difficult time learning science, even when proven science teaching techniques are used by the teacher.	SA A UN D SD				
LON 3. Children who speak English as a second language are not able to achieve in science even when the instruction is effective.	SA A UN D SD				
LON 4. Children who speak English as their second language do not have the ability to be successful in science even when the science instruction is effective.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the content validity of each of the items in the set below. Each item in the set is intended to assess in combination: the **Outcome Expectancy** of prospective elementary teachers with regard to teaching science to students of different **Gender,** and is designed to be **Positively** stated.

Task: Please read each item carefully and assess its content validity. If you judge the item to be content valid, place a check mark in the left most or 1st column labeled "Item is Content Valid." If you find it is not content valid, but would be with some minor modifications, please note the modifications to the item and place a check mark in the 2nd column labeled "Item Content Valid w/ Noted Mod." If you find the item is not content valid and would not be even with modifications, please mark the 3rd column labeled "Item not Content Valid." Finally, please select the strongest four items from among the items you determined to be valid and would recommend be included in the SEBEST. Mark these in the right most column marked "Rank" as "1", "2", "3" and "4" for your top four choices.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Gender is the sexual identity, especially in relation to society or culture.

Positively Stated Item one that has an affirmative element or characteristic.

Draft Items		Item is Content Valid	Item Content Valid w/Mod	Item not Content Valid	Rank
GOP 1. Girls will aspire to become scientists if they receive effective science instruction.	SA A UN D SD				
GOP 2. Girls can develop in science at the same level as boys when they receive science instruction that is meaningful to them.	SA A UN D SD				
GOP 3. Girls have the ability to compete with boys in science when they receive quality science instruction.	SA A UN D SD				
GOP 4. Teachers should expect girls and boys to achieve equally in science.	SA A UN D SD				
GOP 5. Girls will learn science if they receive effective science instruction.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the content validity of each of the items in the set below. Each item in the set is intended to assess in combination: the **Outcome Expectancy** of prospective elementary teachers with regard to teaching science to students of different **Gender,** and is designed to be **Negatively** stated.

Task: Please read each item carefully and assess its content validity. If you judge the item to be content valid, place a check mark in the left most or 1st column labeled "Item is Content Valid." If you find it is not content valid, but would be with some minor modifications, please note the modifications to the item and place a check mark in the 2nd column labeled "Item Content Valid w/ Noted Mod." If you find the item is not content valid and would not be even with modifications, please mark the 3rd column labeled "Item not Content Valid." Finally, please select the strongest four items from among the items you determined to be valid and would recommend be included in the SEBEST. Mark these in the right most column marked "Rank" as "1", "2", "3" and "4" for your top four choices.

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Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Gender is the sexual identity, especially in relation to society or culture.

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Draft Items		Item is Content Valid	Item Content Valid w/Mod	Item not Content Valid	Rank
GON 1. Even good science teachers cannot help girls learn science as well as boys.	SA A UN D SD				
GON 2. Girls' achievement in science is not directly related to their teacher's effectiveness as a science teacher.	SA A UN D SD				
GON 3. Females do not have the ability to learn science as well as their male counter parts, even when effective teaching techniques are used.	SA A UN D SD				
GON 4. Girls are not as capable as boys in learning science even when effective instruction is provided.	SA A UN D SD				
GON 5. Females do not have the ability to achieve good grades in science, even when effective teaching techniques are used.	SA A UN D SD				
GON 6. Teachers should not expect girls and boys to achieve equally in science.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the content validity of each of the items in the set below. Each item in the set is intended to assess in combination: the **Outcome Expectancy** of prospective elementary teachers with regard to teaching science to students of different **Socioeconomic Status,** and is designed to be **Negatively** stated.

Task: Please read each item carefully and assess its content validity. If you judge the item to be content valid, place a check mark in the left most or 1st column labeled "Item is Content Valid." If you find it is not content valid, but would be with some minor modifications, please note the modifications to the item and place a check mark in the 2nd column labeled "Item Content Valid w/ Noted Mod." If you find the item is not content valid and would not be even with modifications, please mark the 3rd column labeled "Item not Content Valid." Finally, please select the strongest four items from among the items you determined to be valid and would recommend be included in the SEBEST. Mark these in the right most column marked "Rank" as "1", "2", "3" and "4" for your top four choices.

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Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Socioeconomic Status of a person is determined by both social and economic factors of a in the person's life.

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Draft Items		Item is Content Valid	Item Content Valid w/Mod	Item not Content Valid	Rank
SON 1. When children from impoverished homes do not succeed in science it cannot be blamed on the quality of teaching.	SA A UN D SD				
SON 2. The science achievement level of children from low socioeconomic backgrounds is not related to the quality of the science teaching.	SA A UN D SD				
SON 3. A teacher is not responsible for the science achievement of children from low socioeconomic backgrounds.	SA A UN D SD				
SON 4. Good teaching cannot help children from low socioeconomic backgrounds achieve good grades in science class.	SA A UN D SD				
SON 5. Effective science teaching cannot help children from impoverished homes overcome hurdles to become good science students.	SA A UN D SD				
SON 6. Effective science teaching cannot improve the science achievement of children from impoverished background.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the content validity of each of the items in the set below. Each item in the set is intended to assess in combination: the **Outcome Expectancy** of prospective elementary teachers with regard to teaching science to students of different **Socioeconomic Status,** and is designed to be **Positively** stated.

Task: Please read each item carefully and assess its content validity. If you judge the item to be content valid, place a check mark in the left most or 1st column labeled "Item is Content Valid." If you find it is not content valid, but would be with some minor modifications, please note the modifications to the item and place a check mark in the 2nd column labeled "Item Content Valid w/ Noted Mod." If you find the item is not content valid and would not be even with modifications, please mark the 3rd column labeled "Item not Content Valid." Finally, please select the strongest four items from among the items you determined to be valid and would recommend be included in the SEBEST. Mark these in the right most column marked "Rank" as "1", "2", "3" and "4" for your top four choices.

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Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Socioeconomic Status of a person is determined by both social and economic factors of a in the person's life.

Positively Stated Item one that has an affirmative element or characteristic.

Draft Items		Item is Content Valid	Item Content Valid w/Mod	Item not Content Valid	Rank
SOP 1. When children from low socioeconomic backgrounds succeed in science, it can be attributed to good teaching.	SA A UN D SD				
SOP 2. Children from low socioeconomic backgrounds are capable of earning high science grades when science is taught well.	SA A UN D SD				
SOP 3. Extra effort in science teaching can improve the success in science of children from impoverished homes.	SA A UN D SD				
SOP 4. A good science teacher can help impoverished children achieve in science at the level of children from higher socioeconomic backgrounds.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the content validity of each of the items in the set below. Each item in the set is intended to assess in combination: the **Outcome Expectancy** of prospective elementary teachers with regard to teaching science to students of different **Ethnicity,** and is designed to be **Positively** stated.

Task: Please read each item carefully and assess its content validity. If you judge the item to be content valid, place a check mark in the left most or 1st column labeled "Item is Content Valid." If you find it is not content valid, but would be with some minor modifications, please note the modifications to the item and place a check mark in the 2nd column labeled "Item Content Valid w/ Noted Mod." If you find the item is not content valid and would not be even with modifications, please mark the 3rd column labeled "Item not Content Valid." Finally, please select the strongest four items from among the items you determined to be valid and would recommend be included in the SEBEST. Mark these in the right most column marked "Rank" as "1", "2", "3" and "4" for your top four choices.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Ethnicity is the race, background, or affiliation of a person

Positively Stated Item one that has an affirmative element or characteristic.

Draft Items		Item is Content Valid	Item Content Valid w/Mod	Item not Content Valid	Rank
EOP 1. Native American children can successfully learn science when effective teaching techniques are employed.	SA A UN D SD				
EOP 2. With effective teaching, Hispanic children can achieve in science.	SA A UN D SD				
EOP 3. Children of color can succeed in science when proven science teaching strategies are employed.	SA A UN D SD				
EOP 4. White children can learn science as well as other children when effective science teaching is employed.	SA A UN D SD				
EOP 5. Effective teaching can help Black children overcome their home background to achieve in science.	SA A UN D SD				
EOP 6. Effective teaching can help Asian children overcome their home background to achieve in science.	SA A UN D SD				

Item Set Content Domain: You are asked to judge the content validity of each of the items in the set below. Each item in the set is intended to assess in combination: the **Outcome Expectancy** of prospective elementary teachers with regard to teaching science to students of different **Ethnicity,** and is designed to be **Negatively** stated.

Task: Please read each item carefully and assess its content validity. If you judge the item to be content valid, place a check mark in the left most or 1st column labeled "Item is Content Valid." If you find it is not content valid, but would be with some minor modifications, please note the modifications to the item and place a check mark in the 2nd column labeled "Item Content Valid w/ Noted Mod." If you find the item is not content valid and would not be even with modifications, please mark the 3rd column labeled "Item not Content Valid." Finally, please select the strongest four items from among the items you determined to be valid and would recommend be included in the SEBEST. Mark these in the right most column marked "Rank" as "1", "2", "3" and "4" for your top four choices.

Definitions:

Outcome Expectancy is a person's estimate that a given behavior will lead to certain outcomes. **Outcome Expectancy is differentiated from personal self-efficacy in that a person may believe a given behavior will lead to an outcome (which is Outcome Expectancy) but they may not believe they have the capability to perform the action (which is related to Personal Self-Efficacy).** The focus in the proposed items (below) is to be upon **prospective elementary teachers' Outcome Expectancy for elementary students.**

Ethnicity is the race, background, or affiliation of a person

Negatively Stated Item an act indicating or expressing a contradiction, denial, or refusal.

Draft Items		Item is Content Valid	Item Content Valid w/Mod	Item not Content Valid	Rank
EON 1. Hispanic children cannot learn science as well as other children even with effective science teaching.	SA A UN D SD				
EON 2. Children of color cannot learn science as well as other children even when effective science teaching instruction is provided.	SA A UN D SD				
EON 3. Even when teachers use the most effective science techniques in teaching science, Native American children cannot overcome their home background to achieve in science.	SA A UN D SD				
EON 4. Even when teachers use the most effective science techniques in teaching science, children of color cannot overcome their home background to achieve in science.	SA A UN D SD				
EON 5. Black children cannot successfully learn science even when effective teaching techniques are employed.	SA A UN D SD				
EON 6. Asian children cannot successfully learn science even when effective teaching techniques are employed.	SA A UN D SD				
EON 7. White children cannot achieve in science even with effective teaching.	SA A UN D SD				

Appendix C

"FIRST DRAFT" OF THE SELF-EFFICACY BELIEFS ABOUT EQUITABLE SCIENCE TEACHING (SEBEST) INSTRUMENT

Self-**E**fficacy **B**eliefs about **E**quitable **S**cience **T**eaching

****

Please indicate the degree to which you agree or disagree with each statement below by shaping in the appropriate letters on the scan sheet.

5 = Strongly Agree
4 = Agree
3 = Uncertain
2 = Disagree
1 = Strongly Disagree

****

	Strongly Agree		Uncertain		Strongly Disagree
1. I will be able to effectively teach science to children whose first language is not English.	5	4	3	2	1
2. I do not have the ability to teach science to children from economically disadvantaged backgrounds.	5	4	3	2	1
3. Girls can learn science if they receive effective science instruction.	5	4	3	2	1
4. Even when teachers use the most effective science techniques in teaching science, some Native American children cannot achieve in science.	5	4	3	2	1
5. I will be able to meet the learning needs of children of color when I teach science.	5	4	3	2	1
6. I can do a great deal as a teacher to increase the science achievement of children who do not speak English as their first language.	5	4	3	2	1
7. I can help girls learn science at the same level as boys.	5	4	3	2	1
8. Even when teachers use the most effective science techniques in teaching science, some children of color cannot achieve in science.	5	4	3	2	1
9. I do not know how to teach science concepts to children who speak English as a second language.	5	4	3	2	1
10. I will be effective in teaching science in a meaningful way to girls.	5	4	3	2	1
11. I will not be able to successfully teach science to Black children.	5	4	3	2	1
12. Children of color can succeed in science when proven science teaching strategies are employed.	5	4	3	2	1
13. Effective science teaching will enable children who are English Language Learners to overcome obstacles and be successful in science.	5	4	3	2	1
14. Children who speak English as a second language are not able to achieve in science even when the instruction is effective.	5	4	3	2	1
15. Girls are not as capable as boys in learning science even when effective instruction is provided.	5	4	3	2	1

	Strongly Agree		Uncertain		Strongly Disagree
16. Girls can develop in science at the same level as boys if they receive science instruction that is effective.	5	4	3	2	1
17. I will be able to help girls to learn science.	5	4	3	2	1
18. I cannot help girls learn science at the same level as boys.	5	4	3	2	1
19. Effective science teaching can help children from low socioeconomic backgrounds overcome hurdles to become good science learners.	5	4	3	2	1
20. Children who speak English as a second language are not able to learn science as well as their counterparts, even with effective science teaching.	5	4	3	2	1
21. Children of color cannot learn science as well as other children even when effective science teaching instruction is provided.	5	4	3	2	1
22. I will be able to successfully teach science to Native American children.	5	4	3	2	1
23. When children from low socioeconomic backgrounds succeed in science, it can be attributed to good teaching.	5	4	3	2	1
24. I will not be able to successfully teach science to Asian children.	5	4	3	2	1
25. Girls do not have the ability to learn science as well as their boys counterparts, even when effective teaching techniques are used.	5	4	3	2	1
26. I will have the ability to help children from low socioeconomic backgrounds be successful in science.	5	4	3	2	1
27. I will not be able to help girls learn science.	5	4	3	2	1
28. Effective science teaching cannot improve the science achievement of children from impoverished background.	5	4	3	2	1
29. I will be able to successfully teach science to children of color.	5	4	3	2	1
30. Girls have the ability to compete academically with boys in science when they receive quality science instruction.	5	4	3	2	1
31. I will be able to effectively monitor the science understanding of children who are English Language Learners.	5	4	3	2	1
32. Even good science teaching cannot help girls learn science as well as boys.	5	4	3	2	1
33. More effective teaching on my part will not help of children from low socioeconomic backgrounds achieve in science.	5	4	3	2	1
34. I will not be able to teach science successfully to white children.	5	4	3	2	1

	Strongly Agree		Uncertain		Strongly Disagree
35. With effective science teaching, children who speak English as a second language can achieve as well in science as their peers.	5	4	3	2	1
36. I will have the ability to help children from impoverished backgrounds be successful science learners.	5	4	3	2	1
37. With effective teaching, Hispanic children can achieve in science.	5	4	3	2	1
38. When the science grades of children from low socioeconomic backgrounds improve, it will be because I put extra effort into my science teaching.	5	4	3	2	1
39. I do not know how to teach in a manner that will turn girls on to science.	5	4	3	2	1
40. Good teaching cannot help children from low socioeconomic backgrounds achieve in science.	5	4	3	2	1
41. Children who are English Language Learners do not have the ability to be successful in science even when the science instruction is effective.	5	4	3	2	1
42. White children can learn science as well as other children when effective science teaching is employed.	5	4	3	2	1
43. A good science teacher can help children from impoverished backgrounds achieve in science at the same level as children from higher socioeconomic backgrounds.	5	4	3	2	1
44. I do not know teaching strategies that will help children who are English Language Learners achieve in science.	5	4	3	2	1
45. I will not be able to teach science to children who speak English as a second language as effectively as I will to children who speak English as their first language.	5	4	3	2	1
46. I will not have the ability to help children from impoverished backgrounds be successful science learners.	5	4	3	2	1
47. The science achievement level of children from low socioeconomic backgrounds is not related to the quality of the science teaching.	5	4	3	2	1
48 Children who are English Language Learners can be successful in learning science if the teaching is effective	5	4	3	2	1

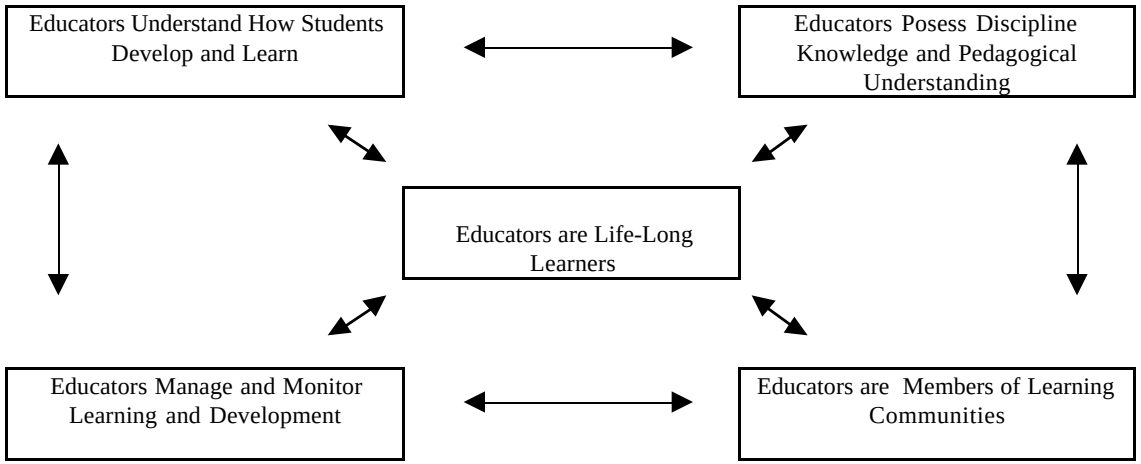
Appendix D

EK ED CONCEPTUAL FRAMEWORK

AND

URBED CONCEPTUAL FRAMEWORK

Elementary and Kindergarten Teacher Education
Conceptual Framework



The diagram above is the Penn State model for the understandings, skills arid dispositions new teachers are expected to develop as a result of their teacher preparation at University Park. It has been recognized by the National Commission on Teaching arid America's Future that what teachers know and do is the most important influence on what children learn. The conceptual framework for new teachers presented here, approved by accrediting agencies such as the Pennsylvania Department of Education (PDE) and the National Council of Accreditation of Teacher Education (NCATE), reflects contemporary thinking about teaching and learning as advocated by the National Association for the Education of Young Children (NAEYC), the Association for Childhood Education International (ACEI), and the National Middle School Association (NMSA). This framework offers a context for describing and discussing educational excellence for teacher education students as well as university and school-based faculty. The model is organized in series of nodes that builds on the central node of Educators are Life-Long Learners.

Educators are Life-Long Learners is the central theme in all of Penn State's teacher education programs. It implies that the formal knowledge and skills learned as a part of University and field-based courses are necessary, but insufficient, to deal with the complexities and fast-paced changes found in diverse education settings. The EK ED program emphasizes the development of knowledge, skills, and dispositions by beginning teachers that allows them to be critically reflective about their work as well as the multidimensional contexts in which their work takes place. From this vantage point, teacher education is an attempt to prepare professionals who continually: a) analyze, discuss, evaluate and change their own practices, adopting an analytic approach towards teaching; b) take greater responsibility for their own professional growth and acquire a degree of professional autonomy; c) appraise the moral and ethical issues implicit iii classroom practices including critical examination of their own beliefs about teaching; and d) examine and redevelop their own theories of educational understanding and practice, offering a principled basis for their own work and decisions. By embracing the notion of life-long learning, it is expected that elementary school teachers will continually make collective and individual decisions about their work in order to help learners develop as active, knowledgeable citizens of a multicultural world.

Educators Understand How Students Develop and Learn is a key supporting node in the Penn State EK ED model in that successful educators base their teaching on a thorough understanding of physical, social, emotional, cognitive, and linguistic developmental characteristics of early and middle childhood as well as early adolescence. Elementary teachers draw upon an in-depth knowledge of child and adolescent development to understand students' thinking, abilities and interests, adapting curriculum and pedagogy to support student learning and development. Elementary teachers understand that cultures and

social groups differ in ways that are critical and affect learning. They know and demonstrate that all children learn when developmental factors are recognized, respected, and accommodated

At the heart of the node, Educators Possess Discipline Knowledge and Pedagogical Understanding, is the need for a rich understanding of the subject(s) taught, as well as of specialized knowledge about how to promote student understanding. Understanding of the central concepts to be learned by students is a prerequisite to effective professional practice, as is an adequate understanding of how knowledge in the discipline is created and organized. Equally important is the notion that specialized knowledge requires specialized teaching strategies. Awareness of the conceptions that learners bring to the education setting help educators select proper instructional strategies and materials to best facilitate student learning.

The node Educators Manage and Monitor Learning Environments ensures that Penn State educators create, enrich, maintain, and alter education settings in order to best provide learning opportunities for all children. In addition to developing a repertoire of techniques to manage education settings, Penn State educators become proficient at a range of instructional strategies and know when to use each to support critical thinking, problem solving, active engagement, self-motivation and collaboration. In addition, learner assessment is a major component of this node of the professional knowledge base. Graduates from Penn State's education programs can be expected to choose and utilize multiple assessment approaches -- from standardized assessments to alternative assessments -- to monitor and promote intellectual, social and physical development.

Since Educators are Members of Multiple Learning Communities, Penn State teachers do not view themselves as isolated figures in the education community. Our educators rapidly learn that they are members of multiple communities - from the highly specialized, content-specific professional societies to the community that brings together parents and policymakers -- in order to work collaboratively to evaluate and improve education settings for all learners. Penn State educators are aware of local, state, and national curriculum and policy issues that impact their work with learners. Further, they understand their role in society and are disposed to attend to their work to educate all in a professional, responsible, and ethical manner.

Outcomes Framework

In the framework presented above, the complex activity of teaching is neatly organized into 5 nodes. Although presented as distinct, the nodes, of course, are related to one another. The following outcomes framework makes more specific the understandings, skills and dispositions expected of the Penn State teacher. It is based on research on effective classroom practice as well as teacher professional standards and teacher performance assessment models from the Interstate New Teacher Assessment and Support Consortium (INTASC) and the National Board for Professional teaching Standards (NB IPTS). This outcome framework should be used by prospective teachers and their mentors to conduct conversations about areas for professional improvement. The outcomes, while not completely parallel to the Penn State Teacher Education Model, subsume key ideas in that model and are organized around four main domains for teaching: Planning and Preparation, Instruction, Reflection and Professional Responsibilities.

A. Planning and Preparation for Learning with Understanding
   Demonstrates Understanding of Content
   a) understands central concepts, tools of inquiry and structure of subject to be taught (i.e., English Language Arts, Mathematics, Sciences, Social Studies, visual and Performing Arts, Health and Physical Education
   b) understands the connections among concepts, procedures, and applications from the content areas taught to elementary students
   c) seeks resources to deepen own understanding of content
2. Demonstrates Understanding of Learners
   a) understands that cultures and social groups differ in ways that are critical and affect learning
   b) understands social, emotional and intellectual characteristics of learners
   c) understands learner prior knowledge and uses it in planning
   d) understands learner diversity and background
   e) considers, accommodates, and integrates the physical, social, emotional, cognitive, and linguistic developmental characteristics of children and young adolescents into instructional plans
3. Demonstrates Understanding of Content-Related Pedagogy
   a) makes curricular decisions based on knowledge of content and learners
   b) makes instructional decisions based on knowledge of content and learners
   c) values teaching for understanding
   d) selects learning activities in support of learning with understanding
   e) plans for instructional technologies appropriately in order to support learning
   f) uses local, state, and national learning goals to plan for student learning
   g) anticipates learner difficulties with specific content
4. Selects Appropriate instructional Goals
   a) develops clear, achievable learning goals
   b) accounts for learner diversity in setting learning goals
   c) sets goals suitable for a variety of learners
   d) plans curricula that are achievable but also challenging for children at various developmental levels.
5. Designs Coherent Opportunities for Student Learning
   a) acknowledges that all children can learn when developmental factors are recognized, respected, and accommodated
   b) chooses learning activities to support learning with understanding by diverse learners
   c) purposively sequences learning activities so they facilitate learning with understanding by diverse learners
   d) purposively selects learning materials and resources to support learning with understanding by diverse learners
   e) plans explicitly for instructional grouping
   f) plans for seamless transitions between lessons
   g) designs productive individual and group tasks
   h) is creative, flexible and thorough in planning and organizing for learning by diverse

learners
i) considers opportunities for ongoing assessment

6. Plans the Learning Environment
   a) supports an atmosphere of care and respect
   b) supports, teaches and protects student rights and responsibilities as citizens of a democratic society
   c) plans an environment that is nurturing
   d) plans an environment that supports of student inquiry and intellectual risk-taking
   e) supports a community of learners by planning for meaningful student participation, ownership and initiative in learning activities
   f) plans physical space to support learning by all students
   g) considers equitable access to all learning resources

II. The Act or Teaching: Facilitating Learning with Understanding

I. Engages Diverse Learners
   a) uses teaching approaches that are sensitive to the multiple experiences of learners and that address different learning and performance modes
   b) establishes instructional groupings to productively engage diverse learners
   c) selects learning tasks, technologies and instructional strategies for enhancing student engagement
   d) represents content in multiple ways, appropriate to the culturally diverse and special needs inclusive classroom
   e) facilitates connections of new content to student prior understandings and experience
   f) chooses instructional materials to engage diverse learners
   g) paces lesson to facilitate learning by all
   h) structures lesson in coherent, organized sequence

2. Assesses Student Understanding
   a) understands the characteristics, uses, advantages and limitations of different types of assessment appropriate for evaluating how K-6 students learn, what they know and are able to do in each subject area
   b) checks for student understanding continuously using a variety of formal and informal assessment techniques (e.g. observation, portfolios of elementary student work, teacher-made tests, performance tasks, projects, student self assessments, peer assessment, and standardized tests) to enhance her/his knowledge of individual learners, evaluate students' progress and performances, and .modify teaching and learning strategies
   c) provides high quality feedback to learners to facilitate continued learning
   d) provides feedback in a timely manner

3. Manages Classroom Procedures
   a) productively engages individual and groups in learning tasks
   b) uses a range of strategies to promote positive relationships, cooperation and purposeful learning in the classroom
   c) makes transitions productive and seamless
   d) establishes routines for handling materials and supplies
   e) establishes routine for non-instructional duties
   f) communicates high academic and behavioral expectations for all learners

4. Manages Student Behavior
   a) communicates clear standards for conduct to learners, parents. etc.
   b) understands how culture influences human interactions and behavior
   c) fosters respect, cooperation, and resolution of conflict
   d) proactively manages student behavior
   e) responds to misbehavior effectively and sensitively
   f) demonstrates care and respect for students
   g) creates learning communities in which elementary students assume responsibility for themselves and one another, participate in decision making, work collaboratively and independently, and engage in purposeful learning activities

5. Communicates Effectively Using verbal, Nonverbal, and Media Communication Techniques
   a) understands communication theory, language development, and the role of language in learning among elementary students
   b) understands how cultural and gender differences can affect communication in the classroom
   c) anticipates possible student misunderstandings
   d) uses a variety of media communication tools, including audio-visual aids and computers, to enrich learning opportunities
   e) provides clear directions and procedures
   f) expresses self well in oral and written forms
   g) communicates using standards conventions
   h) uses appropriate and effective questioning and discussion techniques

C. Reflecting on Teaching for Understanding

1 Reflection-in-Action
   a) adjusts lessons while in progress in reaction to student learning and behavior
   b) captures and uses "teachable moments" as appropriate
   c) reacts to understanding of students by selecting appropriate instructional strategies
   d) persists in promoting learning with understanding by all students
   e) seeks and considers evidence of learner understanding in making instructional decisions

2. Reflection-on-Action
   a) critically analyzes engagement of diverse learners
   b) critically analyzes assessment of student understanding
   c) critically analyzes management of classroom procedures
   d) critically analyzes management of student behavior
   e) critically analyzes communications with students
   f) cites specific examples from lessons to support analyses
   g) offers specific alternatives for future lessons

3. Inquires Critically and Thoughtfully
   a) uses and values critical inquiry to solve pedagogical problems
   b) uses classroom observation, information about students, and research as sources for evaluating the outcomes of teaching and learning and as a basis for experimenting with, reflecting on, and revising practice
   c) examines beliefs and assumptions of educational practices
   d) considers new/different perspectives
   e) explores ways to ensure all students are afforded opportunities to learn with understanding

D. Maintaining Professional Responsibilities

1 Fulfills Professional Responsibilities
   a) applies knowledge of current research and national, state, and local guidelines relating to the disciplines taught in elementary school
   b) establishes appropriate and effective system for maintaining student records
   c) prepares short range and long range lesson and unit plans as required
   d) communicates effectively and professionally with colleagues and other member of a diverse community
   e) is prompt, consistent and thorough in fulfillment of professional responsibilities
   f) maintains appropriate personal appearance
   g) exhibits initiative, motivation, and enthusiasm
   h) advocates for children, families, and schools

2. Builds and Maintains Professional Relationships
   a) works cooperatively with colleagues, parents, policymakers, etc. to improve education for all learners
   b) works cooperatively with university supervisor
   c) works cooperatively with cooperating teacher
   d) works cooperatively with specialists and other school personnel
   e) works cooperatively with other university personnel
   f) acts in a professional, responsible, caring and ethical manner

3. Establishes and Maintains Collaborative Relationship with Families
   a) understands different family beliefs, traditions, values, and practices across cultures and within society and uses that knowledge effectively to promote academic, social and emotional growth of children
   b) respects parents' choices and goals for their children
   c) communicates effectively with parents about curriculum and children's progress

4. Seeks and values Professional Growth
   a) continuously seeks opportunities for professional growth
   b) seeks the intellectual tools necessary to explore critical learning and teaching issues
   c) takes responsibility for learning to teach
   d) conducts systematic research on own classroom practices for the purposes of improvement
   e) is receptive to feedback from instructors, supervisors, cooperating teachers, children, etc.
   f) demonstrates thoughtful risk-taking when appropriate
   g) has a growing repertoire of instructional strategies
   h) has a growing repertoire of assessment strategies

Appendix E

ITEM CONTRIBUTION TO 48 ITEM “FIRST DRAFT’ SEBEST

Table A

Reliability Analysis for the Entire Instrument after Items were Removed

Statistics for	Mean	Variance	Std Dev	N of Variables
SCALE	151.4470	120.2483	10.9658	34

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
1	148.4562	109.7029	.4251	.8539
2	146.9770	112.3652	.4203	.8538
3	146.5806	117.9113	.1942	.8586
4	146.8848	113.5191	.3554	.8555
5	146.8802	113.8467	.3246	.8564
6	147.8433	109.7531	.4294	.8537
7	146.5899	117.1782	.2840	.8572
8	146.9309	113.1295	.3621	.8554
9	148.0000	109.2778	.4572	.8527
10	146.7097	115.1144	.4141	.8548
12	146.9585	113.4844	.3334	.8562
14	146.8249	115.8673	.2760	.8573
15	146.5161	118.0194	.3918	.8571
16	146.5760	116.4583	.4508	.8555
17	147.8894	110.7099	.3176	.8587
18	146.7235	114.9047	.3136	.8565
19	146.8940	114.5674	.3035	.8568
21	146.6544	115.9494	.3147	.8565
22	146.9862	110.4396	.5416	.8506
24	146.8986	112.2304	.4056	.8542
25	146.5576	117.6367	.2550	.8577
26	146.7880	113.1586	.5235	.8524
28	147.0323	113.9110	.2403	.8599
29	146.7926	112.3411	.5074	.8521
30	146.7512	115.7804	.2879	.8570
31	147.4009	111.5283	.4211	.8538
34	146.6590	114.6332	.4136	.8546
40	146.7880	114.7882	.3412	.8559
41	146.7696	113.5578	.4825	.8531
42	146.7558	113.5836	.4369	.8538
43	146.9263	112.9853	.4923	.8527
44	146.7097	115.3088	.3306	.8561
45	148.1429	109.9471	.3721	.8562
48	146.9032	114.3471	.3615	.8554

Reliability Coefficients

N of Cases = 217.0 N of Items = 34

Alpha = .8590

Table B

Reliability Analysis for the Sub-Scale for Personal Self-Efficacy after Items were Removed

Statistics for	Mean	Variance	Std Dev	N of Variables
SCALE	72.1521	53.4907	7.3137	17

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
1	69.1613	45.5618	.4765	.8072
2	67.6820	48.3382	.3986	.8119
5	67.5853	48.8735	.3409	.8152
6	68.5484	45.5544	.4851	.8065
7	67.2949	51.2089	.3109	.8170
9	68.7051	45.0145	.5328	.8029
10	67.4147	50.2161	.3860	.8138
17	68.5945	45.5385	.3979	.8151
18	67.4286	49.8108	.3121	.8164
22	67.6912	46.8348	.5454	.8035
24	67.6037	48.5644	.3553	.8145
26	67.4931	48.8807	.5028	.8084
29	67.4977	47.9919	.5246	.8061
31	68.1060	46.9563	.4700	.8075
34	67.3641	49.5844	.4246	.8118
44	67.4147	50.4846	.2864	.8175
45	68.8479	45.1481	.4540	.8097

Reliability Coefficients

N of Cases = 217.0 N of Items = 17

Alpha = .8201

Table C

Reliability Analysis for the Sub-Scale for Outcome Expectancy after Items were Removed

Statistics for	Mean	Variance	Std Dev	N of Variables
SCALE	79.2949	29.7552	5.4548	17

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
3	74.4286	27.9775	.2920	.7791
4	74.7327	25.8912	.3937	.7724
8	74.7788	25.6545	.4031	.7718
12	74.8065	25.8790	.3644	.7755
14	74.6728	27.3508	.2832	.7801
15	74.3641	28.3900	.4800	.7765
16	74.4240	27.7639	.4682	.7729
19	74.7419	26.1831	.3708	.7743
21	74.5023	27.1586	.3706	.7742
25	74.4055	28.1033	.3148	.7784
28	74.8802	26.0597	.2510	.7913
30	74.5991	27.0469	.3364	.7763
40	74.6359	26.6122	.3798	.7732
41	74.6175	26.2743	.4932	.7658
42	74.6037	25.7867	.5194	.7630
43	74.7742	25.6201	.5608	.7602
48	74.7512	26.3637	.4037	.7714

Reliability Coefficients

N of Cases = 217.0 N of Items = 17

Alpha = .7844

Appendix F

DEMOGRAPHIC DATA QUESTIONNAIRE

SEBEST Respondent Background Information

Please **do not** put your name on this form

1. Student Status at Penn State (select one):

__ Bachelor Degree and Teacher Certification
__ Teacher Certification Only
__ Other _____

2. Semester Standing at Penn State (circle one)

5th 6th 7th 8th 9th 10th

3. Current GPA (e.g., 2.95) _____

4. Gender (mark one): __ female __ male

5. Ethnicity (mark one):

__ American Indian or Alaskan Native
__ Asian OR Pacific Islander
__ Black (Non-Hispanic)
__ Hispanic
__ White (Non-Hispanic)

6. Native/Primary language (check one):

__ English
__ Spanish
__ French
__ Other _____

7. Second Language (check one):

__ English
__ Spanish
__ French
__ Other _____

Thank you

Appendix G

RELIABILITY ANALYSIS FOR THE SEBEST ON THE URBED AND EK ED GROUPS AT MID-SEMESTER AND THE EK ED GROUP AT THE END OF THE SEMESTER

Table D

Reliability Analysis for the Entire Instrument for the URBED Group at Mid-semester

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation		Alpha if Item Deleted
1	146.0000	173.9048	.0954	.	.9049
2	143.6818	173.0844	.3819	.	.8984
3	143.6364	169.4805	.4440	.	.8971
4	144.0000	162.6667	.6208	.	.8938
5	145.0909	169.8009	.2913	.	.9000
6	143.5909	165.8723	.5132	.	.8958
7	143.5909	172.5390	.4992	.	.8976
8	143.6818	172.7987	.1850	.	.9015
9	144.1818	172.8225	.1732	.	.9020
10	143.8636	163.5519	.7292	.	.8927
11	144.0000	166.0952	.4392	.	.8972
12	144.1818	160.8225	.5620	.	.8948
13	144.9091	168.8485	.3711	.	.8983
14	144.0455	159.9502	.6342	.	.8932
15	143.9545	178.8074	-.0724	.	.9062
16	143.8182	166.4416	.7276	.	.8939
17	143.8636	169.8377	.4945	.	.8967
18	143.8182	165.5844	.7859	.	.8932
19	144.3182	167.9416	.4818	.	.8965
20	143.6818	171.8463	.4868	.	.8974
21	145.5000	164.9286	.3615	.	.9000
22	143.7273	166.0173	.7880	.	.8934
23	143.8636	160.4091	.7202	.	.8919
24	143.9091	170.3723	.2612	.	.9006
25	144.4091	164.4437	.5658	.	.8948
26	143.5909	173.3009	.4248	.	.8982
27	144.0455	160.2359	.7366	.	.8916
28	144.0000	172.3810	.1815	.	.9021
29	143.8636	164.5996	.5318	.	.8954
30	143.7273	165.7316	.8083	.	.8932
31	143.6364	170.8139	.6131	.	.8964
32	143.6364	169.3853	.7437	.	.8953
33	143.9545	165.5693	.4113	.	.8980
34	143.7273	173.5411	.2679	.	.8994

Reliability Coefficients 34 items

Alpha = .8999 Standardized item alpha = .9217

Table E

Reliability Analysis for the Personal Self-Efficacy Dimension for the URBED Group at Mid-semester

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
1	67.7273	48.1126	.2905	.8687	.8044
3	65.3636	49.2900	.4139	.9065	.7947
5	66.8182	47.0130	.4501	.8772	.7912
7	65.3182	51.3701	.3917	.9205	.7992
9	65.9091	48.6580	.3290	.8117	.7995
11	65.7273	46.7792	.4606	.9680	.7904
13	66.6364	46.0519	.5962	.9082	.7818
15	65.6818	54.3225	-.1050	.6144	.8270
17	65.5909	49.8723	.4177	.8263	.7954
19	66.0455	47.6645	.5324	.6604	.7875
21	67.2273	42.9459	.5753	.9366	.7805
23	65.5909	47.9675	.3915	.9496	.7952
25	66.1364	44.5043	.7278	.8796	.7725
27	65.7727	46.2792	.5417	.9210	.7849
29	65.5909	47.8723	.3994	.9524	.7947
31	65.3636	51.1948	.3851	.9584	.7989
33	65.6818	49.2749	.2258	.6898	.8086

Reliability Coefficients 17 items

Alpha = .8048 Standardized item alpha = .8217

Table F

Reliability Analysis for Outcome Expectancy Dimension for the URBED Group at Mid-semester

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation		Alpha if Item Deleted
2	73.5455	53.4978	.3181	.	.8819
4	73.8636	45.6472	.7624	.	.8645
6	73.4545	48.4502	.5601	.	.8741
8	73.5455	50.4502	.3666	.	.8828
10	73.7273	47.5411	.7600	.	.8663
12	74.0455	45.4740	.6094	.	.8733
14	73.9091	46.0866	.6069	.	.8728
16	73.6818	48.9892	.7853	.	.8679
18	73.6818	49.4654	.7241	.	.8698
20	73.5455	52.3550	.4948	.	.8778
22	73.5909	48.3485	.9061	.	.8647
24	73.7727	52.4697	.1740	.	.8929
26	73.4545	53.4026	.3932	.	.8805
28	73.8636	50.2186	.3449	.	.8849
30	73.5909	49.2056	.7906	.	.8682
32	73.5000	51.0238	.7538	.	.8724
34	73.5909	54.2532	.1495	.	.8867

Reliability Coefficients 17 items

Alpha = .8821 Standardized item alpha = .9041

Table G

Reliability Analysis for the Entire Instrument for the EK ED Group at Mid-semester

	Scale Mean if Item Deleted	Corrected Variance if Item Deleted	Item-Total Correlation		Alpha if Item Deleted
1	147.1667	114.2393	.3456	.	.8818
2	145.0588	118.1153	.2563	.	.8825
3	145.2843	115.6114	.4199	.	.8792
4	145.3725	115.3252	.3816	.	.8801
5	146.4706	113.7368	.3755	.	.8809
6	144.9510	118.8194	.4629	.	.8800
7	145.1765	116.0478	.5155	.	.8780
8	144.9608	118.9885	.5089	.	.8799
9	146.3824	114.6741	.2637	.	.8857
10	145.1373	117.8820	.4203	.	.8797
11	144.9608	118.2757	.5163	.	.8793
12	145.4314	115.6537	.3460	.	.8810
13	146.6961	115.2632	.3206	.	.8821
14	145.2647	115.5629	.3986	.	.8797
15	145.2451	114.4245	.5019	.	.8776
16	145.2549	116.0136	.4139	.	.8794
17	145.1961	115.7037	.5574	.	.8774
18	145.3235	115.4091	.4515	.	.8786
19	145.5294	112.8259	.6007	.	.8756
20	145.0686	118.4804	.2878	.	.8816
21	147.0588	115.1054	.3144	.	.8825
22	145.0490	117.0570	.5542	.	.8783
23	145.0686	117.6091	.3252	.	.8810
24	145.2647	117.3055	.3612	.	.8804
25	146.0490	115.9481	.3136	.	.8819
26	145.1275	115.4192	.4772	.	.8782
27	145.4118	113.4327	.4305	.	.8792
28	144.9608	118.7113	.4627	.	.8799
29	145.2549	112.6671	.6194	.	.8752
30	145.2843	114.2847	.5079	.	.8775
31	145.0392	116.5133	.6208	.	.8775
32	145.0294	117.3952	.5362	.	.8786
33	145.1667	114.7145	.4215	.	.8792
34	145.1275	116.3697	.5241	.	.8781

Reliability Coefficients 34 items

Alpha = .8828 Standardized item alpha = .9051

Table H

Reliability Analysis for the Personal Self-Efficacy Dimension for the EK ED Group at Mid-semester

	Scale Mean if Item Deleted	Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted
1	67.5000	42.7277	.4191	.5095	.8165
3	65.6176	44.8128	.4033	.3897	.8166
5	66.8039	41.4661	.5311	.5634	.8083
7	65.5098	44.8464	.5364	.5353	.8119
9	66.7157	42.3639	.3605	.3581	.8236
11	65.2941	47.0414	.3970	.4329	.8198
13	67.0294	43.9694	.3489	.3151	.8208
15	65.5784	43.9888	.4963	.4505	.8117
17	65.5294	45.1625	.5057	.5427	.8134
19	65.8627	43.2483	.5693	.5040	.8077
21	67.3922	43.1912	.3955	.4088	.8180
23	65.4020	46.4012	.2698	.2308	.8230
25	66.3824	43.0306	.4703	.4247	.8125
27	65.7451	44.1720	.3478	.2742	.8206
29	65.5882	43.3733	.5634	.5617	.8082
31	65.3725	45.4638	.5976	.6710	.8125
33	65.5000	44.6089	.3686	.3999	.8185

Reliability Coefficients 17 items

Alpha = .8245 Standardized item alpha = .8478

Table I

Reliability Analysis for the Outcome Expectancy Dimension for the EK ED Group at Mid-semester

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation		Alpha if Item Deleted
2	74.8824	28.6593	.3627	.	.8431
4	75.1961	27.8424	.4056	.	.8419
6	74.7745	30.1170	.4318	.	.8400
8	74.7843	29.8936	.5672	.	.8372
10	74.9608	28.9885	.5150	.	.8354
12	75.2549	27.7562	.3949	.	.8432
14	75.0882	28.1407	.4053	.	.8410
16	75.0784	27.9542	.4862	.	.8357
18	75.1471	28.3247	.4286	.	.8390
20	74.8922	29.1863	.3700	.	.8415
22	74.8725	28.6866	.6428	.	.8313
24	75.0882	28.9525	.3870	.	.8408
26	74.9510	27.4332	.5923	.	.8298
28	74.7843	29.6956	.5231	.	.8371
30	75.1078	27.6615	.5005	.	.8350
32	74.8529	28.7801	.6442	.	.8316
34	74.9510	28.5619	.5541	.	.8332

Reliability Coefficients 17 items

Alpha = .8456 Standardized item alpha = .8683

Table J

Reliability analysis for the Entire Instrument for the EK ED Group at End of the Semester

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
1	147.9541	166.9145	.4346	.9146
2	146.2752	176.8865	.3783	.9151
3	146.7798	168.0251	.4671	.9136
4	146.6972	168.6205	.4755	.9134
5	147.4771	169.4925	.4048	.9146
6	146.4404	176.2672	.1642	.9174
7	146.6055	170.7966	.4159	.9142
8	146.3394	174.4670	.3597	.9148
9	147.5596	164.9524	.4248	.9158
10	146.4771	169.8073	.5778	.9123
11	146.4404	171.8413	.5200	.9131
12	146.7156	168.4276	.4651	.9136
13	147.7706	166.3265	.4983	.9132
14	146.5872	170.3372	.4400	.9139
15	146.4495	171.9905	.6255	.9126
16	146.5963	170.2985	.4412	.9138
17	146.6055	166.9448	.7679	.9101
18	146.6330	169.6789	.4547	.9137
19	146.7615	166.3315	.6373	.9111
20	146.4128	173.5965	.4264	.9141
21	148.3028	171.6575	.2822	.9170
22	146.4128	174.8928	.3145	.9152
23	146.4312	171.1179	.6108	.9124
24	146.5505	171.3794	.4476	.9137
25	147.2385	169.8500	.4091	.9145
26	146.3853	171.7205	.5965	.9126
27	146.6972	166.8797	.6171	.9114
28	146.4312	170.4512	.5548	.9126
29	146.5321	167.8253	.7495	.9105
30	146.6606	169.1337	.4799	.9133
31	146.4312	171.6920	.6365	.9124
32	146.5138	167.3262	.6855	.9108
33	146.6239	165.9035	.5513	.9123
34	146.5688	170.8401	.5941	.9124

N of Cases = 109.0 N of Items = 34

Alpha = .9158

Table K

Reliability Analysis for the Persona Self-Efficacy dimension for the EK ED Group at the End of the Semester

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
1	68.3761	57.1628	.5161	.8672
3	67.2018	59.7922	.4206	.8708
5	67.8991	57.9805	.5566	.8646
7	67.0275	60.9715	.4071	.8707
9	67.9817	55.3885	.5250	.8685
11	66.8624	62.2124	.4500	.8695
13	68.1927	56.6570	.6032	.8624
15	66.8716	62.3352	.5418	.8680
17	67.0275	59.7307	.6580	.8626
19	67.1835	58.3549	.6296	.8619
21	68.7248	59.7198	.3830	.8732
23	66.8532	62.4783	.4538	.8696
25	67.6606	59.3189	.4808	.8679
27	67.1193	58.4393	.6302	.8620
29	66.9541	59.8775	.6772	.8625
31	66.8532	61.8857	.5905	.8667
33	67.0459	59.5071	.4347	.8702

N of Cases = 109.0 N of Items = 17

Alpha = .8738

Table L

Reliability Analysis for the Outcome Expectancy Dimension for the EK ED Group at the End of the Semester

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
2	74.6606	40.8744	.2723	.8556
4	75.0826	36.6505	.4418	.8504
6	74.8257	39.7379	.1853	.8620
8	74.7248	38.7754	.4251	.8502
10	74.8624	36.7679	.6112	.8417
12	75.1009	35.0545	.5809	.8423
14	74.9725	36.1381	.5527	.8437
16	74.9817	37.9071	.3579	.8542
18	75.0183	36.6663	.4726	.8483
20	74.7982	38.7367	.4383	.8497
22	74.7982	39.3293	.3245	.8540
24	74.9358	38.1347	.3947	.8515
26	74.7706	37.4562	.6813	.8413
28	74.8165	37.3734	.5476	.8447
30	75.0459	35.9516	.5486	.8440
32	74.8991	35.4619	.7400	.8350
34	74.9541	37.8034	.5539	.8451

N of Cases = 109.0 N of Items = 17

Alpha = .8557

JENNIFER M. RITTER

EDUCATION:

August 1999: Doctor of Philosophy, The Pennsylvania State University, University Park, Pennsylvania

Area of specialization: Science Education

August 1993: Master of Education, Edinboro University, Edinboro, Pennsylvania

Area of specialization: Educational Administration Certification: Elementary Principal

May 1990: Courses leading to Secondary Certification, Gannon University, Erie Pennsylvania

Certification: Secondary Biology

August *1985:* Bachelor of Science, Mercyhurst College, Erie, Pennsylvania

Area of specialization: Biology and Chemistry

PROFESSIONAL EXPERIENCES:

1999-present: Assistant Professor of Education, Millersville University.

1998-1999: Graduate Teaching Assistant, The Pennsylvania State University, Instructor of pre-student teaching supervision.

1995-1998: Graduate Teaching Assistant, The Pennsylvania State University, Instructor of elementary science methods, SCIED *458.*

June 1997-August 1997: Graduate Teaching Assistant, Pennsylvania State University: Dubois Campus, Instructor of graduate science methods, SCIED 497.

1997-1998: Laboratory Coordinator, Science Education Laboratory, The Pennsylvania State University.

1995-1997: Graduate Teaching Assistant, The Pennsylvania State University, Supervisor of pre-student teaching field experience, CI *495B.*

1990-1995: Science Teacher for seventh and eighth grade, Saint George Catholic School, Erie, Pennsylvania.

1986-1990: Science Teacher for third through ninth grade, Saint Gregory School North East, Pennsylvania.