

PERSONALITY AND SCIENCE TRAINING AS PREDICTORS OF SCIENCE TEACHING
EFFICACY BELIEFS

by

Holly H. Saint

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

Curriculum and Instruction
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PERSONALITY AND SCIENCE TRAINING AS PREDICTORS OF SCIENCE TEACHING EFFICACY BELIEFS

Abstract

Various factors have been researched over the past decade related to teaching efficacy under NCLB. Bandura's Social Cognitive Theory (SCT) guided this correlational study with 13 Alabama and 10 Tennessee public school districts to examine 114 K-4 teachers' personality measured by the Big Five Inventory (BFI) personality factors; science pre-service training and school-district professional development training measured by an unpublished Science Training Survey; and science teaching efficacy beliefs measured by the Science Teacher Efficacy Belief Instrument (STEBI). The BFI's personality factors and science training were examined in combination using a hierarchical linear regression in an eight-step model while controlling for gender, years of experience, and classroom setting. The combination of the BFI factors, pre-service training, and professional development training was shown as a significant predictor of science teaching efficacy beliefs. The BFI factors, pre-service training, and professional development training were entered as individual blocks showing that three BFI factors (Agreeableness, Conscientiousness, and Openness), pre-service training, and professional development training were shown as significant, blocked predictors of science teaching efficacy beliefs.

Descriptors: self-efficacy, teacher efficacy, science efficacy, efficacy predictors, personality, BFI, pre-service training, professional development, NCLB, STEBI

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Dedication/ Acknowledgments

I would like to dedicate this dissertation to the ones who have supported me and guided me throughout this experience.

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List of Abbreviations

Alabama City School District (ACSD)

Alabama County School District (ACOSD)

Big Five Inventory (BFI)

Hands On Science Program (HASP)

Highly Objective Uniform State Standard of Evaluation (HOUSSE)

Institutional Review Board (IRB)

Kaiser Meyer Olkin (KMO)

National Science Foundation (NSF)

No Child Left Behind (NCLB)

Personal Science Teaching Efficacy (PSTE)

Principal Components Analysis (PCA)

Science Teacher Efficacy Belief Instrument (STEBI)

Science Teacher Efficacy Belief Instrument Pre-Service (STEBI-B)

Science Teaching Outcome Efficacy (STOE)

Social Cognitive Theory (SCT)

Social Learning Theory (SLT)

Statistical Packaging for the Social Sciences (SPSS)

Teacher Efficacy Scale (TES)

Tennessee City School District (TCSD)

Tennessee County School District (TCOSD)

Variance Inflation Factor (VIF)

CHAPTER ONE: INTRODUCTION

National assessment of reading and writing under President George Bush's initiation of the No Child Left Behind (NCLB) Act (No Child Left Behind, 2002) has focused on an educational reform to well-equip pre-service teachers and experienced classroom teachers with the qualifications needed to prepare successful readers and writers of today (No Child Left Behind, 2002). NCLB's primary focus has been to promote highly qualified educators who are held accountable for students' academic outcomes in the form of standardized testing (Linek, Fleener, Fazio, Raine & Klakamp, 2003). Much of the United States' elementary teachers' pre-service training and professional development training over the past decade has been constructed on the pillars of NCLB targeting teacher accountability of students' standardized achievement (Marx & Harris, 2006; Oxford, 2008) where there is pressure to govern instructional practices and methods leading to less autonomic teachers (Crow, 2005). Pre-service teacher training and school district training programs have been examined under NCLB for teacher quality and application that will impact students' achievement; yet much of the available training targets reading and math (Zientek, 2007). Some grants for disciplined partnerships (math and science) have been established, but the grants are limited in scope for offering a curriculum geared for the sciences and social sciences where teacher recruitment and professional development training in the sciences have become two essential problems (Smith & Kovacs, 2011).

Therefore, this chapter examined Alabama and Tennessee K-4 teachers' personality, science pre-service training, and school-district science professional development training spanning a teacher's career. This study focused on the ability of personality - as measured using the Big Five Inventory (BFI), science pre-service training, and science professional development

training - as measured using the Science Training Survey - to predict Alabama and Tennessee K-4 teachers' science teaching efficacy beliefs while controlling for gender, years of experience, and classroom setting. A researcher-made survey known as the Science Training Survey was created as an instrument to measure teachers' perception of their science pre-service training and science professional development training. The survey was not a validated instrument so it had to be validated to begin the correlational research.

Background

Teachers' teaching efficacy beliefs can be shaped by their social experiences including teacher engagement and collaborative experiences. Albert Bandura's Social Cognitive Theory (SCT) guides the examination of teacher efficacy beliefs and characterizes past experiences as informative factors for a person's future cognitive processing and application (Bandura, 1983). SCT posits that a teacher's behaviors and personality, even self-efficacy beliefs, interact with environmental experiences and influence one another in a mutual fashion (Tschannen-Moran & Woolfolk, 2007, p. 945). Personality can be shaped by a teacher's experiences, and a teacher's personality has the potential to help determine his or her teaching efficacy level and beliefs at the pre-service level and professional level (Strobel, Tumasjan & Spörrle, 2011). Sayed (2002) emphasizes that "teachers' perceptions, identities, and skill and competencies crucially mediate the implementation of mandated policy change" (p. 31), especially under the NCLB mandate, and personal and professional identities can be lost in the process (Day, Stobart, Sammons & Kington, 2006).

Bandura's SCT assumes the ability of past experiences to predict teacher efficacy beliefs (Adams & Forsyth, 2006), and pre-service training and professional development training may

serve as past experiences to correlate with low or high teaching efficacy beliefs stemming from social training opportunities. Pre-service teachers and experienced teachers may experience training opportunities that include ongoing collaboration, dialogue, and interaction with students and teachers to further develop teacher personality. Teacher efficacy beliefs can be further facilitated as teachers cognitively process their social learning experiences (Putney, 2001). Teachers are encouraged to master situations when they are successfully performed by others in social settings so observant teaching efficacy beliefs can be increased (Palmer, 2006). Teachers with higher teaching efficacy beliefs are equipped with the mindset committed to teaching for an extended amount of time and even gaining the most from training opportunities (Ware & Kitsantas, 2007), and teachers who believe in themselves have higher expectations not only for themselves, but also for their students (Shidler, 2009).

Research has shown that single workshop professional development, teacher collaboration, and available resources influence teacher efficacy beliefs, and higher teacher efficacy beliefs influence student achievement (Fancera & Bliss, 2011; Moolenaar et al., 2012). Teachers have perceptions of their capacity to teach even through training experiences (Bandura, 2001), and it is important to research K-4 teachers' efficacy beliefs based on varied levels of teaching experience (Jennings & Greenberg, 2009). Even a teacher's age or years of experienced teaching, especially teaching science, is needed for researching teacher efficacy beliefs as high, moderate, or low compared with the teacher's level of teaching experience (Yeo, Ang, Chong, Huan & Quek, 2008) especially since Bandura (1997) stresses that teaching efficacy beliefs are not uniform across different tasks, subject matter, and amount of time. There is a call to explore teachers' years of teaching experience related to personality and training experiences, and

Bandura (1997) argues that self-efficacy and teaching efficacy beliefs are the most changeable in the first years of teaching experience. Some studies have addressed that novice teachers' efficacy beliefs significantly decrease because of unrealistic perspectives toward teaching, especially with certain subject matter (de la Torre Cruz & Casanova Arias, 2007). Tschannen-Moran and Hoy (2007) state that "it is of both theoretical and practical importance to understand the sources teachers tap when making judgments about their capability for instruction" (p. 953).

Experienced teachers are teachers "who believe strongly in their teaching efficacy and are more likely to foster self-efficacy beliefs in their students through the development of challenging and engaging learning environments" (Roberts, Mowen, Edgar, Harlin & Briers, 2007, p. 93), and people or teachers with higher efficacy beliefs believe highly in their capabilities to tackle new challenges rather than avoid them (Bandura, 1997). Experienced teachers, as opposed to pre-service teachers, are generally given more opportunities to learn new information and apply new methods and strategies during teacher instruction. Pre-service teachers are not given as many opportunities until they have had field experience or student teaching opportunities where they are given some feedback from cooperating teachers, supervisors, and fellow classmates (Chan, 2008). Therefore, this study targeted experienced K-4 teachers of science who have had pre-service teaching experience and in-service teaching experience. Experienced teachers' teaching efficacy beliefs are believed to be better established than pre-service teachers or novice teachers (Putman, 2012; Tschannen-Moran & Hoy, 2007) so experienced elementary teachers, who have entered the teaching profession under the implementation of NCLB or before, were targeted as participants.

Research has addressed that teachers with more than 10 years of experience have higher efficacy beliefs in regards to classroom management rather than student and teacher relationships and instructional practices (Yeo et al., 2008), while novice or experienced teachers with fewer than 10 years of teaching experience tend to have greater student engagement with instructional practices (Putman, 2012). There is a critical need for current research on predictors of teacher efficacy beliefs at the elementary and middle-school experienced-teacher level with any number of years of teaching experience (Usher & Pajares, 2008; Wolters & Daugherty, 2007).

Professional development opportunities have been geared more toward elementary and high school teachers (Faulkner & Cook, 2006; Hill, 2007; Martin & Umland, 2008); yet varied grade-level teachers perceive training opportunities differently, especially under the NCLB mandate. Current research over the past decade has targeted elementary teachers in grades 3-4 and middle school in grades 5-8 and how the teachers' efficacy levels can or do increase student efficacy and student achievement (Chong, Klassen, Huan, Wong & Kates, 2010; Friedel, Cortina, Turner & Midgley 2010; Hsieh, Yoonjung, Min & Schallert, 2008). Factors besides NCLB standards and standardized testing have potential to be thoroughly examined, especially related to elementary science teaching.

Problem Statement

Under the pressures of the NCLB mandate over the past decade, many teachers have faced the ongoing challenges of prioritizing reading and math as the top content areas of teaching and learning (Dillon, 06; McReynolds, 06; Shaul & Ganson, 2005). It is critical for teachers to tap into their personality and training experiences to see their relativity for creating the time and space for science teaching and learning to inspire minds to live, learn, and work in a complex

world of educational reform pressures. It is important to research personality and training experiences as related variables in that Bandura (1997) sees both variables as reciprocals related to science teaching efficacy beliefs despite economical constraints such as limited funding and teaching constructs. A person's mind, behavior, and environment work in mutual fashion, and teachers may feel that the NCLB mandate has affected their personalities and training opportunities. Personalities may have contributed to different training opportunities in different ways, or training experiences may have affected teacher personalities positively or negatively, and examining personality in educational reform movements is critical to note how teachers are trained in the educational reform so that personalities and voices may be suppressed.

The problem is that governmental action under NCLB has given financial support for training opportunities and assessment measures primarily related to reading and math (Hill, 2007; Plash & Piotrowski, 2006) and limited funds and training to the sciences (Smith & Kovacs, 2011; Zientek, 2007) while leading away from the examination of factors increasing teacher effectiveness to impact student achievement. The educational reform's primary focus has been to promote highly qualified teachers who are held accountable for students' academic outcomes in the form of standardized testing (Linek, Fleener, Fazio & Klakamp, 2003); yet the current educational system favors producing highly-qualified teachers through educationally reformed teacher-training programs rather than producing more effective teachers throughout a teaching career (Levine, 2006). Teacher recruitment and professional development training in the science and social sciences have become problematic due to reading and math priorities (Smith & Kovacs, 2011) so teachers of science may not feel fully capable or may not feel there is sufficient time to teach specific science content, topics, or skills well enough for students'

understanding and application. Unfortunately, “The United States is running at top speed in opposing and conflicting directions regarding how best to prepare effective teachers” (Levine, 2006, p. 39), and how the NCLB reform has affected teachers’ attitudes and practices especially toward science is still questionable (Smith & Kovacs, 2011).

In the midst of educational reform, the availability of many resources, funding, and partnerships needed to teach science has been limited revealing that science instruction has not been a top priority trickling from lawmakers’ beliefs to teachers’ beliefs (Marx & Harris, 2006). Time shortages and scripted lessons have been found as frustrating demands limiting innovative lessons and students’ creativity (Smith & Kovacs, 2011). Talented elementary, middle-school, and high-school teachers need to be trained well in a pre-service teaching program; recruited for innovative instructional practices; and continuously trained and supported in teaching and learning science throughout a teaching career to maximize teacher retention and effectiveness (Marx & Harris, 2006). It is necessary to examine science teaching efficacy beliefs along with personality and training experiences because individuals operate individually and socially and are not just products of their environment (Bandura, 1997) in that psychological factors and experiences are related contributing to self-efficacy beliefs and teaching efficacy beliefs (Pajares, 2002).

Teaching efficacy beliefs are changeable in the first few years of teaching experience and will not remain constant even across varied activities, disciplines, and time (Bandura, 1997). Experienced teachers’ teaching efficacy beliefs are to be better established than pre-service or novice teachers (Putman, 2012; Tschannen-Moran & Hoy, 2007), so it was important to control

for teachers' years of experienced teaching so personality, training, and science teaching efficacy beliefs could show an explanatory association between blocks of remaining predictor variables.

Purpose Statement

Social Cognitive Theory (SCT) was the guiding theory of this study developed by Albert Bandura. SCT is defined as the ability for an individual to exercise control of thoughts, feelings, motivations, and actions (Bandura, 1986). SCT is based on the assumption that psychological factors and experiences work in a reciprocal fashion to increase self-efficacy and even self-efficacy beliefs (Bandura, 1997). SCT defines personality as a complex system of cognitive and affective processes (Bandura, 1986). Accordingly this study draws on John Digman's (1996) research of personality expression as five factors described in the Big Five Inventory as - Agreeableness, Conscientiousness, Extraversion, Neuroticism, and Openness (Digman, 1996; John, 1991). SCT regards mastery experiences as purposeful performances that are most influential for self-efficacy beliefs, while vicarious experiences are typically observational experiences that produce actions in others (Bandura, 1986). In this study, the Science Training Survey measured teachers' perceptions of their pre-service training and professional development training experiences as mastery and vicarious experiences. Teachers' pre-service training was examined as training experience before actual teaching takes place (Alkhawaldeh, 2011), and teachers' professional development training was examined as science school-district training spanning over an experienced elementary teacher's teaching career so each teacher could have had time to accrue some science district training opportunities. Self-efficacy beliefs are "beliefs in one's capability to organize and execute the courses of action required in managing prospective situations" (Bandura, 1997, p. 2).

Bandura's SCT guided the research to measure gender and teachers' years of experience as control variables, while a correlation analysis empirically showed that classroom setting was significantly related to science teaching efficacy beliefs. The control variables were entered as the first predictor block in a hierarchical multiple regression analysis, followed by the BFI's personality factors in Blocks 2-6, science pre-service training in Block 7, and science school-district professional training in Block 8. Bandura (1997) indicates that one's environment, cognitive processing, and behavior work in a causal, reciprocal fashion emphasizing that personality and training experiences predict efficacy beliefs; efficacy beliefs influence one's personality and training experiences; personality influences training experiences; and training experiences influence personality. The purpose of this correlational study was to combine the BFI factors with pre-service training and science school-district training to show which block of variables, if any, significantly contributed to the hierarchical regression model and predicted K-4 teachers' science teaching efficacy beliefs while controlling for gender, teachers' years of experience, and classroom setting.

Significance of the Study

School accountability is crucial beginning in the latter grades of elementary school due to standardized testing (Usher & Pajares, 2008; Wolters & Daugherty, 2007), and funding supports the NCLB mandate through training opportunities, but how effective are these training experiences regarding teacher personality and the availability of training and resources to benefit the teachers' capacity to teach science? Teachers' personalities may determine engagement, collaboration, and extension of training experiences to reflect higher teacher efficacy beliefs

(Burns & Christiansen, 2011), and the teachers' personalities can potentially influence training opportunities for igniting teachers' motivation and new ideas, especially in science.

Identifying personality using the BFI factors, pre-service training, and professional development training as predictors of teaching efficacy beliefs can inform pre-service institution directors and school system directors of new, innovative ideas for future science curriculum and ongoing training development. Pre-service teacher training experiences in science can be designed or reconstructed to allow pre-service teachers the opportunities to analyze certain aspects of the science teaching program (Simmons & Kington 2006; Zembal-Saul, Blumenfeld & Krajcik 2000), and teaching institutions must discard unproductive programs, strengthen average programs, and extend strong programs with pre-service teachers' perceptions in mind (Levine, 2006, p. 41). Analyzing pre-service training programs and teaching opportunities can be transpired into school-district professional development as well as corresponding professional development teachers receive for additional graduate-level training. Curriculum-focused professional communities at the pre-service level can be bridged with district-level professional development training to educate effective teachers (Levine, 2006) where teachers are given the support for curriculum planning and integration to increase their teaching beliefs, especially in science (Fishman, Marx, Best & Tal, 2003; Ross & Bruce, 2007).

This study's results can contribute to public schools' teaching and training opportunities across the United States since NCLB is a federal mandate for all public schools in the United States. This study's results can also extend to private schools and areas outside the United States by creating pre-service training experiences with course design and school partnerships, especially science partnerships, that help build science teacher efficacy beliefs in today's schools

(Latham, Crumpler & Moss, 2005). This correlational study is critical to add to the limited body of research of internal and external factors of teacher efficacy beliefs so educational stakeholders can make rational decisions for training and curriculum reflecting current research (Adeyanju, Ajayi & Akinsanya, 2011; Jennings & Greenberg, 2009).

Research has provided limited citations that a combination of teacher personality, pre-service training, and professional development training spanning a teacher's professional career predicts teachers' efficacy beliefs (Goddard, Hoy & Hoy, 2004). Internal and external factors of teacher efficacy beliefs have shown contrasting findings depicted in the review of the literature (Goddard, Hoy & Hoy, 2004). Training experiences have indicated fluctuations in teaching efficacy levels (Lee & Houseal, 2003), and various structures of training experience may predict the fluctuating levels (Burton & Pac, 2009). It is critical to examine predictor variables to design or redesign training experiences to address the predictor variables in conjunction with higher or lower teacher efficacy beliefs. Teachers' personalities and training experiences must be examined as potential factors of changing teachers' beliefs of teaching and learning to surmise classroom application (Overbaugh & Ruiling, 2008, p. 46), and then teachers' perceptions must be taken into account when structuring training and classroom teaching.

This study is also critical for targeting pre-service training and professional development training in specialized content areas relating to teacher efficacy beliefs. For example, a K-4 science teacher who may have limited training of observing an effective role model, such as a professor or cooperating intern teacher; teaching in a district with readily available resources and funding; and/or participating in relevant professional development training may not feel as capable of understanding science concepts much less teaching science. A teacher who has

actively participated in many effective pre-service training and professional development training opportunities may be more adept at understanding science and how to teach science effectively. Partnerships between universities and schools must be ongoing to support pre-service teachers to influence teacher efficacy beliefs since “teacher-preparation programs have been mandated to produce better assessments of teacher interns” (Latham et al., 2005, p. 146). This study could make critical advancements of personality and training experiences related to higher or lower efficacy beliefs of elementary teachers who teach all subject matter.

Research Question and Hypotheses

One research question and eight related hypotheses guided this correlational research study to examine the combination of predictor variables to predict K-3 and K-4 teachers’ science teaching efficacy beliefs. The hypotheses were analyzed using a hierarchical multiple regression with 8 blocks of predictor variables. The predictor variables included the control variables (gender, years of experience, and classroom setting) entered into a hierarchical regression in Block 1; a combination of the BFI factors, pre-service training, and professional development training entered into a temporal Block 2; each BFI factor entered individually in Blocks 2-6; science pre-service training in Block 7, and science school-district professional development training entered in Block 8.

RQ1: What combination of predictor variables (teacher personality based on the BFI’s five factors, science pre-service training, and science school-district professional development training application spanning a teacher’s career), if any, significantly predicts science teaching efficacy beliefs while controlling for demographic variables (gender, years of experience, and classroom setting)?

H₁: The BFI factors, pre-service training, and professional development training significantly predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₀₁: The BFI factors, pre-service training, and professional development training do not significantly predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₂: The BFI “Agreeableness” personality factor significantly contributes to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₀₂: The BFI “Agreeableness” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₃: The BFI “Conscientiousness” personality factor significantly contributes to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₀₃: The BFI “Conscientiousness” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₄: The BFI “Extraversion” personality factor significantly contributes to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₀₄: The BFI “Extraversion” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₅: The BFI “Neuroticism” personality factor significantly contributes to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₀₅: The BFI “Neuroticism” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₆: The BFI “Openness” personality factor significantly contributes to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₀₆: The BFI “Openness” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₇: Pre-service training significantly contributes to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₀₇: Pre-service training does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₈: Professional development training significantly contributes to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₀₈: Professional development training does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

Identification of Variables

The controlled, predictor variables examined in combination were (gender, years of experience, and classroom setting), personality measured by the BFI's five factors, pre-service training, and science school-district professional development training extended over an experienced K-3 or K-4 teacher's teaching career. Personality and the training variables were examined in combination because Bandura acknowledges that teacher efficacy beliefs are determined based on specific content and subject areas taught (Bayraktar, 2011), and training openness and application can relate to a teacher's personality as well as subject matter, especially science.

Gender was the first controlled demographic variable. Years of teaching experience was the second controlled demographic variable that included teachers' years of teaching as an elementary teacher. Classroom setting was the third controlled demographic variable that

focused on teachers teaching in a self-contained classroom to teach all subject matter or a departmentalized teaching setting focused on teaching specific content (i.e. science only) to varied classes or on varied levels.

Personality was a predictor variable measured using the BFI to target personality in entity combined with social training experiences. *Personality* was examined as the expression of someone when encountering situations and someone's psychological realm of motivation, emotion, thought, and intelligence (Mayer & Korogodsky, 2011). According to Digman (1996), the BFI is a structural model with 44 phrases designed to measure a person's expression including five main personality factors discussed thoroughly in the review of the literature - Agreeableness, Conscientiousness, Extraversion, Neuroticism, and Openness (Digman, 1996). Current literature with the BFI has shown personality as a weak predictor of teacher efficacy (Henson & Chambers, 2003; Roberts, Mowen, Edgar, Harlin & Briers, 2007) as well as a strong predictor (Poulou, 2007) so this study's focus was to examine conflicting literature findings.

The training variables measured in this correlational study included pre-service training and school-district professional development training spanning a teaching career. *Pre-service training* is experience when potential teachers are well-equipped with the content knowledge, instructional application, collaboration efforts, and management skills needed to perform as a classroom teacher (Alkhawaldeh, 2011). *Professional development training* is the use of action research for curriculum development that is used in school-district planning for a specific content area – science, math, etc. (Ferrance, 2000, p. 29). Science pre-service training design and science school-district professional development training application were measured using a six-point, unpublished survey known as the Science Training Survey. The survey was initially

validated before the quantitative research. The Science Training Survey was measured on a six-point scale of (1 = Strongly Disagree, 2 = Disagree, 3 = Mildly Disagree, 4 = Mildly Agree, 5 = Agree, and 6 = Strongly Agree) including a N/A response. The initial survey included 29 researcher-developed items based on Bandura's SCT and current literature of social cognition being developed by experiences, even training experiences (Bandura, 1982). Content and face validity for the Science Training Survey was determined by an outside statistician, and the construct validity was further analyzed using Principal Component Analysis (PCA). Items were reported on two sub-scales (Pre-service Training and Professional Development Training). PCA reported three components. Components 1 and 3 were Professional Development Training, and Component 2 was Pre-Service Training. Cronbach's alpha was used to assess the internal reliability of the survey's items. The initial survey began with 29 items, and it was later narrowed to 20 items based on the extraction of unreliable, insignificant items.

The criterion variable was *science teaching efficacy beliefs*, which is a teacher's prospect of the capability to be effective at creating student learning in science (Ross & Bruce, 2007). Science teaching efficacy beliefs were measured using Enochs and Riggs (1990) Science Teaching Efficacy Belief Instrument (STEBI), which included 25 items on a five-point Likert Scale with reverse rating (Check this: 1 = Strongly Agree, 2 = Agree, 3 = Undecided, 4 = Disagree, 5 = Strongly Disagree) (McDonnough & Matkins, 2010, p. 16). The instrument stemmed from Gibson and Dembo's Teaching Efficacy Scale (TES) (Woolfolk & Hoy, 1990). The STEBI included two varied subscales – Personal Science Teaching Efficacy (PSTE) and Science Teaching Outcome Efficacy (STOE). The STEBI was chosen as the appropriate scale not only due to its consistent validity (McDonnough, 2010), but also due to its division of PSTE

and STOE sub-scales reflecting teachers' personal teaching beliefs projecting students' achievement (Forbes, 2011).

Definitions

The following terms were pertinent in this correlational study.

- a. *Field experience* is working with a cooperating teacher possibly to assist, tutor, observe, and teach in a school setting (Byrd & Garofalo, 1982).
- b. *Highly qualified status* represents the status of a teacher's credentials that have been thoroughly examined by the Highly Objective Uniform State Standard of Evaluation (HOUSSE) and have been found to fulfill the requirement of classes or course hours and the passing score of content knowledge needed to teach specific content (Plash & Piotrowski, 2006).
- c. *Pre-service training or practicum* represents beginning field coursework where pre-service teachers observe, cooperate with classroom teachers, and possibly teach small lessons or conduct small activities with support from the classroom teacher (McDonnough & Matkins, 2010).
- d. *Self-efficacy* is a person's belief in the ability to produce effective results of a specific behavior (Bandura, 1982).
- e. *Student teaching or internship* is typically a "culminating field experience where pre-service teachers devote 10-15 weeks primarily to work in a school setting, including a 3-to-6 week period where these students have total responsibility for planning, teaching, and evaluating outcomes" (McDonnough & Matkins, 2010, p. 13).
- f.

Research Design

This research study was conducted quantitatively using a correlational design to explore the possible relationship of personality and training as predictor variables of science teaching efficacy beliefs while controlling for gender, years of experience, and classroom setting. The study explored each predictor variable in a combination format. A correlational design was the appropriate design because the “correlational design allows us to analyze how these variables, either singly or in combination, affect the pattern of behavior” (Gall, Gall & Borg, 2007, p. 336); yet, there is no manipulation of the predictor variables or criterion variable and no explainable causality of the variable relationships (Tabachnick & Fidell, 2007). The research design was also appropriate due to limited research of relationships between predictor variables and teaching efficacy beliefs, especially with pre-service training, professional development training, and personality with teacher efficacy beliefs (Roberts, Harlin & Ricketts, 2006). A correlational study was necessary for exploring the “degree of the relationship between the variables being studied” and the degree of teacher efficacy as low, moderate, or high (Gall et al., 2007, p. 336). A hierarchical regression was the appropriate analysis used in this correlational study “to evaluate the relationship between a set of predictor variables and an outcome, controlling for or taking into account the impact of a different set of predictor variables on the outcome” (Berndt & Williams, 2013, p. 10).

Summary

This chapter has provided an overview of the background of this correlational study. The quantitative correlational design was chosen as the most appropriate design for targeting highly-qualified K-4 teachers and addressing the research questions relating efficacy to a

combination of the personality and science training variables. Personality and training are variables that can be continuously examined in combination with other variables to predict science teaching efficacy beliefs, especially higher or lower science teaching efficacy beliefs.

CHAPTER TWO: REVIEW OF THE LITERATURE

This literature review provides an overview of the most current but limited research of teaching efficacy beliefs related to three predictor variables – personality, science pre-service teacher training, and science professional development training. This chapter dissects teacher efficacy beliefs under the NCLB's pillars that help guide government funding, training opportunities, and teaching experiences that have developed more within the last decade with student achievement at the heart of teaching and learning. Focus has been more on teachers' capacity to impact student achievement, and factors in combination that potentially influence a teacher, especially a teacher's efficacy beliefs, have needed thorough examination. This review has synthesized the current but limited research regarding personality and training factors predicting experienced teacher efficacy beliefs and has supported the need for more quantitative research. Bandura's SCT guides this literature review for examining personality and training experiences as predictor variables of teaching efficacy beliefs

Theoretical Framework

This correlation study is constructed on the framework of Canadian psychologist Albert Bandura's SCT (1986). SCT evolved from American psychologists Neal Miller and John Dollard's work in the 1940's to bridge behaviorism with psychoanalytical concepts (Pajares, 2002; Rolnick & Rickles, 2010). Miller and Dollard's proposed learning theory focused on biological and social drives of producing certain behavior patterns rather than behavioral association; however, Bandura went a step further in bridging social and cognitive learning with observing, modeling, mental processing, and reinforcing (Bandura, 1977; Pajares, 2002). The

model and learner both play active roles in learning, and emphasis is placed on internal thought and cognition to connect social learning to cognitive development rather than behavioral learning (Bandura, 2001). Therefore, Bandura's Social Learning Theory (SLT) later became known as the Social Cognitive Theory (SCT). Although social (environmental) factors shape human behavior, cognitive processing and interpretation are critical for people's sense-making of their own psychological processing (Bandura, 1977; Pajares, 2002).

SCT focuses on a person's capability of learning and teaching being based on observation and imitation in a social setting rather than learning and teaching in a behavioral setting of association and response (Pajares, 2002). Bandura (1977) suggests that individuals' success is dependent upon pre-set expectations in the ability to perform certain actions connected with outcome expectations of the desired outcome to be achieved. SCT posits that a person's knowledge and capacity of performing is based on the belief about the action and outcome; the belief about the ability to cope with the task; and the socialization with outside influences and experiences stimulated by observation, imitation, and modeling (Arigbabu & Oludipe, 2010; Bandura, 2001). A person's life influences and experiences, whether personal or career-oriented, have helped to shape an individual (Bandura, 1983).

Today's teachers teach primarily in a social setting, and their perspectives are typically shaped by the social realm of teaching and learning that bridge their capabilities with actual performance. Bandura (1983, 1997) emphasizes that a person's efficacy beliefs are shaped by four sources - mastery experiences, vicarious experiences, social influence with verbal persuasion, and internal interpretation (emotions and moods). Mastery experiences are the most influential experiences where teachers gain a sense of efficacy based on their successes, while

vicarious experiences allow teachers to judge their performance based on the views of other teachers or systems (Bandura, 1997). Teachers may rely on mastery experiences, such as pre-service training and professional development training, as constructs for using what practices work best to meet students' needs to increase student achievement. In contrast, teachers may fathom vicarious training experiences as influential based on using instructional practices in the same manner as fellow, successful teachers or leaders. Vicarious experiences, especially modeling and observations, may impact a teacher's teaching performance based on the identification with previously modeled performances. If a teacher as an observer does not identify with a model or act of modeling in a manner that is pertinent to or in agreement with the observer's nature of learning or teaching, then the observer's self-efficacy beliefs may not be positively influenced, even if the performance is modeled by an effective teacher or professional (Tschannen-Moran & Woolfolk, 2007, p. 945). Research has emphasized the importance of not only observation influencing teaching efficacy beliefs, but also verbal persuasion feedback. In pre-service training and professional training, verbal persuasion influences self-efficacy by acknowledging effective teaching and placing emphasis on areas of weakness in a positive manner so teachers may reflect and put forth more effort to fulfill certain objectives (Garvis, Twigg & Pendergast, 2011; Ignat & Clipa, 2010).

Teachers are faced with daily decisions of self-regulating their instructional practices and relationship building (Zito, Adkins, Gavins, Harris & Graham, 2007) by fine-tuning emotions, thoughts, motivations, and experiences. Efficacy influences how teachers teach "students how to set goals, self-monitor, use self-instructions, self-evaluate, and self-reinforce" (Zito et al., 2007, p. 81), and the SCT is a well-researched theory that bridges factors that influence higher teacher

efficacy with ways to not only teach students, but also way to influence higher student efficacy. A person should be aware of the capability to perform (Bandura, 1982), and teachers must be aware not only of their capability to teach, but also the factors that influence their capability to teach (Tschannen-Moran & Hoy, 2007). SCT guides this research study by relating elementary science teachers' personality and science training experiences as social networks that could significantly influence their efficacy in today's public schools functioning under NCLB.

SCT is a well-researched theory that has advanced the literature over the past two decades on how performance relates to one's perception of capability better known as efficacy and the self-regulation of instruction and learning (Zito et al., 2007). SCT has informed research over the past two decades that a person's efficacy plays a critical role in decision-making and performance. This study has the potential to extend the SCT based on the relationship between experiences and teachers' efficacy beliefs so future researchers and readers may understand how efficacy beliefs proceed in a three-fold fashion – experiences as predictors of teaching efficacy potentially influencing student achievement.

Literature

Researching teacher efficacy beliefs has made a contribution to the field of education for the past two decades; however, researching varied factors that influence experienced teacher efficacy beliefs has shown a significant gap even though current research is still developing. Connecting research that we know with developing research can help to fill the gap of examining factors of teacher efficacy beliefs, especially science teacher efficacy beliefs.

No Child Left Behind (NCLB)

NCLB has produced federal mandates for teacher accountability based on students' standardized testing achievement (Dillon, 2006; McReynolds, 2006), and focus has been more on teacher effectiveness being based on higher student achievement (Shaul & Ganson, 2005). The loss of control has been relinquished more into the hands of governmental positions overseeing the production of student scores, and if reading and math standards are not met, then federal funding is withdrawn, especially science funding, which is already limited in scope (McReynolds, 2006). The 2007 reauthorization of the NCLB has regarded an "effective teacher" as a highly-qualified teacher who improves standardized achievement scores (National Council for Teacher Quality, 2007); yet less autonomic teachers continue to be produced (Day et al., 2006). Shaul (2005) states that

highly-qualified teachers must have a bachelor's degree; be fully certified or hold a license in the area in which they teach in the state; and demonstrate subject matter competency in the area in which they teach by passing a state content examination (p. 60).

Highly-qualified teachers must demonstrate content understanding and communicate content and instructions clearly and effectively for students' science comprehension and application (Zumwalt & Craig, 2005); yet if focus is not placed on the sciences, it is very probable that students will not have as many meaningful learning opportunities related to life (Shaul & Ganson, 2005).

Teaching efficacy beliefs is one aspect of education that may be viewed differently in that teachers' efficacy beliefs may fluctuate dependent on the success of students' achievement

(Evans, 2009), but internal governing causes are to be considered, despite product factors such as students' achievement. A teacher's personality is an internal factor in need of close examination under NCLB because experienced teachers' personality types may have become less stable after the implementation of NCLB. In regards to science instruction, the NCLB mandate has mounted reading and math instruction as well as standardized testing as top priorities and has limited even more time for science instruction and science training opportunities (Marx & Harris, 2006) leading to 71% of the nation's school districts narrowing curricula to meet reading and math benchmarks (Dillon, 2006). The narrowing of curricula continues to affect not only science instruction but also science training opportunities.

Social Cognitive Theory and Teaching Efficacy Beliefs

Teacher efficacy is a teacher's belief of succeeding in given teaching situations when faced with challenges to make critical judgments of effective teaching (Gibson, 2004, p. 198), and teachers with higher teaching efficacy beliefs are presumed to be able to address and overcome many obstacles during a teaching career by exerting extra effort (Bandura, 1997). Teachers with higher teaching efficacy beliefs create more time for helping students to experience different learning activities while addressing student difficulties as well as supporting students' motivation and process of learning with new teaching ideas (Tschannen, 1998). Bandura (1997) acknowledges that self-efficacy is comprised of efficacy expectations and outcome expectations. Both types of expectations contribute to teachers' beliefs of effective behavior to positively influence a desired outcome, and certain performances that control more of a desired outcome will allow teaching efficacy beliefs to account more for the outcome (Bandura, 1986). Bandura acknowledges that teaching efficacy beliefs are determined based on

specific content and subject areas taught (Bayraktar, 2011), and training openness and application can relate to a teacher's personality. Teaching efficacy beliefs can be lowered if teachers constitute certain subject matter, observed performances, or personal performances as failures. Future teaching moments can be negatively affected due to a teacher's contribution of a past performance failure or observed performance failure to current performances, especially if a teacher attempts to perform (or teach) subject matter in which she feels less effective (Tschannen-Moran & Hoy, 2007).

Bandura's SCT posits that teachers who predict unsuccessfulness in teaching certain content, students, or context are more likely to extend less effort in preparation, training, and instruction and will submit to failure when faced with initial difficulty, especially with certain subject matter (Tschannen-Moran & Hoy, 2007). Subject matter may factor into a teacher's perceived efficacy. It can be difficult to determine one factor's influence on teaching efficacy so research has begun to emphasize the need for variables to be studied jointly as predictors of teacher efficacy beliefs (Cantrell & Hughes, 2008; Usher & Parajes, 2008; Yeh, 2006). Despite external factors contributing to higher or lower teaching efficacy beliefs, "teachers can be their own role models improving their teaching in an area of concern through a thorough analysis of their own teaching in an area of strength" (Bencze & Upton, 2006, p. 222-223).

Teaching experience has been one of the top-researched predictor variables of teaching efficacy beliefs, but experience has shown conflicting relationships in that teachers with longer years of teaching experience have higher teaching efficacy beliefs (Cheung, 2008; Wolters & Daughtery, 2007), even though fewer years of teaching experience have been strongly related to teaching efficacy beliefs (Guo, Piasta, Justice & Kaderavek, 2010). Research has been more

focused on teaching efficacy beliefs at a specific moment in teaching rather than over an extended period of time (Pas, Bradshaw & Hershfeltd, 2012). It has related teaching efficacy beliefs mostly to outcomes such as student achievement, students' attitudes, and subject matter taught (Aydin & Boz, 2010), but sources predicting teaching efficacy like teachers' mastery still have great potential for future research (Tschannen-Moran & Hoy, 2007).

Elementary Science Teachers' Science Teaching Efficacy Beliefs

“In science teaching contexts, self-efficacy is an individual's belief that one has the ability to effectively perform science teaching behaviors as well as one's belief that students can learn science given factors external to the teacher” (Ramey-Gassert, Shroyer & Staver, 1996, p. 96.) Research using the Science Teaching Efficacy Belief Instrument (STEBI) has primarily examined factors that teachers believe have influenced their teaching efficacy beliefs, and some factors have increased teaching efficacy beliefs (Cantrell, Moore & Young, 2003) while others have decreased teaching efficacy beliefs (Ginns & Watters, 1999). Until the STEBI's development, “teacher efficacy was primarily researched on general beliefs rather than specific subject area” (Enochs & Riggs, 1990, p. 627). In pre-service training, the STEBI-B, a pre-service assessment represented with –B, has shown that pre-service teachers have had higher science teaching confidence when teaching in small group settings; being assisted with an effective, cooperating teacher; and teaching across the disciplines (Wingfield et al., 2000), but how many pre-service training teachers have had opportunities to work with a cooperating science teacher, especially an effective science teacher, to observe, or to teach in any science classroom where science is even taught, especially taught effectively? Research has shown that pre-service teachers who have taken four or more science courses have shown significantly

higher Personal Science Teaching Efficacy (PSTE) than teachers who have taken fewer than four courses (Bleicher, 2004), and the higher PSTE has been found more significant in males.

Science teaching is not only based on teaching application, but also teaching beliefs, especially in inquiry-based courses and teaching experiences. Inquiry-based teaching necessitates opportunities for elementary teachers to create a clear understanding of science teaching and science knowledge that can be dispensed and inquired into students' learning (Forbes 2011; Zembal-Saul, 2000). In control-group, inquiry-based teaching and practices, experimental-group pre-service teachers' PSTE beliefs have improved and sustained; however, Science Teaching Outcome Expectancy (STOE) beliefs have been less stable (Leonard et al., 2011). Hodson (2003) addresses three major targets for students' learning outcomes in a science classroom. Students should learn science, learn about science, and be able to do science, but unfortunately, teachers with low science teaching efficacy beliefs focus on the teaching and learning aspect of science.

Teachers can impact students learning and application of science by mastering science content and teaching practices. Mastery-oriented experiences and beliefs have been found as predictors of science teaching efficacy beliefs and have related to higher student engagement and more effective teacher classroom management (Palmer, 2011; Rubie-Davies, Flint & McDonald, 2012). In addition, Palmer (2011) notes that situ feedback has been shown to increase teaching efficacy beliefs. Under the NCLB mandate, school-day time constraints with emphasis on reading and math, has limited teaching time where teachers can reflect on their understanding of science and application scientific concepts. Palmer (2011) notes that a significant increase in an

elementary teacher's efficacy beliefs can still be made in a teaching area, such as science, even with limited experience or teaching time (p. 593).

There are a variety of factors that have the potential to predict higher or lower teachers' science efficacy beliefs. How much science is taught in the everyday classroom, number of undergraduate science teaching courses, and a teacher's personal perception of science in general has significantly predicted higher anxiety in teaching science, especially in experienced teachers (Nejla, 2011; Yuruk, 2011, p. 24). Many elementary teachers are required to teach science, but some teachers may not favor teaching science in general apart from personal training or teaching experiences. Some teachers tend to focus on what they deem as interesting and important, and students' learning, especially science learning, may be negatively influenced by teachers' anxiety of teaching science, lack of time to teach science, or teachers' choice not to teach science. Cantrell (2003) found positive relationships with science teaching efficacy beliefs and gender, partnerships, number of years teaching experience, number of classes taught, and amount of time teaching per week. Cantrell's study was limited to high-school teachers whose factors may differ from elementary and middle-school teachers. "Other factors, such as lack of money and supplies, diminished content preparation, limited support from educational leaders, inadequate professional development, and even low self-confidence in teaching science contribute to the decreasing amount of science taught in the elementary classroom" (Tushie, 2009, p. 1). Socio-economic level and teacher gender have also been found as predictors of teaching efficacy beliefs (Moseley & Taylor, 2011; Rubie-Davies et al., 2012), but gender has also been shown to have no significant effect on teaching efficacy beliefs (Nneji, 2013). Researchers and educational leaders must dig deep to understand how elementary teachers view science teaching

and learning; what factors contribute to teachers' views of science teaching and learning; and how teachers are currently using various curriculum materials to teach and engage students (Forbes, 2011).

Personality and Teaching Efficacy

Personality traits have been researched considerably over the past few decades and have transitioned more into education. "Personality traits are basic tendencies that refer to the abstract, underlying potentials of the individual" (John & Srivastava, 1999, p. 42). Three American psychologists—Floyd Allport, Gordon Allport, and Raymond Cattell - ignited distinct personality trait theories that have transcended into new trait theories based on the broadness and narrowness of their own trait theories (Wiseman & Bogner, 2003).

American psychologist Floyd Allport was best known for his classification of personality traits as being inherently social bridging personality with social psychology (Allport & Allport, 1921). German psychologist, Hugo Münsterberg (1914), aligned his views with Floyd Allport in that "our personality is the individual with his whole social setting" (p. 219) and that

if we study individual psychology, we are led from the simple states to those most complex formations, which constitute the personal individuality. The end point of individual psychology is therefore the observation of the individuals in their differences. But this is exactly the starting point for the social psychologist (p. 44).

Unlike Floyd Allport and Hugo Münsterberg, American psychologist Gordon Allport contributed his trait theory of personality with a compilation of 4,500 individual traits themed as cardinal traits that develop an entire personality; central traits that support a personality; and secondary traits that are present at certain points to targeted pure individuality (Allport & Odbert,

1936). Gordon Allport's focus was primarily on psychological personality rather than social psychology (Allport, 1921, 1930), and he stated that

if it cannot fairly be said that personality is exclusively a social phenomenon, neither can it be held that social psychology is identical with the study of personality in its social environment. Many of the problems of social psychology concern universal alteration of behavior, motivation common to all men, or individual differences in respect to some mental process abstracted from personality (p. 732).

Gordon Allport has been known to influence American psychologist Cattell's Sixteen Personality Factor Questionnaire in which Cattell narrowed down Gordon Allport's extensive list of personality factors through factor analysis to develop 16 key personality traits for assessment (John & Srivastava, 1999). Cattell believed that a personality trait is "a permanent entity that does not fade in and out like a state; it is inborn or develops during the life course and regularly directs behavior" (Pompian, 2012, p. 51), and he suggested that people have functional and fluctuating unities shared across with other individuals (Cattell, 1955).

Cattell was a firm believer in personality factors being naturally correlated, and he aimed at measuring personality based on genetically and environmentally bases (Pompian, 2012; Sells, 1959). Cattell's Ecometic Model (1981) factored the environment and personality traits into a behavioral theorized framework (Pompian, 2012). Gordon Allport and Raymond Cattell's personality assessments in the mid-1900s targeted psychological factors such as feelings, emotions, and human behavior related to early experience (Bornstein, 2010). Their assessments

have influenced research over the past 50 years to focus on five core personality traits represented in Digman's (1996) BFI.

Many nonclinical personality psychologists over the past several decades have merged ideas to measure personality based on individual differences to determine emotional and behavioral development (McCrae & Costa, 1999). In contrast, many social researchers and twentieth-century non-psychologists and some personality psychologists such as Floyd Allport and Hugo Münsterberg have viewed personality as a social characteristic dependent upon societal experiences (Mayer & Korogodsky, 2011) and have emphasized personality and experiences as coinciding factors to widen the perspective process of social psychology (Barenbaum, 2003; Robinson & Gordon, 2010).

Personality has been researched well over the past half-century, but trait researchers have targeted individual differences instead of examining the individuals themselves (Pervin, 1994). "When considering personality and individual differences, the vital importance of change and flow must be reconciled with the notion of constancy, and with the assumption that each individual is characterized by stable and distinctive qualities" (Pompian, 2012; Shoda, Lee & Mischel, 2012, p. 316). In contrast, personality traits could be very heritable but not stable as well as not heritable but extremely stable (Hampson & Goldberg, 2006). Shoda et al. (2012) align their assumption with McCrae and Costa (1987), but McCrae and Costa note that basic tendencies remain stable during one's life, but that characteristic adaptations could considerably change over one's life time. Despite many social researchers and non-psychologists' beliefs, exploring personality in entities is critical for viewing people with individual differences, and these individual differences (traits) can then be factored into society, especially into experiences

such as teacher training (John & Srivastava, 1999). Outside experiences such as training experiences can alter personality traits despite heritable ties.

Personality has transpired more into education and efficacy beliefs over the past couple of decades, and educational research has shown personality as a weak predictor of teacher efficacy (Henson & Chambers, 2003; Robert et al., 2007). Personality has been shown as a contributory predictor for teaching efficacy (Poulou, 2007) when a teacher openly interacts within the social realm of learning to build relationships and to share ideas. Teachers who favor more interactive, social teaching and learning through guided practices tend to have higher teaching efficacy beliefs than teachers who rely on observation (Yeh, 2006). Teachers with extraverted personalities are more interactive with students through instruction and extension activities to build repertoire of student engagement and relationships potentially constituting for higher teaching efficacy beliefs. Personality has been found as a limited factor for increasing teaching efficacy beliefs both in pre-service teachers and cooperating teachers (Roberts et al., 2007), and current educational research has focused more on factors that influence a teacher's personality that later influence student achievement (Aremu, Williams & Adesina, 2011).

Personality can be shaped by social experiences so it is important to examine how personality and training experiences relate together to predict teaching efficacy beliefs. A teacher's personality may factor into the fluctuation of efficacy, especially a pre-service teacher's efficacy beliefs over a course of field experience or internship (Roberts, Harlin & Ricketts, 2006), but research has not shown a significant relationship between personality and experienced middle-school teacher efficacy beliefs. More quantitative research is needed to fill the gap not only for the limitation of cited research regarding personality and training as

predictors of teacher efficacy beliefs, but also for conflicting arguments regarding personality as a predictor of teaching efficacy beliefs at varied grade levels.

Personality type could factor into the level of teacher collaboration, student interaction, and student engagement contributing to higher or lower teaching efficacy and student achievement. Evans (2009) emphasizes the need for teachers to be more in control over factors that contribute to their level of teaching efficacy by making decisions that will affect their teaching and students' achievement. If for example, a science teacher feels the need for professional development for the school or district regarding more hands-on and scaled-down models of science content representations, then voices must be heard so that training opportunities are provided to enhance teacher learning for future application. Teacher training can be designed with personality types integrated into the design of school workshops, district-level training sessions, resource availability, and science partnerships.

Most personality research over the past decade has targeted healthcare professionals and job performance, but more research has developed targeting pre-service teachers' personality and undergraduate training (Zellars, Perrewé & Hochwarter, 2000). Targeting experienced teachers with more than one year of teaching experience is critical because personality can be shaped by outside influences, and over time, an experienced teacher's personality may have adapted to the experiences' demands for teaching and learning, especially under NCLB.

Personality and the Big Five Inventory

The early BFI model was first developed by Ernest Tupes and Raymond Christal in 1961, and it finally reached education in the 1980s bridging into the early 1990s when J. Digman advanced the personality inventory. Research stemming from the early 1990s divided

personality into five broad expressed traits or factors – Agreeableness, Conscientiousness, Extraversion, Neuroticism, and Openness (Olver & Mooradian, 2003, p. 110), and it has accounted for the structural relations among expressed personality traits (Goldberg, 1993) rather than explaining personality (John & Srivastava, 1999) as a complete theory (Block, 1995; Eysenck, 1997; McAdams, 1992; Pervin, 1994). The BFI is a personality model that has integrated varied systems of personality descriptions into a common framework (John & Srivastava, 1999). It continues to examine each person's personality characteristics in entities, and it represents the covariation among traits across individuals (Barrick & Mount, 1991; John & Srivastava, 1999, p. 38). The BFI brought about change in how researchers studied personality in that they combined personality traits into coherent patterns to identify individual types sharing common, basic personality traits with other individuals (John & Srivastava, 1999; McCrae & Costa, 1999).

The BFI's five broad factors have distinct characteristics. The "Agreeableness" factor constitutes a caring, compassionate, kind, gentle, and trusting person who cooperates with others (Chamorro, 2007; Judge & Bono, 2000). People with agreeable type personalities tend to have higher levels of emotional exhaustion but smaller levels of depersonalization (Costa & McCrae, 1999; & Mills & Huebner, 1998).

The "Conscientiousness" factor has been empirically and theoretically connected to a social realm of learning and working as a dependable, hard-working, organized, responsible, and strong-willed person (Bowling, 2010; Chamorro, 2007; Judge, Higgins, Thoresen & Barrick, 1999) relating to achievement, dependability, and job performance (Barrick & Mount, 1991; John & Srivastava, 1999). People who are very conscientious have higher levels of emotional

exhaustion especially when working toward personal accomplishments (Costa & McCrae, 1999; Mills & Huebner, 1998).

The “Extraversion” factor contributes to a sociable person who is typically active, assertive, excitement-seeking, extra-outgoing, optimistic, and positive relating to others and social experiences (Chamorro 2007; Judge & Bono, 2000). A teacher can display an extraverted personality which is based on preference outside one’s self into the social world, or he can display an introverted personality based on individuality without having to become part of a greater social setting. Both personality types make contributions to teaching and learning in distinct ways. Extraverted personalities equip individuals for belonging more to the social realm of teaching and learning through collaborative efforts and relationship building while introverted personalities target individuality. Social exclusions can leave individuals longing for expression in some fashion (DeWall, Deckman, Pond & Bonser, 2011), and well-designed teacher training experiences is one facet of socially including teachers. Teachers can become part of the interactive process of teaching and learning with potential to increase teaching efficacy beliefs with teaching specific content.

Well-designed training experiences including collaboration and feedback invite more active participation to promote deeper understanding for future application. Teaching efficacy beliefs have the potential to be influenced by training experiences including opportunities to ask questions, discuss possibilities, take risks, and connect practices using current, available resources. A teacher’s personality type can coincide with relevant training opportunities to maximize learning and application not only to increase teaching efficacy beliefs, but also to increase students’ efficacy beliefs and achievement.

Many teachers tend to display extraverted personalities by showing openness in building relationships through collaborative, engaging activities (Trapnell & Wiggins, 1990). Research supports extraverted personalities, people who are open to varied ideas and who tend to agree, as the personality type to increase teaching efficacy beliefs (Henson & Chambers, 2003; Poulou, 2007), but research has shown mixed findings in that extraverted personalities relate to dominating leadership (Trapnell & Wiggins, 1990) while Watson and Clark (1997) address that an extraverted personality is a construct of sociable leadership. Extraverted personalities have contributed to a low level of emotional exhaustion and an average level of personal accomplishments (Costa & McCrae, 1999; Mills & Huebner, 1998).

The “Neuroticism” factor aligns with an anxious, depressed, fearful, moody, nervous, and tense person who tends to show poor judgment (Chamorro, 2007; Judge & Bono, 2000). High levels of neuroticism have been linked to lack of self-confidence and self-esteem (McCrae & Costa, 1991) as well as teacher burnout (Costa & McCrae, 1999; Mills & Huebner, 1998). Teachers who are overwhelmed with standardized achievement pressures tend to focus more on the product of testing rather than the process of learning. Time constraints and reading and math pressures hover over the teachers’ daily instructional practices, and the teachers may become tense and “push aside” science teaching and hands-on activities to maximize reading and math instruction and activities.

The “Openness” factor is controversial in that it has been linked to training opportunities where an individual values creativity, curiosity, imagination, perception, personal growth, and thoughtfulness while exerting effort toward learning new skills and applying new ideas (Chamorro, 2007; Judge & Bono, 2000; Lee, Johnson & Dougherty, 2000; McCrae & John,

1992) in the form of divergent thinking (McCrae 1987). Openness has been found to positively relate to performance motivation and less teacher burnout (Cano-Garcia, Carrasco-Ortiz, & Padilla, 2005; Judge & Ilies, 2002). Openness opens up many avenues for training experience so teachers can maximize their learning opportunities for application inside and outside the classroom context.

Pre-Service Training and Teaching Efficacy Beliefs

Pre-service training has also been researched over the past two decades, and more attention has been placed on pre-service training experiences related to pre-service teacher efficacy beliefs. Under NCLB, researchers have considerably researched pre-service training teachers' experiences rather than experienced teachers' pre-service training experiences (Henson & Chambers, 2003; Hudson & McRobbie, 2004; McDonnough, 2010). Research over the past two decades has examined teacher training institutions and programs and pre-service teachers' perceptions of their pre-service training to indicate that teachers have felt well prepared for their teaching profession even under NCLB (Bleicher & Lindgren, 2005; Bursal, 2008; Hoy & Woolfolk, 1990), but several studies have shown that pre-service teachers and even experienced teachers have not felt well equipped for teaching specific content, especially science (Bencze & Upton, 2006; Hodson, 2003; Soodak & Podell, 1997). Pre-service teachers and novice teachers with low anxiety of teaching specific content have shown higher efficacy beliefs (Swars, Daane & Giesen, 2006), but a slim number of studies have addressed that novice teachers' efficacy beliefs significantly decrease over time because of unrealistic perspectives toward teaching, especially with certain subject matter like science (de la Torre Cruz & Casanova Arias, 2007).

Personal teaching efficacy beliefs may be increased due to pre-service teacher training and the teaching program's design, but students' achievement may not be positively influenced (Hechter, 2011; Leonard et al., 2011). Formal training opportunities have been associated with teachers' stronger instructional practices and higher teaching efficacy beliefs, while informal training has had little effect on teaching efficacy beliefs but higher levels of student engagement (Tuchman & Isaacs, 2011). Training experiences must be well-designed and relevant to teachers' context to maximize teacher learning and application (Haverback, 2009). Field experience training and tutoring opportunities have shown great strides for helping pre-service teachers develop the skills they need to teach in a real-world classroom setting (Cone, 2009; Newman, 1999; Rethlefsen & Park, 2011; Tang, 2003; Zeichner, 2002), and at other times, field experience training has related to lower and higher efficacy beliefs (Haverback & Parault, 2008; McDonnough & Matkins, 2010; Yuruk, 2011). Research has been limited in examining content-specific field experience especially in science (Haverback & Parault, 2011) although field experience teaching experiences complement teachers' content knowledge as well as confidence (Tschannen-Moran et al., 1998). Personal teaching efficacy beliefs, instructional practices, student engagement, and student achievement may fluctuate depending on a teacher's personality, pre-service training, or professional development or even with personality and training experiences combined.

Research has shown conflicting arguments that specific components of teacher training does and does not predict or increase teacher efficacy beliefs. Pre-service teachers and experienced teachers' efficacy levels increase despite the demands of the training and even the classroom make-up (Burton & Pac, 2009), but experienced teachers have higher efficacy beliefs

for teaching compared to pre-service teachers or novice teachers due to mastering certain teaching concepts (Tschannen-Moran & Hoy, 2007).

Pre-Service Science Training and Science Teaching Efficacy Beliefs

Several studies over the past decade have shown that many pre-service elementary teachers beginning teacher education preparation in an undergraduate training program are not confident in teaching science (Bencze & Upton, 2006; Buss, 2010; Hodson, 2003), and some teachers who may feel confident in teaching science “use didactic approaches and consequently limit students’ opportunities to develop comprehensive scientific literacy” (Bencze & Upton, 2006, p. 223). The teacher education program has been shown to have no effect or only a medium effect on pre-service teaching efficacy beliefs especially science teaching efficacy beliefs since the implementation of NCLB (Bayraktar, 2011). Before NCLB, pre-service teachers’ teaching efficacy beliefs increased throughout undergraduate teacher training (Hoy & Woolfolk, 1993) based on teachers’ mastery experiences of success in science learning environments and vicarious experiences of observing effective models (Huinke & Madison, 1997; Ramey-Gassert & Shroyer, 1992; Scharmann & Hampton, 1995). Most studies over the past two decades have targeted pre-service teachers’ science training as opposed to experienced teachers’ perception of their undergraduate science teacher training (Hudson & McRobbie, 2004; McDonnough, 2010).

Research must address pre-service teaching institutions and programs, especially course design, to acknowledge teaching efficacy beliefs so that teachers feel more comfortable entering the teaching profession and feel more capable teaching subjects such as science (McDonnough & Matkins, 2010). Program design and curriculum refinement need continual examination for

number of science content and teaching courses taken; depth of teacher knowledge of science; practicum for field experience; and student intern teaching that support teachers' capacity to teach so teachers and students benefit by the teachers' perception and application of their capabilities to teach effectively. Pre-service teachers have shown lower teaching efficacy beliefs in science based on enrollment in only one science teaching course during undergraduate work at a college or university (Yuruk, 2011), even though enrollment in science education methods courses have been found more effective for developing teacher understanding than science content courses (Bleicher, 2001; Watters & Ginns, 2000). Teaching methods courses must have self-efficacy and conceptualized understanding as the top two constructs for pre-service teacher training (Bleicher, 2001).

“Effective science teaching methods courses with focus on developing pre-service teachers' conceptual understanding of core science concepts and teaching skills should be provided to enhance teachers' beliefs about their capabilities to teach science to lower science teaching anxiety” (Yuruk, 2011, p. 25). Attention can be given in designing science teaching courses that can enhance teaching efficacy, especially in elementary teachers who teach science, so the teachers can begin to feel more effective teaching an array of science units and concepts across varied science disciplines (Bleicher, 2007; Bleicher & Lindgren, 2005; Palmer, 2011; Watters & Ginns, 1995; Wingfield, 2000). Instructors can provide valuable feedback not only during course attendance, but also during field experience teaching and student intern teaching (Matkins, 2004). This support is critical for developing a less anxious elementary science teacher and one who is more effective.

Many teachers recall their pre-service teaching experience, and research notes that authentic teaching practice through field experience teaching and student intern teaching has been a major component of true engagement in the process of teaching experience (Ball & Forzani, 1999). It is essential that pre-service teachers be exposed to effective role model teaching because some pre-service teachers rarely observe or cooperate with good teacher role models during field experience training due to cooperating teachers' avoidance or hardship to teach science (Enochs & Riggs, 1990; Hudson & McRobbie, 2004; Skamp, 1995). The teachers who have had positive experiences have had skillful mentor teachers (Enochs & Riggs, 1990; Hudson & McRobbie, 2004) as well as inquiry-based teaching experiences (Swars & Doolery, 2006). Elementary science teachers may have had positive or negative experiences with teaching science in pre-service training, but Yuruk (2011) addresses that personal science teaching efficacy beliefs may be a positive or negative influence in an experienced teacher's current science teaching efficacy because no significant mean difference has occurred with Master's level elementary teachers who had positive and negative pre-service teaching experiences (p. 23). Despite insignificant differences between positive and negative pre-service teaching experiences, pre-service elementary teachers of science must be given opportunities to have positive experiences with effective, cooperating college professors and classroom teachers.

Professional Development Training and Teaching Efficacy Beliefs

District-level professional development training is a third factor that has been researched more over the past decade, especially under the NCLB, but it has mostly been researched as a single factor predicting teaching efficacy beliefs. Usher and Parajes (2008) regard mastery experiences as a contributory factor for efficacy, which may stem from well-designed

professional development opportunities. Individual professional development training opportunities have been shown to influence teaching efficacy beliefs and student achievement (Fancera & Bliss, 2011; Moolenaar et al., 2012). Unfortunately, research has predominantly focused on single professional development opportunities such as a training workshop or program (Bruce & Ross, 2008; Cantrell & Hughes, 2008), most of which have not been directly related to the specific content area of teaching or focused on extended professional development training.

Research has shown that single workshop professional development, teacher collaboration, hands-on exploration, and available resources influence teacher efficacy beliefs, and higher teacher efficacy beliefs influence student achievement (Fancera & Bliss, 2011; Moolenaar et al., 2012; Ross, 1992; Vartuli, 2005). Teachers' professional development varies based on resources, support, and motivation, which should be considered for relating professional development training to higher or lower teaching efficacy beliefs (Day & Gu, 2007). Teachers' perceptions of professional development training throughout a teaching career can be altered based on external factors such as the economy, personal life, and school context (Bruce & Ross, 2008; Usher & Parajes, 2008). In contrast, experienced teachers' efficacy beliefs have been found as stable over the course of teaching, even when receiving ongoing professional development and exposure to new teaching ideas (Palmer, 2011, p. 592; Tschannen, 1998, p. 236). Professional development programs may not be effective in altering science teachers' thought processes, instructional practices, or views toward science (Lee, 2004), but an integration of professional development, in-school experiences, and outside experiences has the potential to positively influence elementary teachers' teaching efficacy beliefs (Palmer, 2011).

Examining professional development in a specific discipline throughout a teacher's career has the potential to show how elementary teachers and middle-school teachers perceive their training as a predictor of content-based teaching efficacy beliefs. Teachers may perceive ongoing professional development in a manner of building concepts over time or in consecutive sessions rather than focusing on the effectiveness of one single training opportunity (Shechtman, Levy & Leichtentritt, 2005).

Professional development is an important aspect of the teaching profession that comes in an array of formats such as collaborative meetings, small-group and whole-group workshops, online sessions, etc. Exploring teachers' perceptions of ongoing professional development, even in different formatting, can result in the implementation of new programs, training opportunities, and instructional methods (Overbaugh & Rulling, 2008). It is important to target professional development so student achievement has the ability to reap the benefits of higher teacher efficacy beliefs stemming from refined training opportunities.

Professional Development Training and Science Teaching Efficacy Beliefs

Elementary teachers who teach science participate in district-level science professional development on different levels and in different amounts, and there is a need for science professional development where teachers learn more about subject-matter, how to teach science content, and how to relate science to teacher pedagogy (Dash, DeKramer, O'Dwyer, Masters & Russell, 2012; Marx & Harris, 2006; Shidler, 2009). NCLB primarily targets reading and math instruction professional development, but gains will need to be made to integrate more science into reading and math curriculum. Some elementary teachers still feel the need to be able to learn and apply science learning bridging across school years.

District-level professional development can be designed in various formats, and the National Science Foundation (NSF) provides ongoing support for science inquiry by training elementary and middle-school teachers in inquiry science programs that include science units designed in kits (Marx & Harris, 2006). Many school districts around the United States receive these inquiry-based kits, but how much are the kits being used; how much time is allotted for teaching with the science kits; how do teachers perceive the kit's use; and how much science content is covered in a teaching year when using the science kit? Many teachers are instructed on how to use these science units or kits, especially at the onset of teaching the kits for the first time, and many kits are accompanied with scripted books for teaching certain units. Follow-up procedures are needed to investigate how the resources are being used, if the resources are being used, and how effective the resources are extending beyond standardized testing measures and scripted teaching. Forbes (2011) addresses that school districts, and even educational companies, must investigate more on the use of various curriculum resources that are being used in everyday classrooms if at all (p. 930).

Elementary science teachers need involvement in an array of professional development formats to develop a more solid understanding of science concepts, identify how science relates to many areas of life, and learn and use new, innovative instructional practices for teaching science content and for motivating students' inquiry (Palmer, 2011; Shidler, 2009; Vartuli, 2005). High-school science teacher partnerships are effective, and partnerships should be promoted to help elementary science teachers relate science beyond the elementary years to produce scientifically literate people (Tushie, 2009).

Professional development opportunities can be formatted as workshops and seminars, collaborative teacher study groups, action research teams, collaborative mentorship, coaching projects, guest speaker invites, and scientist partnerships, but it is necessary for teachers to participate in science training for an extended period of time not just as single opportunities (Palmer, 2011). Shidler (2009) found that training or “coaching” teachers for three years helped elementary teachers stay more focused and produced higher student reading achievement, but fewer than three years related to a less-focused teacher whose teaching efficacy beliefs were still developing. Levine (2006) and Dash et.al (2012) emphasize the importance of current, ongoing professional development training leading to greater pedagogical content knowledge and practice, which can impact student achievement.

Research using the STEBI or STEBI-B has primarily examined factors that teachers believe have influenced their science teaching efficacy beliefs (Cantrell, Moore, & Young, 2003), yet decreased their science teaching efficacy beliefs (Ginns & Watters, 1999). Until the STEBI’s development, “teacher efficacy was primarily researched on general beliefs rather than specific subject area” (Enochs & Riggs, 1990, p. 627), but now teaching efficacy can be assessed as a domain to be more explanatory than general teaching efficacy (Pajares, 1997). In pre-service training, the STEBI-B has shown that pre-service teachers have had higher science teaching confidence when teaching in small group settings; being assisted with a cooperating teacher; and teaching across the disciplines (Wingfield et al., 2000), but how many pre-service training teachers have had opportunities to work with a cooperating science teacher, especially an effective science teacher, to observe, or to teach in any science classroom where science is taught well? Pre-service teachers who had taken four or more science courses had shown

significantly higher Personal Science Teaching Efficacy (PSTE) than teachers who took fewer than four courses (Bleicher, 2004), and the higher PSTE was more significant in males. In regards to experienced science teachers, teachers with higher perceptions of PSTE spent more time preparing lessons and teaching science in depth (Riggs & Jesunathadas, 1993), while teachers with lower Science Teaching Outcome Expectancy (STOE) beliefs relied more on textbook-based lessons and less cooperative, hands-on learning experiences (Riggs, 1995).

Summary

This literature review has synthesized the current but limited research primarily over the past two decades and closely over the past decade under NCLB. Research has indicated that teachers' higher efficacy beliefs positively influence teaching practices and student achievement, yet varied, combined factors predicting higher teaching efficacy beliefs have not been examined closely. Current research still has conflicting views of personality predicting teaching efficacy beliefs, especially higher teaching efficacy beliefs. Pre-service training has been found to predict teaching efficacy beliefs, but some studies have deemed otherwise dependent upon the make-up of the pre-service training, such as course design. Professional development training has been found to predict teaching efficacy beliefs, but research has predominantly focused on the use of single training sessions to impact student achievement.

This chapter has identified the gap in the literature of personality and training experiences not being readily found as significant predictors of elementary science teacher efficacy under NCLB. The gap extends across experienced elementary teachers and their perceptions of teaching efficacy relating to specific content. This literature review has helped to identify the importance for today's teachers and their perceptions due to NCLB's focus on student

achievement. The NCLB policy continues to fund and support programs and training opportunities, but how effective are the training experiences for elementary science teachers who have been teaching for an extended period of time? This study has the potential to help fill the gap of examining personality and training opportunities as predictive factors of teaching efficacy beliefs, especially science teaching efficacy beliefs. The methodology of the current research study will be organized and explained in the next chapter.

CHAPTER THREE: METHODOLOGY

Some research has suggested that two isolated factors - personality and training experiences - predict teachers' teaching efficacy beliefs, while other research has suggested no significant prediction of teaching efficacy beliefs. Fine-tuning this research study's methodology is critical for making advancements toward current literature regarding possible predictors of science teaching efficacy beliefs with three predictor variables – personality, pre-service training, and professional development training (Cantrell & Hughes, 2008; Overbaugh & Ruiling, 2008; Usher & Pajares, 2008).

This chapter focuses on a correlational designed study to obtain 114 Alabama and Tennessee K-4 teachers' perceptions of their personality, science pre-service training design, and science school-district professional development training application spanning a teaching career related to science teaching efficacy beliefs. Results were analyzed using a hierarchical linear regression analysis to target the combination of possible significant, predictor variables of science teaching efficacy beliefs. This chapter is organized by an introduction, design, research questions and hypotheses, participants, setting, instruments, procedures, data analysis, and a summary.

Participants

This quantitative research was conducted with a convenient, accessible sample of highly qualified K-4 teachers of science across 13 Alabama public school districts and 10 Tennessee public school districts. A convenient sample “includes the sample whoever happens to be available at the time” (Gay & Airasian, 2003, p. 115). A convenient, accessible sample was the appropriate sample design because the participating teachers came from school districts granting

research approval in Alabama and Tennessee. Also, there were three pre-set criteria for teacher participation; however, there was no control over which K-4 teachers would participate in the research.

The Demographic Survey's requirement for participation targeted teachers who were certified to teach K-3 and/or K-4. It was important to include K-3 and K-4 certified teachers because early childhood teachers could have been excluded because their certification was K-3 and not K-4. The methodology has referred to K-4 consistently to include K-3 and K-4 teachers. Teachers also needed at least one year of teaching experience, and they had to receive undergraduate training in a K-3 or K-4 teaching program. K-4 teachers were required to have at least one year teaching to be considered and "experienced teacher". The one-year marker allowed teachers to base their teaching experiences on their first-year of teaching as well as their pre-service teaching experiences. It was important that the K-4 teachers teach either in self-contained classrooms, where students stay in one classroom all day with the same teacher, or in departmentalized classrooms, where students transition to multiple classrooms to be taught by multiple teachers. Teachers with the same general science pre-service training helped lay the foundation for research because the teachers tended to have the same history of pre-service training with science embedded as a core teaching subject.

The general teaching population was comprised of all public Alabama and Tennessee K-4 teachers. School-district research approval was granted by email discourse with cooperating superintendents signing and dating district-level documented approval letters. The district-level approval resulted in a convenient sample of K-4 teachers represented across 13 Alabama public

school districts with approximately 1,100 available K-4 teachers and 10 Tennessee public school districts with approximately 1,500 teachers.

IRB approval granted research in the 23 school districts. The 2,600 K-4 teachers were emailed a letter stating the purpose of the research, opportunity to participate in the research, opportunity to withdraw at any time, benefits of the research, survey link, survey instructions, and a chance to enter a drawing for one of five Wal-Mart store gift-cards (Appendix E). The emailed letter was sent twice to increase the sampling size of participating teachers. Survey data was combined from the first and second data sets totaling 206 participants. The first and second data sets were used for the validation of the Science Training Survey. Later, 114 teachers' data was used in the correlational study. All teachers' data was collected using a laptop computer with a computer-locked, case-sensitive password as well as a surveymonkey.com case-sensitive password. The teaching sample consisted of 114 teachers out of 2,600 accessible K-3 and K-4 teachers combined resulting in a 4.5% volunteer rate.

The participants' demographic data was initially considered for the analyses to help guide this correlational study. The Demographic Survey included 15 items such as gender, ethnicity, years of teaching experience, teaching grade level, classroom setting (self-contained or departmentalized), content predominantly taught, school setting (public county or city school), undergraduate institution (two or four-year college), pre-service observations, pre-service field teaching, pre-service tutoring, pre-service internship, pre-service cooperating mentor science teacher, years of K-3 or K-4 teaching experience, certification (undergraduate teaching degree, alternative certification, Praxis, National Board Certification), number of ongoing science professional development training hours, and educational level.

Three demographic variables were used as control variables. Gender was the first demographic variable controlled theoretically and empirically. Gender has been shown as a contributing factor of teaching efficacy beliefs (Bleicher, 2004; Moseley & Taylor, 2011; Rubie-Davies et al., 2012) as well as an insignificant factor (Nneji, 2013), and research has primarily supported pre-service teachers. Bandura (1986) regards self-efficacy beliefs as domain constructs that may favor a certain gender. Many males are attracted to math and the sciences creating gender stereotyping not only for math and science capabilities, but also for students' learning. In addition, a bivariate correlation analysis conducted in this study supported the significant relationship between gender and science efficacy beliefs at .87 ($p < .05$); thus, providing support to control for gender.

Bandura (1997) suggests that teaching efficacy beliefs are not constant and can change with years of experience. Therefore, years of experience was the second demographic variable controlled in this study. Research has shown confounding relationships with years of experience and teaching efficacy beliefs (Cheung, 2008; Guo et al., 2010; Wolters & Daughtery, 2007), but in this study years of experience was controlled so there could be an explanation of any association with personality, training, and teaching efficacy beliefs.

Class setting was the third controlled, demographic variable. Class setting is classified as a self-contained setting where a teacher teaches all subject-matter, or a departmentalized setting where a teacher teaches specific subject matter to different sets of students. For example, a teacher may teach science to two different sets of students each day, or the teacher may teach science with varied grade-levels each day. A teacher who teaches in a departmentalized setting

may have more time to devote to the teaching and understanding of science as opposed to a self-contained teacher who prepares for varied content. The bivariate correlation analysis in this study supported that classroom setting (departmentalized vs. self-contained) significantly related to science teaching efficacy beliefs at $p < .05$. Therefore, classroom setting was controlled in this study to prevent an adverse association with science teaching efficacy beliefs. Table 3.1 reports the bivariate correlation coefficients of the predictor variables and criterion variable, and it supports the selection of the three controlled, demographic variables (gender, years of experience, and classroom setting).

Table 3.1

Correlation Coefficients of the Predictor and Criterion Variables

	1	2	3	4	5	6	7
1. Efficacy Beliefs	-						
2. Gender	.87*	-					
3. Yrs. Experience	-.01	.10	-				
4. Class Setting	.20*	-.18*	-.05	-			
5. Personality	.20*	.10	.04	-.05	-		
6. Pre Train	.18	-.05	-.24**	-.11	-.10	-	
7. PD Train	.24*	.17	.31**	.03	.18	.22*	-

Descriptive Participant Data

The following data depicts teachers' responses to the Demographic Survey. The teaching sample consisted of 114 participants, and the number of participants was supported in that 114

participants was greater than $50 + 8$ times the number of variables ($114 > 50 + 8(7) = 106$) (Green, 1991). Participants included 111 females (97.4%) and 3 males (2.6%). Regarding race/ethnicity, 102 were White/Caucasian (89.5%); 9 were Black/African American (7.9%); 2 were American Indian (1.8%); and 1 was Hispanic (.9%). Teachers had 1-41 years of professional teaching experience ($M = 14.69$, $SD = 9.71$). Most teachers taught the third-grade (25.4%, $n = 29$) and fourth-grade (27.2%, $n = 31$) grades. The least number of teachers (18.4%, $n = 21$) taught the second-grade.

Regarding teaching setting, 90 teachers (78.9%) taught in self-contained settings (all subject areas) and 24 teachers (21.1%) taught in departmentalized settings. There were 91 teachers (79.8%) who predominantly taught all general subject matter (Reading, English, Math, and Science). There were 84 teachers (73.7%) who held highly qualified teaching status to teach K-4; 25 teachers (21.9%) were qualified to teach K-3; and 5 teachers (4.4%) were not qualified to teach K-3 or K-4. There were 77 teachers (67.5%) who taught in public county school districts while 37 teachers (32.5%) taught in public city school districts.

In terms of undergraduate educational training, 67 teachers (58.8%) received training from four-year public colleges or universities (basic work and teaching program); 25 teachers (21.9%) received training from four-year private colleges or universities (basic work and teaching program); 21 teachers (18.4%) transferred into a two-year public college or university (teaching program); and only 1 teacher (0.9%) transferred into a two-year private college or university (teaching program). Undergraduate pre-service teacher training primarily consisted of 92 teachers (80.7%) with field experience teaching followed by 84 teachers (73.7%) with observation experience and 75 teachers (65.8%) with internship training.

In pre-service internship teaching, 83 teachers (72.8%) taught science with cooperating mentor teachers, whereas 31 teachers (27.2%) did not. Teachers' pre-service program design consisted of 27 teachers (23.7%) who tutored, 68 teachers (59.6%) who created individual/group presentations, 75 teachers (65.8%) who completed internship, 84 teachers (73.7%) who completed field observations, and 92 teachers (80.7%) who had field teaching opportunities.

Teachers taught elementary science at the K-3 or K-4 level 0-41 years ($M = 12.42$, $SD = 9.50$). There were 100 teachers (87.7%) who obtained teacher certification to teach elementary science from undergraduate elementary training programs; whereas 7 teachers (6.1%) obtained their credentials through alternative/add-on certifications and 7 teachers (6.1%) by the Praxis test.

Regarding the completion of school district science professional development training hours teachers participated in throughout their teaching careers, 39 teachers (34.2%) completed 0-10 hours and 27 teachers (23.7%) completed 90 hours and above. See Table 3.4 for number of training hours. Concerning educational attainment, 59 teachers (51.8%) completed graduate school; 25 teachers (21.9%) had completed some graduate coursework; 22 teachers (19.3%) were four-year college graduates; and 8 teachers (7%) had taken some post-graduate school courses.

The first Science Training Survey's question was an open-ended question that asked, "In your opinion, what is science?" There were varied responses, but most teachers regarded science as the study of living things around you as categorized into Life sciences. Several teachers acknowledged science as exploration and discovery, especially with hands-on learning with science-based kits for teaching and learning. Only a few teachers believed science was the study of Earth and space for the Spatial and Earth sciences. The different science disciplines have

potential to be integrated into a future survey or interview regarding collaboration, hands-on learning, resources, and funding for the science disciplines.

Setting

The setting included 13 Alabama public schools and 10 Tennessee public school districts totaling 23 public school districts. The 13 Alabama public school districts included eight county districts and five city districts, and the 10 Tennessee public school districts included seven county districts and three city districts were targeted. The 23 public school districts were targeted as accessible districts based on receiving research approval from 13 Alabama superintendents and 10 Tennessee superintendents.

Alabama Public County School Districts

Eight Alabama public county school districts were included in this correlation study. The eight targeted districts were divided into four northern-based Alabama districts, three southern-based Alabama districts, and one centrally-located Alabama district. Each district's K-4 teachers were accessible via email ranging from 30-200 accessible K-4 district teachers. Each district's general make-up is described below and is based on student population as extremely small (< 2,000 students), very small (2,000-3,999 students), small (4,000-5,999 students), medium-sized (6,000-9,999 students), large (10,000-14,999 students), very large (15,000-19,999 students), or extremely large (20,000 + students). Alabama county school districts were represented as Alabama County School District Number (ACOSD 1-8).

ACOSD 1 is a medium-sized county school district in northern Alabama represented with approximately 112 K-4 teachers in 7 of 15 schools. ACOSD 1 houses approximately 8,498

students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 53% free and reduced lunch students (<http://febp.newamerica.net/k12/AL/100420>, 2012).

ACOSD 2 is an extremely small county school district in southern Alabama represented with approximately 30 K-4 teachers in 1 of 3 schools. ACOSD 2 houses approximately 1,579 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 90% free and reduced lunch students (<http://febp.newamerica.net/k12/AL/100480>, 2012).

ACOSD 3 is a small county school district in central Alabama represented with approximately 60 K-4 teachers in 6 of 10 schools. ACOSD 3 houses approximately 4,070 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 67% free and reduced lunch students (<http://febp.newamerica.net/k12/AL/100600>, 2012).

ACOSD 4 is a very small county school district in northern Alabama represented with approximately 64 K-4 teachers in 5 of 8 schools. ACOSD 4 houses approximately 2,895 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 64% free and reduced lunch students (<http://febp.newamerica.net/k12/AL/100840>, 2012).

ACOSD 5 is a very large county school district in northern Alabama represented with approximately 300 K-4 teachers in 17 of 26 schools. ACOSD 5 houses approximately 19,897 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 32% free and reduced lunch students (<http://febp.newamerica.net/k12/AL/102220>, 2012).

ACOSD 6 is a very small county school district in northern Alabama represented with approximately 50 K-4 teachers in 5 of 11 schools. ACOSD 7 houses approximately 3,650 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 76% free and reduced lunch students (<http://febp.newamerica.net/k12/AL/102310>, 2012).

ACOSD 7 is a very small county school district in southern Alabama represented with approximately 50 K-4 teachers in 3 of 5 schools. ACOSD 7 houses approximately 2,260 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 76% free and reduced lunch students (<http://febp.newamerica.net/k12/AL/102790>, 2012).

ACOSD 8 is a very small county school district in southern Alabama represented with approximately 32 K-4 teachers in 2 of 7 schools. ACOSD 8 houses approximately 3,418 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 60% free and reduced lunch students (<http://febp.newamerica.net/k12/AL/103480>, 2012).

Alabama Public City School Districts

Five Alabama public city school districts were included in this correlation study. The five targeted districts were divided into two northern-based Alabama districts and three southern-based Alabama districts. The districts' K-4 teachers were accessible via email ranging from 18-160 available K-4 district teachers. Each district's general make-up is described below and based on size of student population as extremely small (< 2,000 students), very small (2,000-3,999 students), small (4,000-5,999 students), medium-sized (6,000-9,999 students), large (10,000-14,999 students), very large (15,000-19,999 students), or extremely large (20,000 + students).

ACSD 1 is a medium-sized city school district in northern Alabama represented with approximately 191 K-4 teachers in 7 of 12 schools. ACSD 1 houses approximately 8,821 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 53% free and reduced lunch students (<http://febp.newamerica.net/k12/AL/101170>, 2012).

ACSD 2 is a medium-sized city school district in southern Alabama represented with approximately 143 K-4 teachers in 9 of 13 schools. ACSD 2 houses approximately 9,098

students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 61% free and reduced lunch students (<http://febp.newamerica.net/k12/AL/101230>, 2012).

ACSD 3 is a very small city school district in southern Alabama represented with approximately 18 K-4 teachers in 2 of 4 schools. ACSD 3 houses approximately 2,867 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 63% free and reduced lunch students (<http://febp.newamerica.net/k12/AL/101410>, 2012).

ACSD 4 is an extremely small city school district in northern Alabama represented with approximately 36 K-4 teachers in 1 of 3 schools. ACSD 4 houses approximately 1,639 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 54% free and reduced lunch students (<http://febp.newamerica.net/k12/AL/101720>, 2012).

ACSD 5 is an extremely small city school district in southern Alabama represented with approximately 24 K-4 teachers in 1 of 2 schools. ACSD 5 houses approximately 1,000 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 48% free and reduced lunch students (<http://febp.newamerica.net/k12/AL/101720>, 2012).

Tennessee Public County School Districts

Seven Tennessee public county school districts were included in this correlation study. The seven targeted county districts included two northern-based Tennessee districts, two southern-based Tennessee districts, and three centrally-located Tennessee districts. The districts' K-4 teachers were accessible via email ranging from 22-595 available K-4 district teachers. Each district's general make-up is described below and based on size of student population as extremely small (< 2,000 students), very small (2,000-3,999 students), small (4,000-5,999 students), medium-sized (6,000-9,999 students), large (10,000-14,999 students), very large

(15,000-19,999 students), or extremely large (20,000 + students). Tennessee county school districts are represented as Tennessee County School District Number (TCOSD 1-7).

TCOSD 1 is a medium-sized county school district in central Tennessee represented with approximately 180 K-4 teachers in 7 of 13 schools. TCOSD 1 houses approximately 7,951 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 59% free and reduced lunch students (<http://febp.newamerica.net/k12/TN/4700180>, 2012).

TCOSD 2 is an extremely small county school district in central Tennessee represented with approximately 22 K-4 teachers in 3 of 5 schools. TCOSD 2 houses approximately 1,868 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 66% free and reduced lunch students (<http://febp.newamerica.net/k12/TN/4700850>, 2012).

TCOSD 3 is a medium-sized county school district in northern Tennessee represented with approximately 140 K-4 teachers in 11 of 16 schools. TCOSD 3 houses approximately 7,537 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 62% free and reduced lunch students (<http://febp.newamerica.net/k12/TN/4701470>, 2012).

TCOSD 4 is a medium-sized county school district in northern Tennessee represented with approximately 174 K-4 teachers in 11 of 17 schools. TCOSD 4 houses approximately 9,966 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 59% free and reduced lunch students (<http://febp.newamerica.net/k12/TN/4700001>, 2012).

TCOSD 5 is a large county school district in northern Tennessee represented with approximately 220 K-4 teachers in 10 of 17 schools. TCOSD 5 houses approximately 11,713 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 51% free and reduced lunch students (<http://febp.newamerica.net/k12/TN/4702760>, 2012).

TCOSD 6 is an extremely small county school district in southern Tennessee represented with approximately 24 K-4 teachers in 1 of 2 schools. TCOSD 6 houses approximately 977 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 49% free and reduced lunch students (<http://febp.newamerica.net/k12/TN/4703060>, 2012).

TCOSD 7 is an extremely large county school district in central Tennessee represented with approximately 545 K-4 teachers in 24 of 42 schools. TCOSD 7 houses approximately 31,616 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 11% free and reduced lunch students (<http://febp.newamerica.net/k12/TN/4704530>, 2012).

Tennessee Public City School Districts

Three Tennessee public city school districts were included in this correlation study. The three targeted city districts included one northern-based district, one centrally-located district, and one southern-based district. The districts' K-4 teachers were accessible via email ranging from 25-150 available K-4 district teachers. Each district's general make-up is described below and based on size of student population as extremely small (< 2,000 students), very small (2,000-3,999 students), small (4,000-5,999 students), medium-sized (6,000-9,999 students), large (10,000-14,999 students), very large (15,000-19,999 students), or extremely large (20,000 + students). Tennessee city school districts are represented as Tennessee City School District Number (TCSD 1-3).

TCSD 1 is a very small city school district in central Tennessee represented with approximately 25 K-4 teachers in 1 of 3 schools. TCSD 1 houses approximately 2,270 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 59% free and reduced lunch students (<http://febp.newamerica.net/k12/TN/4702400>, 2012).

TCSD 2 is an extremely small city school district in northern Tennessee represented with approximately 30 K-4 teachers in 1 of 3 schools. TCSD 2 houses approximately 1,267 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 63% free and reduced lunch students (<http://febp.newamerica.net/k12/TN/4703300>, 2012).

TCSD 3 is a very small city school district in southern Tennessee represented with approximately 140 K-4 teachers in 4 of 7 schools. TCSD 3 houses approximately 3,347 students (<http://nces.ed.gov/ccd/districtsearch>, 2011-2012) with approximately 45% free and reduced lunch students (<http://febp.newamerica.net/k12/TN/4704200>, 2012).

Teachers from each school district were able to access the online survey at www.surveymonkey.com by clicking on a link in the emailed letter. Teachers were required to access the emailed survey link through school-district email addresses. Teachers could access the survey conveniently from home, school, or any location with Internet access.

Instrumentation

Four instruments - the Demographic Survey, Big Five Inventory (BFI), Science Training Survey, and Science Teaching Efficacy Belief Instrument (STEBI) were compiled into one survey and administered online through www.surveymonkey.com. The surveys were compiled into one document so each teacher clicked on the “Next” icon to proceed in order – Demographic Survey, BFI, Science Training Survey, and STEBI. An in-hand version of the survey was available upon superintendent or participant request. The online demographic survey was made available to approximately 2,600 K-4 teachers across 23 public school districts (See Appendix F). The demographic survey’s 15 questions consisted of teacher gender, teacher ethnicity, number of professional teaching experience years, current grade-level, teaching setting (self-

contained or departmentalized), teaching content, highly-qualified status, school location (city or county), undergraduate training (2 year private or public college; 4 year private or public college), pre-service training design (presentations, observation, field experience teaching, tutoring, internship teaching), cooperating mentor science teacher, number of years teaching science, number of participating professional development hours, and level of education.

The second instrument administered online was the abbreviated form of the Big Five Inventory (BFI) used to measure expressed personality traits (See Appendix G). According to Digman (1996), the BFI is a 44-item structural, hierarchical personality model including five main personality factors that have stemmed from various factor-analysis studies - Agreeableness, Conscientiousness, Extraversion, Neuroticism, and Openness (John & McCrae, 1999), and has been found as the most-widely used and extensively researched personality model (John & McCrae, 1999). The BFI provides a model of personality structure that examines each person's expressed personality traits as an entity representing the covariation among traits across individuals and are assumed to stay stagnant (Barrick & Mount, 1991; John & Srivastava, 1999, p. 38). "Agreeableness" was measured on items 2, 7, 12, 17, 22, 27, 32, 37, and 42.

"Conscientiousness" was measured on items 3, 8, 13, 18, 23, 28, 33, 38, and 43. "Extraversion" included items 1, 6, 11, 16, 21, 26, 31, and 36. "Neuroticism" was measured on items 4, 9, 14, 19, 24, 29, 34, and 39. "Openness" included items 5, 10, 15, 20, 25, 30, 35, 40, 41, and 44.

The BFI required approximately 10 minutes for teachers' rating of their personality based on 44 short phrases on a five-point scale of (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). An overall maximum raw score was 220, and a minimum score was 44. "Agreeableness" and "Conscientiousness" included a max raw score of 45 and a

minimum of 9. “Extraversion” and “Neuroticism” included a max raw score of 40 and a minimum of 8. “Openness” included a max raw score of 50 and a minimum of 10. The teachers rated their perceptions with phrases such as “is curious about many different things” and “makes plans and follows through with them” (John, Donahue & Kentle, 1991; John, Naumann & Soto, 2008). Each phrase was categorized by personality factor or scale. Each BFI factor was coded using reversed itemizing and scaled scoring (See Appendix I) (John, Donahue & Kentle, 1991; John, Naumann & Soto, 2008). “A composite score correlation using standardized scores and actual mean r_{xx} ” for each predictor variable – personality, pre-service training, and professional development training – was computed to relate each factor’s score to the overall personality scale score (Warr, Bartram & Brown, 2005).

The abbreviated form of the BFI was used for short completion time as well as strong validity stemming from extensive research with the longer form (Bernard, Walsh & Mills, 2005; Thalmayer, Saucier & Eigenhuis, 2011, p. 1006). The predictive validity and criterion validity of the abbreviated BFI has held well over the long-form (Thalmayer et al., 2011, p. 1006). Statistics using the BFI and its five factors have been found valid and reliable (Worrell & Cross, 2004), especially exploratory factor analyses, which have consistently shown stability and predictive validity (Marsh et al., 2010). Convergent and discriminant validity, test-retest reliability, and internal consistency of all BFI factors have been verified (Benet-Martinez & John, 1998; Gosling & Rentfrow, & Swann, 2003; Rammstedt & John, 2007; Soto et al., 2008), and the researcher investigated reliability using Cronbach’s alpha reported for Agreeableness as .76, Conscientiousness as .70, Extraversion as .82, Neuroticism as .81, and Openness as .71. The BFI’s instrument reliability was .68, which is considered to on the borderline of acceptable and

questionable. The lower instrument reliability coefficient may be based on fewer survey items on the shorter-personality scale compared to the longer-form, but the sub-scaling reliability has shown continuous reliability and validity (Benet-Martinez & John, 1998; Gosling, et. al, 2003; Rammstedt & John, 2007; Soto et.al, 2008).

The third instrument administered online was the Science Training Survey developed by the researcher to measure elementary teachers' science pre-service training and ongoing, science professional development training. The survey's intent was for K-4 teachers to share their perception of their vicarious and mastery experiences of science pre-service training, which may have included field experience (observation, tutoring, and practice teaching lessons) and student teaching (internship). The survey's questions were related to the researcher's experiences as an elementary science teacher and based on teachers' vicarious and mastery experiences stemming from observation, cooperation, and actual teaching experience (Bandura 1982, 1997). Positive vicarious and mastery experiences, especially with rewarding teaching opportunities, have been found to positively influence teaching efficacy beliefs (Tschannen, 2007); therefore, the survey's items transcended from observant training to hands-on training questioning.

The initial development of the Science Training survey included 29 items. Teachers rated their science pre-service teacher training and science school-district professional development training for 20 items on a six-point Likert scale of (1 = Strongly Disagree, 2 = Disagree, 3 = Moderately Disagree More than Agree, 4 = Moderately Agree More Than Disagree, 5 = Agree, and 6 = Strongly Agree). The maximum raw score for pre-service training was 48 and 72 for professional development training. The minimum score for both sub-scales was 0 regarding N/A responses as 0 points. Research supports the Likert scale rating as a

validated instrument, and 6-9 points is support with a more normal distribution compared to a five-point Likert scale survey (Leung, 2011). Three survey items were open-ended responses for teachers to elaborate on science and additional training comments. Item 1 (*In your opinion, what is science*), Item 15 (*Please provide additional insight related to science pre-service training, especially your science pre-service training*), and Item 29 (*Please provide any additional insight related to your science school-district training throughout your teaching career*) were open-ended questions for teachers to provide their own perception in writing.

Researcher-developed questions were written for clarity with operational definitions for teacher understanding that help “to increase validity by ensuring accurate responding” (Hartley & Maclean, 2006, p. 823), and to support Bandura’s (1986, 1997) theory of effective models, valuable engagement, and necessary resources to create vicarious and mastery experiences for shaping an individual’s efficacy beliefs. Teachers were instructed to rate their perception of their undergraduate science teacher training and ongoing school district level science professional development training. Content and face validity were established by an outside statistician who was required to have a doctoral degree in mathematics/statistics. Written feedback and dialogue helped to ensure content validity for each survey item’s readability, suitability and applicability for appropriately assessing teacher training and science teaching efficacy (Tabachnick & Fidell, 2007). Feedback resulted in the removal of three items resulting in 23 items.

In addition, Principal Components Analysis (PCA) was used to further examine the construct validity. Factor Extraction and Direct Oblimin Rotation were conducted resulting in three additional items being deleted from the survey due to factors loading under .30 (Tabachnick & Fidell, 2007). Therefore, the survey resulted in 23 validated items to be used for

analysis on three components. Pre-Service Training was loaded on Component 2 “Instructional Learning”, and Professional Development Training loaded on Component 1 “Relative Integration” and Component 3 (Collaborative Experience). Pre-service training items 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, and 15 were scored on a range of 0-66, and the professional development training included items 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, and 29 scored on a range of 0-72. Reliability was investigated using Cronbach’s alpha. Cronbach’s alpha for the pre-service training “Instructional Learning” sub-scale was .89. Cronbach’s alpha for the professional development “Relative Integration” and “Collaborative Experience” sub-scales was .91 and .80 respectively.

The fourth instrument used in this study was the Science Teaching Efficacy Belief Instrument (STEBI) used to measure elementary teachers’ science teaching efficacy beliefs (Appendix K). The STEBI is an adapted version of the Science Teaching Efficacy Scale of the long form of the Gibson and Dembo’s 1984 Teacher Efficacy Scale (TES). The STEBI stems from research on the TES based upon Bandura’s SCT in the 1980s when researching and measuring teacher efficacy ignited as an interest for researchers (Tschannen-Moran & Hoy, 2001), The TES “is a 22 item scale in a 6 point Likert Scale format with two subscales” – Personal Teaching Efficacy (PTE) and General Teaching Efficacy (GTE) (Lamorey, 2005, p. 72). The TES has been the most widely used standardized efficacy instrument in the field of education and psychology since the 1980s (Ross, 1992). Unlike the TES, the STEBI-B includes two different subscales – Personal Science Teaching Efficacy (PSTE) and Science Teaching Outcome Efficacy (STOE). Integrity of validity with the PSTE and STOE subscales of the STEBI upholds valid findings as the instrument is directly related to the TES with focus

specifically for science teaching efficacy beliefs (Bleicher & Lindgren, 2005; McDonnough, 2010), and factor analyses over the past two decades have “consistently shown validity with the two subscales of the STEBI” (Bleicher, 2001; McDonnough, 2010, p. 16). PSTE and STOE supports Bandura’s SCT in that self-efficacy expectations are beliefs that an action can be performed successfully, and that the outcome is performed successfully (Bandura, 1997).

Enochs and Riggs (1990) developed the STEBI-B, which has been thoroughly researched over the past two decades, as a construct to explore Bandura’s SCT (Lumpe, Haney, & Czerniak, 1998). It is sometimes referred to as Form B with the additional B representing pre-service teacher status. In this study, the STEBI was used to assess the PSTE and STOE of experienced elementary teachers of science who have taught for at least one year. The STEBI included 25 items on a five-point Likert Scale rating (1 = Strongly Agree, 2 = Agree, 3 = Undecided, 4 = Disagree, 5 = Strongly Disagree) (McDonnough, 2010; Riggs & Knoch, 1990) stemming from Gibson and Dembo’s TES (Woolfolk & Hoy, 1990). The STEBI used reversed raw scoring ranging from 25-125 on the overall scale. The sub-scaled raw scoring ranged from 14-70 for Personal Science Teaching Efficacy and 11-55 for Science Teaching Outcome Efficacy. (See Appendix L).

The STEBI was administered online and took approximately 10 minutes to complete. The STEBI-B consists of 23 items, and the STEBI consists of 25 items divided into personal science teaching efficacy and science teaching outcome expectancy sub-scales. Based on the STEBI used in this study, Item 20 (*Effectiveness in science teaching has little influence on the achievement of students with low motivation*) and Item 25 (*Even teachers with good science*

teaching abilities cannot help some kids learn science) were two items added, but not part of the STEBI-B.

Convergent and discriminant validity are two critical aspects of the TES (Gibson & Dembo, 1984) and have transpired into the STEBI. Convergent, discriminant score validity and reliability have been determined by using Pearson total correlations between the standard scores of science teaching efficacy with the sub-scale scores of PSTE and STOE (Bleicher, 2001; Bleicher, 2004; Erford, Duncan & Savin-Murphy, 2010). The divergent (discriminant) sub-scaled questions, especially personal science efficacy beliefs, are not related to teacher efficacy beliefs, and convergent sub-scaled questions are related to teacher efficacy beliefs (Gall et al., 2007). Cronbach's alpha was used to check for internal reliability of the two subscales (Erford et al., 2010). Cronbach's alpha was .88 for the Personal Science Teaching Efficacy sub-scale and .68 for the Science Teaching Outcome Efficacy sub-scale. Cronbach's alpha for the total scale was .80.

Table 3.2 is a summary of the predictor variables and the measurement methods that are reported on a Likert-scale.

Table 3.2

Predictor Variables and Measurement Methods

Theoretical Framework	Variable	Data Source & Measurement	Unit of Analysis
“Big Five Inventory” (BFI) Personality Model (Digman, 1996; John & McCrae, 1999)	BFI: Agreeableness	Self-reported survey responses of agreement to personality phrases.	Likert Scale 1-5 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
“Big Five Inventory” (BFI) Personality Model (Digman, 1996; John & McCrae, 1999)	BFI: Conscientiousness	Self-reported survey responses of agreement to personality phrases.	Likert Scale 1-5 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
“Big Five Inventory” (BFI) Personality Model (Digman, 1996; John & McCrae, 1999)	BFI: Extraversion	Self-reported survey responses of agreement to personality phrases.	Likert Scale 1-5 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
“Big Five Inventory” (BFI) Personality Model (Digman, 1996; John & McCrae, 1999)	BFI: Neuroticism	Self-reported survey responses of agreement to personality phrases.	Likert Scale 1-5 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
“Big Five Inventory” (BFI) Personality Model (Digman, 1996; John & McCrae, 1999)	BFI: Openness	Self-reported survey responses of agreement to personality phrases.	Likert Scale 1-5 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
“Pre-Service Training Survey” (Bandura, 1982, 1986 & 1997).	Science Pre-Service Training	Self-reported survey responses of agreement with training statements.	Likert Scale 1-6 1 = Strongly Disagree 2 = Disagree 3 = Moderately Disagree More than Agree 4 = Moderately Agree More than Disagree 5 = Agree 6 = Strongly Agree

“Professional Development Training Survey” (Bandura, 1982, 1986 & 1997).	Science Professional Development Training	Self-reported survey responses of agreement with training statements.	Likert Scale 1-6 1 = Strongly Disagree 2 = Disagree 3 = Moderately Disagree More than Agree 4 = Moderately Agree More than Disagree 5 = Agree 6 = Strongly Agree
“Science Teaching Efficacy Belief (STEBI) Instrument” (Enochs & Riggs, 1990; Gibson & Dembo, 1984).	Science Teaching Efficacy Beliefs	Self-reported survey responses of agreement with science teaching beliefs.	Likert Scale 1-5 1 = Strongly Agree 2 = Agree 3 = Undecided 4 = Disagree 5 = Strongly Disagree

Instrument Reliability

Instrument reliability was investigated with Cronbach’s alpha for each survey and subsaling. On the BIF, reliability coefficients ranged from .69 for Conscientiousness to .81 for Neuroticism with an overall reliability of .68. The internal consistency of the Science Training Survey was .92 with sub-scale coefficients of .91 for Pre-service Training and .95 for Professional Development Training. The reliability coefficient for Science Teaching Efficacy Beliefs was .80. Overall, the professional development training sub-scale of the Science Training Survey had a reliability of .95. Table 3.3 shows the number of variable items and reliability coefficients of each predictor variable and criterion variable.

Table 3.3

Reliability Coefficients

Scale	N of Items	Cronbach's alpha
BFI: Agreeableness	9	.76
BFI: Conscientiousness	9	.69
BFI: Extraversion	8	.82
BFI: Neuroticism	8	.81
BFI: Openness	10	.71
Big Five Inventory	44	.68
Pre-Service Training Perception	8	.91
Professional Development Training	12	.95
Science Teacher Pre-service & Development Training	20	.92
Efficacy Beliefs	13	.90
Outcome Expectancies	12	.70
Science Teaching Efficacy Beliefs	25	.80

Procedures

This correlational study followed clear, specific procedures so the study could be replicated for future research. Initially, approval was sought twice to elicit participation. The first set of data was used to validate the Science Training Survey, and the second set of data was used in this correlational study. Approval was granted by documented school-district letterhead via email. The Institutional Review Board (IRB) granted approval to conduct research for the validation of the Science Training Survey. Request for a teacher email roster was sent to

cooperating superintendents, and responses either included teacher email rosters or directions to use school websites' email roster. An email was sent to each accessible K-3 and K-4 teacher email across the six participating school-districts. The email included a consent letter with the purpose of the validation research, opportunity to participate, and opportunity to withdraw without penalty. Information was included for an opportunity for teachers to voluntarily participate in a Wal-Mart gift-card give-away after completing the entire survey. Teachers were instructed to complete the entire survey and then email the researcher with the corresponding email address to enter for the random drawing of one of five \$20 gift-cards. At the bottom of the consent email, the survey link was included for direction to www.surveymonkey.com. Participants then clicked on the link to consent for voluntary participation with the survey. Teacher responses were collected into the www.surveymonkey.com database.

In the spring of 2013, Alabama and Tennessee superintendents were emailed and phoned for permission to conduct the correlational research in their school-districts. Approval was granted from 23 public school district superintendents, and approval was emailed on as district-letter documentation with superintendent name, signature, and date, and some approval documentation was emailed or mailed to Liberty University. IRB granted approval for research (See Appendix E). A K-4 elementary teacher email roster was obtained from each superintendent's office so that email contacts could be made across each approved school-district. Several school districts would not release an email roster but did permit access to each school webpage's teachers' email addresses. An informed teacher consent letter was emailed to each K-4 teacher with a statement of purpose of the research, benefits of the research, opportunities to withdraw from the research, the survey link, and an opportunity to participate in

a Wal-Mart store gift-card give-away. Teachers then clicked on the survey link to acknowledge their understanding of the research and their consent to participate in the research. Emphasis was placed on the opportunity to participate in a chance to win one of five \$20 Wal-Mart store gift cards available to all participating teachers who completed the survey. Elementary teachers who completed the entire survey emailed the researcher to say, “Enter me in the gift-card drawing.”

Data collection occurred when teachers completed the one-document survey in the following order – Demographic Survey, BFI, Science Training Survey, and STEBI. Paper copies of the surveys were available if needed for each school district for teachers who did not readily use email. The survey link was open for approximately one month. A follow-up email was sent to the K-4 teachers to remind the teachers that a deadline to complete the survey was approaching if they still wanted to participate. After collecting the survey data, a follow-up email was provided to each superintendent and principal thanking them for their permission, time, and efforts with the study. A follow-up email was sent to the five winners of the Wal-Mart gift cards to congratulate them on their winnings.

Research Design

This research study was conducted using a correlational design because a correlational design is used for discovering a relationship between predictor variables and criterion variables (Gay & Airasian, 2003). The correlational design was not used to establish cause and effect (Gall, Gall & Borg, 2007). The correlational design was selected as the appropriate design since similar studies have examined teachers’ efficacy beliefs and predictor variables (personality and environment) using the same correlational design (Decker & Rimm-Kaufman, 2008; Roberts, Harlin & Briers, 2007; Senter & Sungur-Vural, 2013; Vaccaro, 2009). These mentioned studies

have not examined science teaching efficacy beliefs relating predictor and criterion variables, but the examination of general teaching efficacy beliefs and varied predictor variables can be applied to this correlational study.

Research Hypotheses

The eight hypotheses examined in this study are as follows.

H₀₁: The BFI factors, pre-service training, and professional development training do not significantly predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₀₂: The BFI “Agreeableness” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₀₃: The BFI “Conscientiousness” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₀₄: The BFI “Extraversion” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₀₅: The BFI “Neuroticism” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₀₆: The BFI “Openness” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₀₇: Pre-service training does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

H₀₈: Professional development training does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

Data Analysis

Prior to analyzing the data, Principal Components Analysis (PCA) was used to examine the construct validity of the Science Training Survey. A PCA was the appropriate analysis to scale down a large number of survey items to fewer items that loaded reliably on different components (Tabachnick & Fidell, 2007). The direct oblimin rotation method was performed oblique rotation to begin the process of item retention and extraction. Tabachnick and Fidell (2007) support the use of oblique rotation when factors are correlated by the data (p. 646). The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was .92 and exceeded the needed .60 value of concern (Kaiser, 1974). The Barlett’s Test of Sphericity was significant ($p < .01$) supporting the factorability of the correlation matrix and the assumption of multivariate normality. With these two tests, the data was determined to be suitable. Inspection of the correlation matrix indicated only some of the coefficients were greater than the threshold of .30 showing support of

the direct oblimin rotation method (Tabachnick & Fidell, 2007).

Based on the evaluation of the Eigenvalues and Cattell's (1996) scree plot, inspection of the correlation matrix, and the conceptual understanding of the literature, three items' coefficients did not load on a component of .30 resulting in a forced three-component solution with the removal of the three items (Tabachnick & Fidell, 2007). Cronbach's alpha was then used to check for internal consistency for each of the three components.

After validating the Science Teacher Training Survey, a hierarchical multiple regression was used to determine which combination of factors, if any, significantly predicted science teaching efficacy beliefs at the ($p < .05$) level. The hierarchical multiple regression was the appropriate regression analysis because it assessed the overall model and relative contribution of different blocks of variables (Miles & Shevlin, 2001). The hierarchical regression was also appropriate in that it shows a significant testing for the difference between models in the regression (Tabachnick & Fidell, 2007).

The variables were entered into Blocks 1-8 to show any possible, significant predictors of science teaching efficacy beliefs and to show any significant contribution of each new added variable into the model. Block 1 consisted of the demographic variables (gender, years of experience, and classroom setting). Gender, pre-service teaching and observations, and years of experience can have positively or negatively influence efficacy beliefs (Bandura, 1986). In this study, gender and classroom setting showed empirical significance relating to science teaching efficacy beliefs so controlling these variables on a temporal basis was important to prevent these variables from explaining any significant prediction of science teaching efficacy beliefs.

A temporal Block 2 was entered to examine the combination of personality, pre-service training, and professional development training to predict science teaching efficacy beliefs. The combination was examined for significance, and then the combination of variables was removed and replaced with the entry of each individual predictor variable. Blocks 2-6 included the BFI personality traits entered as (Agreeableness, Conscientiousness, Extraversion, Neuroticism, and Openness). The BFI factors were entered before training to support the concept of personality being measured as an entity of individual differences factored into societal experiences (John & Srivastava, 1999; McCrae & Costa, 1999). The Science Training Survey's pre-service training sub-scale and professional development training sub-scale were entered into Blocks 7 and 8 respectively. Each blocked variable was assessed on what it added to science teaching efficacy beliefs after controlling for each block. See Table 3.4 for Data Source Blocks.

Table 3.4

Data Source Blocks

Data Blocks	Variables
Block 1	Controlled Demographic Data Gender, Years of Experience, and Classroom Setting
Temporal Block 2	Combination of Personality, Pre-Service Training, and Professional Development Training
Block 2	BFI: Agreeableness
Block 3	BFI: Conscientiousness
Block 4	BFI: Extraversion
Block 5	BFI: Neuroticism
Block 6	BFI: Openness
Block 7	Science Training Survey Pre-Service Training “Instructional Learning” Sub-Scale
Block 8	Science Training Survey Professional Development “Relative Integration” Sub-Scale and “Collaborative Experience” Sub-Scale

The Demography Survey’s control variables used dummy coding variables for categorical responses to be used as nominal responses if needed. For instance, gender was represented as (male – 1 and female – 2). Classroom setting was represented as (self-contained teaching – 1 and departmentalized teaching – 2). Years of teaching experience was not coded as a dummy variable but was reported on a scale of 1-41 teaching years.

Prior to conducting the analysis, assumption testing was completed to critically examine normality, homoscedasticity, linearity, extreme outliers, and multicollinearity. The first assumption was for the data to be normally distributed. Skewness measures the lack of

symmetry, while kurtosis measures the data as peaked or flat on a normal distribution, and they were both investigated by descriptive reporting to check for normality of the predictor variables and criterion variable. A visual examination of a histogram was used to check for normal data distribution (Gall et al., 2007), and a probability-probability (p-p plot) was examined to ensure the normal distribution of the residuals. The Bartlett's Test of Sphericity was used to test for multivariate normality, , which was reported in the correlation matrix. The second assumption (homoscedasticity) and the third assumption (linearity) were visually assessed by a scatterplot to show a linear relationship with the predictor variables and criterion variable (Gall et al., 2007). The fourth assumption (extreme outliers and multivariate normality) was assessed using Cook's Distance and visual boxplots to note any multivariate outliers that would influence the data in any way. The fifth assumption was multicollinearity, which is the degree of the relationship between two predictor variables (Gall et al., 2007).

Multicollinearity and singularity were assessed using a correlation matrix where the *Pearson r*, also known as the product-moment correlation coefficient r , was computed "for determining the magnitude of relationship between" elementary teachers' science teaching efficacy beliefs with each predictor variable (Gall et al., 2007, p. 347). The *Pearson r* computation was important in determining the degree of the relationship between (personality and pre-service training) related to teaching efficacy, and (personality and professional development training) related to teaching efficacy. The correlation coefficient table showed positive correlations close to 1.0, negative correlations close to -1.0, and no correlations at 0.0 (Gall et al., 2007).

The presence or absence of multicollinearity was assessed by the Variance Inflation Factor (VIF) with condition indices examination in that the VIF measured how much the variance of regression coefficients increased compared to the predictor variables being uncorrelated (Warner, 2008). The VFI limit for the regression coefficients was 10 (Warner, 2008).

Summary

Chapter Three has dissected the methodology of the current research study. The Big Five Inventory (BFI) and the Science Teaching Efficacy Belief Instrument (STEBI) are two valid, reliable instruments that can make future advancements in this study. The Science Training Survey had good reliability as checked by an outside statistician and Cronbach's alpha as well as construct validity as assessed with Principal Components Analysis (PCA). The Science Training Survey has great potential in adding to limited research relating science training and science teaching efficacy. It is critical that procedures be clearly outlined and followed influencing, which was evident in this correlational study to influence the study's findings. The findings of this correlational study are presented in Chapter Four and are separated into the Science Training Survey validation and quantitative research integrating the Science Training Survey into the correlational research design.

CHAPTER FOUR: FINDINGS

This research study began with validating the researcher-developed Science Training Survey. Correlational research was then conducted after the validation of the Science Training Survey. The correlational research targeted personality and science training as predictors of science teaching efficacy beliefs while controlling for teachers' gender, years of experience, and classroom setting. This chapter is bisected into the validation of the Science Training Survey followed by the results of the correlational research.

Variable Descriptive Statistics

Descriptive statistics for the three controlled variables are presented in Table 4.1.

Table 4.1

Controlled Demographic Variable Descriptive Data

Variable	<i>M</i>	<i>SD</i>	<i>Mo</i>	<i>F</i>
Gender	1.97	.16	2.00	3 male 111 female
				# of Teachers (Years of Experience)
				1 (6, 8, 19, 27 years)
				2 (5, 7, 12, 15, 17, 23, 24, 29 years)
Years of Experience	14.70	9.71	2.00 ^a	3 (8, 14, 20, 26, 28, 35 years)
				4 (1, 9, 16, 22, 25, 30 years)
				5 (3, 11 years)
				7 (4, 13 years)
				8 (21 years)
				9 (10, 24 years)
Classroom Setting	1.21	.41	1.00	90 self-contained 24 departmentalized

a Multiple models exist. The smallest value is shown.

Descriptive statistics were also reported for each instrument and its sub-scales. The highest endorsements were received for the BFI's personality factors Agreeableness ($M = 4.24$,

$SD = .38$) and Conscientiousness ($M = 4.06$, $SD = .41$), whereas the lowest endorsement was received for Neuroticism ($M = 2.44$, $SD = .61$) as shown in Table 4.2.

Table 4.2

Instrument Sub-Scaled Descriptive Data

Scale	<i>M</i>	<i>SD</i>
BFI – Agreeableness	4.24	.38
BFI – Conscientiousness	4.06	.41
BFI – Extraversion	3.74	.61
BFI – Neuroticism	2.44	.61
BFI – Openness	3.70	.43
Personality	3.64	.21
Pre-service Training Perception	3.63	1.57
Prof. Dev. Training Perception	3.74	1.73
STEBI – Personal Efficacy	49.26	7.23
STEBI - Outcome Expectancy	42.06	4.76
Science Efficacy Beliefs	91.32	8.50

Science Training Survey Validity

Prior to integrating the Science Training Survey into quantitative research and conducting an analysis, validation of the survey was established. Before conducting any analysis, six items were removed from the Science Training Survey due to poor researcher questioning. Therefore, the initial 29 items were reduced to 23 Likert-type scale items. To test the suitability of the data, the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy statistic and the Bartlett's Test of Sphericity were conducted to test the validity of the teaching sample. The Kaiser-Meyer-

Olkin Measure of Sampling Adequacy was .89 exceeding the needed value of concern at .60 (Kaiser, 1974). The Bartlett's Test of Sphericity was significant ($p < 0.1$) supporting the factorability of the correlation matrix and assumption of multivariate normality of 23 survey items. With this, the data were determined to be suitable.

Principal Components Analysis (PCA) was then conducted with the direct oblimin method with oblique rotation. Results showed five Eigenvalues exceeding one explaining 37.15% of the variance for component one; 17.13 of the variance for component two; 8.21% of the variance for component three; 5% of the variance for component four; and 4.62% of the variance for component five. The total variance for all 23 included items was 62.48%.

Cattell's (1996) scree plot shows the five Eigenvalues compared with the Science Training Survey's 23 factors. The Eigenvalues show a flat trend beginning at component 4; therefore, components 4-23 accounted for a smaller amount of the total variance successfully.

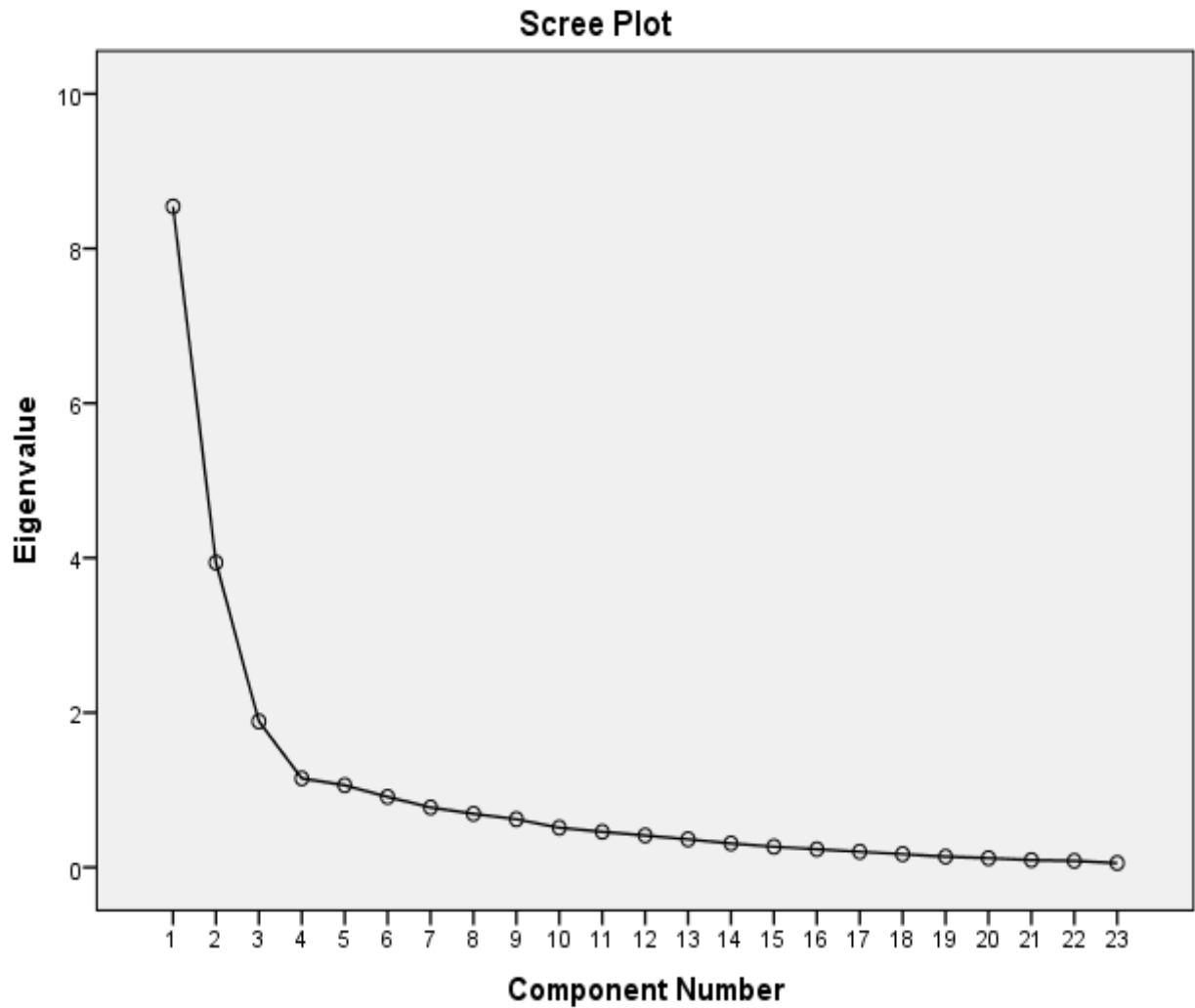


Figure 1. Science Training Survey Three-Component Scree Plot

Based on Cattell's (1996) scree plot, the component loading matrix, and literature regarding vicarious and mastery learning experiences as critical aspects of pre-service training and professional development training (Bandura, 1986; Moolenaar et al., 2012), a three-component solution was forced. The inclusion of survey items depended on a loading of .30; thus, three items were removed (Tabachnick & Fidell, 2007). The three items were also

extracted since they may indicate a poor fit with other component items (Pallant, 2007) resulting in 20 total items. Table 4.3 shows the three survey items that did not load at .30 or higher.

Table 4.3

Extracted Science Training Survey Items

<i>Communalities</i>		
	Initial	Extraction
Item 2	1.00	.37
Item 4	1.00	.61
Item 5	1.00	.57
Item 6	1.00	.67
Item 7	1.00	.75
Item 8	1.00	.80
Item 9	1.00	.66
Item 10	1.00	.58
Item 11	1.00	.48
Item 12	1.00	.18
Item 13	1.00	.20
Item 17	1.00	.07
Item 18	1.00	.61
Item 19	1.00	.49
Item 20	1.00	.75
Item 21	1.00	.73
Item 22	1.00	.78
Item 23	1.00	.83
Item 24	1.00	.81
Item 25	1.00	.83
Item 26	1.00	.85
Item 27	1.00	.87
Item 28	1.00	.87

Extraction Method: Principal Component Analysis.

The Kaiser-Myer-Olkin (KMO) Measure of Sampling Adequacy statistic and the Bartlett's Test of Sphericity were conducted again to test the validity of the survey with the items' removal. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was .91 showing an increase from .89 with all included items. The Bartlett's Test of Sphericity was still significant ($p < 0.1$) supporting the factorability of the correlation matrix and assumption of multivariate normality of 23 initial survey items. Table 4.4 shows that the data were determined to be suitable again.

Table 4.4

KMO and Bartlett's Test of Extracted Survey Items

<i>Multivariate Normality Test</i>		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.90
	χ^2	3675.20
Bartlett's Test of Sphericity	Df	190
	p	.00

The Principal Components Analysis (PCA) was conducted again with the forced three-component solution showing 20 Likert Scale items. Results showed a three-component solution with three Eigenvalues exceeding one explaining 42.19% of the variance for component one; 18.77% of the variance for component two; and 9.19% of the variance for component three.

The forced three-component solution included 8 items on Component 1 (Professional Development Training), 8 items on Component 2 (Pre-Service Training), and 4 items on Component 3 (Professional Development Training). Table 4.5 provides the structure matrix listing the correlations for the three components.

Table 4.5

Science Training Survey Structure Matrix

<i>Components</i>	1	2	3
Item 27	.93		
Item 28	.93		.31
Item 26	.92		
Item 23	.91		.36
Item 25	.91		
Item 24	.90		.39
Item 22	.88		.35
Item 21	.82		.49
Item 8	.32	.88	
Item 7		.87	
Item 6		.82	.32
Item 9		.79	
Item 10		.756	.32
Item 11		.67	
Item 5		.63	.60
Item 2		.58	.38
Item 20	.33		.86
Item 4		.44	.78
Item 18	.50		.74
Item 19	.34		.69

Extraction Method: Principal Component Analysis.

Rotation Method: Oblimin with Kaiser Normalization.

The items loaded into the forced three-component solution and were labeled as the Professional Development Training sub-scale noted as Component 1 with items 21, 22, 23, 24, 25, 26, 27, and 28 and as Component 3 with items 4, 18, 19, and 20. The Pre-Service Training sub-scale was noted as Component 2 with items 2, 5, 6, 7, 8, 9, 10, and 11. These component labels stemmed from the literature regarding vicarious and learning experiences embedded into

pre-service training and professional development training (Bandura, 1986; Moolenaar et al., 2012), and each item's descriptive pattern load is presented in Table 4.6.

Table 4.6

Science Training Survey Pattern Matrix

<i>Component 1 (Relative Integration)</i>	<i>F₁</i>	<i>h²</i>	<i>M</i>	<i>S.D.</i>
21. School district science professional development over the course of my teaching career has been related to what I believe students should learn and be able to do.	.76	.74	3.88	1.65
22. School district science professional development over the span of my teaching career has been related specifically to what science content I teach.	.85	.78	3.68	1.68
23. The number of science district professional development hours that I have participated in over my teacher career has been beneficial in developing my ability to teach elementary science.	.89	.83	3.63	1.82
24. District science professional development training ideas and resources over the course of my teaching career have been integrated into my current teaching practices.	.86	.81	3.80	1.74
25. District professional training resources have been made readily available for teaching elementary science.	.93	.83	3.35	1.75
26. District professional training resources have aided my ability to teach specific elementary science content.	.93	.85	3.45	1.75
27. My use of district professional	.93	.88	3.60	1.68

training instructional practices has made me feel more effective at teaching elementary science.				
28. My use of district professional training resources has made me feel more effective at teaching elementary science.	.93	.89	3.56	1.69
<hr/>				
<i>Component 2 (Instructional Learning)</i>	<i>F₂</i>	<i>h²</i>	<i>M</i>	<i>S.D.</i>
2. Learning new instructional practices on my own during my undergraduate teacher training has aided my ability to teach elementary science.	.51	.39	3.89	1.61
5. Collaboration with fellow classmates during my undergraduate teacher training has aided my ability to teach elementary science.	.50	.59	4.21	1.53
6. Collaboration with course professors during my undergraduate teacher training has aided my ability to teach elementary science.	.81	.68	3.77	1.64
7. The number of science content-based courses taken in my undergraduate training has provided me with a strong foundation for teaching elementary science.	.88	.77	3.39	1.54
8. The number of science teaching-based courses taken in my undergraduate teacher training has well-prepared me for teaching elementary science.	.89	.81	3.30	1.48
9. The assigned teaching-based resources (textbooks, CDs, etc.) in my undergraduate teacher training have been effective in helping develop my ability to teach elementary science.	.83	.66	3.19	1.43
10. Observing different teachers' practices in my undergraduate teacher training has aided my ability to teach elementary science.	.73	.58	4.07	1.48
11. Field experience teaching in my undergraduate teacher training has aided my ability to teach elementary science.	.65	.49	4.28	1.44

<i>Component 3 (Collaborative, Experiential))</i>	<i>F₃</i>	<i>h²</i>	<i>M</i>	<i>S.D.</i>
4. Learning by doing or through hands-on learning opportunities has aided my ability to teach elementary science.	.73	.66	5.08	1.25
18. Collaboration with fellow teachers during district professional development training has been beneficial in developing my ability to teach elementary science.	.65	.61	4.40	1.50
19. Learning about a new teaching resource or instructional practice on my own has been beneficial in developing my ability to teach elementary science.	.66	.50	4.52	1.28
20. Learning by doing through hands-on opportunities with professional instructional practices or resources has aided my ability to teach elementary science.	.86	.75	4.97	1.18

Table 4.7 shows the correlation with components 1, 2, and 3. Components 1 and 2 showed a small, positive inter-correlation ($r = .24$). Components 1 and 3 showed a small, positive inter-correlation ($r = .34$). Components 2 and 3 showed a small, positive inter-correlation ($r = .30$).

Table 4.7

Science Training Survey Component Correlation Matrix

Component	1	2	3
1. Relative Integration	1.00	.24	.34
2. Instructional Learning	.24	1.00	.30
3. Collaborative Experience	.34	.30	1.00

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

The analysis of tolerance and Variance Inflation Factor (VIF) also examined multicollinearity to show that all three tolerance values on the Science Training Survey exceeded .10 level. The tolerance level for the professional development training was .92 for Component 1 and .94 for Component 3. The tolerance level for the pre-service training was .90 for Component 2. All VIF values fell below the 10 marker for Components 1-3 as 1.10, 1.10, and 1.20 respectively. Therefore, the assumption of no multicollinearity was acceptable (Tabachnick & Fidell, 2007).

Science Training Survey Reliability

Reliability is the measure of consistency and “the degree to which test scores are free from errors of measurement” (AERA, APA & NCME, 1985). The Science Training Survey’s reliability was investigated with Cronbach’s alpha and Spearman-Brown coefficient after the extraction of six survey items resulting in a 20 item survey. Table 4.8 reports Cronbach’s alpha for the component model and each component as reliable based on the Science Training Survey’s pre-service training and professional development training sub-scales.

Table 4.8

Science Training Survey Component Reliability

Component Model and Factors	Cronbach's Alpha	N of items
Full Model	.93	20
Component 1 (Relative Integration)	.97	8
Component 2 (Instructional Learning)	.89	8
Component 3 (Collaborative Experience)	.80	4

The Kaiser-Meyer-Olkin statistic and Bartlett's Test of Sphericity indicated validity with the sample (Steven, 1996), and the KMO reported no violation of the assumption of no multicollinearity. The Barlett's Test of Sphericity indicated approximate, multivariate normality for Principal Components Analysis to be conducted. The model's Cronbach's alpha of .93 showed excellent reliability.

Hierarchical Multiple Regression

The hierarchical multiple regression analysis was used to determine which combination of factors (the Big Five Inventory personality factors, pre-service training, and professional development training), if any, predicted elementary teachers' science teaching efficacy beliefs while controlling for gender, years of experience, and classroom setting and to show if each block of variable(s) added any significance to the overall model.

Assumption Testing

Preliminary assumption tests were conducted to critically examine normality, homoscedasticity, linearity, extreme outliers, and multicollinearity. Normality and absence of multivariate outliers were examined with the normal P-P plot of standardized residuals (Tabachnick & Fidell, 2007). The P-Plot in Figure 1 assesses the residuals.

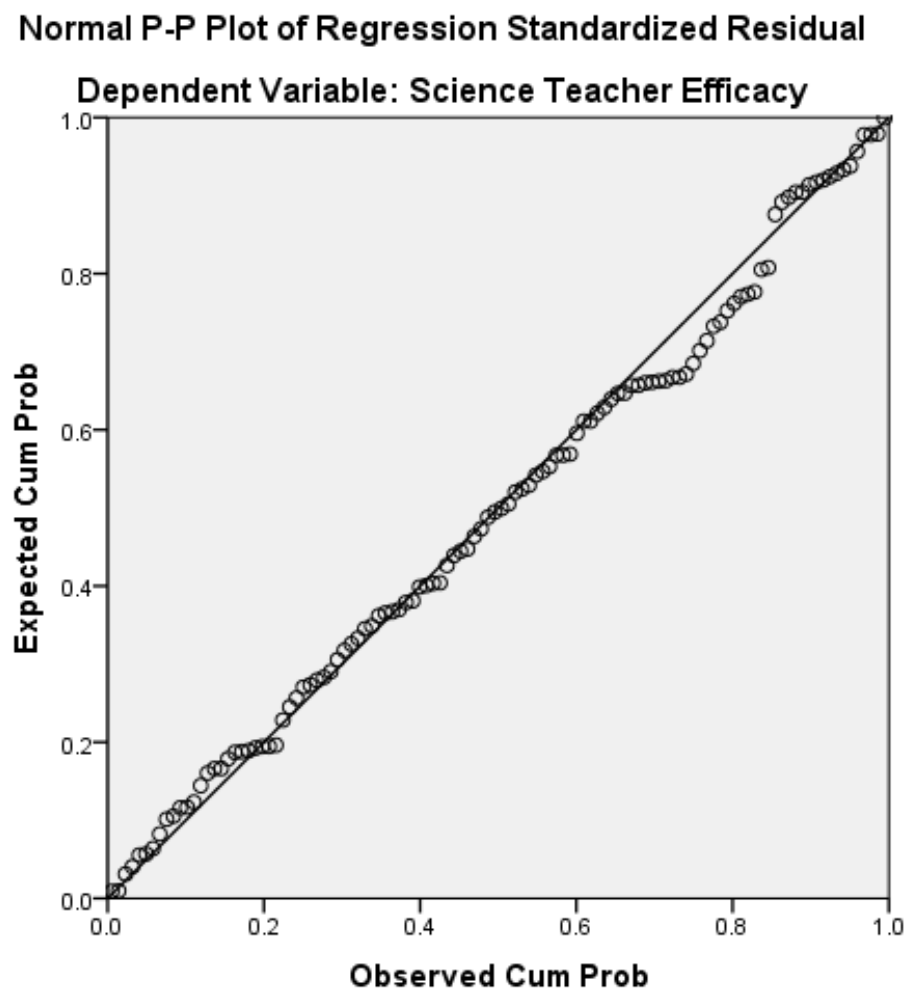


Figure 2. Science Teaching Efficacy P-Plot

A visual examination of a histogram was used to check for normal data distribution showing that univariate normality was found acceptable for each variable (Gall et al., 2007). The data was also screened for normality with skewness and kurtosis statistics. Data was screened for normality because normality is an assumption of parametric statistics such as the Pearson r and multiple regression. In SPSS, skewness and kurtosis values that fall within two times the standard error are considered to be approximately normal. As presented in Table 4.9, skewness and kurtosis values for all variables fell within the range of normality, and most of the values were negatively skewed.

Table 4.9

Skewness and Kurtosis Data Screen

	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
Agreeableness	-.11	.23	-.34	.45
Conscientiousness	-.23	.23	.18	.45
Extraversion	-.31	.23	-.54	.45
Neuroticism	.44	.23	-.35	.45
Openness	-.34	.23	.18	.45
Personality	.32	.23	.83	.45
Pre-service Training Perception	-.91	.23	.82	.45
Professional Development Training	-.39	.23	-.38	.45
Efficacy Beliefs	-.24	.23	.05	.45
Outcome Expectancies	.20	.23	-.47	.45
Teaching Efficacy Beliefs	.07	.23	.48	.45

The second assumption (homoscedasticity) and the third assumption (linearity) were visually assessed by a scatterplot showing a linear relationship with the BFI personality factors, pre-service training, and professional development training with science teaching efficacy (Gall et al., 2007). The fourth assumption (extreme outliers) was assessed using Cook's Distance and visual boxplots, and the assumption of not multivariate outliers was met.

The fifth assumption was multicollinearity. The correlations among variables was small to moderate ranging from $-.45$ to $.43$, and $.22$ to $.33$ for the predictor variables; thus, not violating the assumption of caution for correlations $.90$ and above (Warner, 2008) and $.80$ and above (Tabachnick & Fidell, 2007). Table 4.10 shows the correlation coefficients matrix of the predictor variables and the criterion variable.

Table 4.10

Correlation Coefficients Matrix of Predictor and Criterion Variables

	1	2	3	4	5	6	8	9
1. Efficacy Beliefs	-							
2. Agreeableness	.17	-						
3. Conscientiousness	.13	.43**	-					
4. Extraversion	.05	.27**	.21*	-				
5. Neuroticism	-.21*	.28**	-.45**	-.29**	-			
6. Openness	.33**	.15	.13	.25**	-.17	-		
7. Pre-Serv. Training	.18	.03	.08	-.08	-.22*	.01	-	
8. Prof. Dev. Training	.24*	-.19*	-.05	-.06	-.01	.03	.22*	-

* $p < .05$; ** $p < .01$

Table 4.11 provides a summary of the variables' correlated coefficients and their significance levels

Table 4.11

Correlated Coefficients Summary

Variable Inter-correlation	Correlation Coefficient	p
BFI "Openness" and Science Teaching Efficacy Beliefs	.33	< .01
Personality and Science Teaching Efficacy Beliefs	.20	< .05
Professional Development Training and Science Teaching Efficacy Beliefs	.24	< .05
Professional Development Training and Pre-Service Training	.22	< .05

The analysis of tolerance and Variance Inflation Factor (VIF) also examined multicollinearity to show that all tolerance values of each predictor variable related to the remaining predictor variables exceeded the .10 level. The BFI factors were examined although each factor represented sub-scales of the BFI. All VIF values fell below the 10 marker for all the predictor variables. Therefore, the assumption of no multicollinearity was acceptable (Tabachnick & Fidell, 2007). Table 4.12 reports the tolerance and VIF range of the predictor and criterion variables.

Table 4.12

Tolerance and VIF Levels of Predictor and Criterion Variables

	Tolerance Range	VIF Range
BFI "Agreeableness"	.19 - .86	1.12 – 4.50
BFI "Conscientiousness"	.24 - .86	1.17 – 4.24
BFI "Extraversion"	.49 - .86	1.20 – 2.06
BFI "Neuroticism"	.51 - .86	1.20 – 2.00
BFI "Openness	.26 - .86	1.20 – 3.80
Pre-Service Training	.72 – .94	1.06 – 1.40
Prof. Dev. Training	.72 - .92	1.10 – 1.40

Hypotheses' Analyses

The eight hypotheses were examined and analyzed as significant blocks to the overall model for predicting science teaching efficacy beliefs. Each model was analyzed to reject or retain each of the eight hypotheses.

H₀₁: The combination of the BFI factors, pre-service training, and professional development training does not significantly predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

The demographic variables (gender, pre-service training, and professional development training) were controlled in Block 1. Personality based on the BFI factors, pre-service training, and professional development training were temporarily entered into a Block 2 to examine the combination of personality, pre-service training, and professional development training. The combination of the controlled demographic variables in Block 1 was not statistically significant ($F(3, 110) = 23.29; p = .08$). Block 1 within the regression analysis explained approximately 23% of the variance of science teaching efficacy beliefs, $R^2 = .06$. Overall, Block 1 was statistically significant ($F(10, 103) = 39.99; p = .00$) with the combination of personality and training variables. The combination of the BFI factors, pre-service training, professional development training, and demographic variables showed a significant predictive relationship to science teaching efficacy beliefs; therefore, **H₀₁** was rejected. The combination of the predictor variables was removed from the temporal Block 2 and replaced with successive blocks of each individual BFI factor, pre-service training, and professional development training.

H₀₂: The BFI “Agreeableness” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

Block 2 of the model included the addition of the BFI “Agreeableness” factor to the controlled variables (gender, years of experience, and classroom setting) in Block 1. The

addition of the “Agreeableness” factor was statistically significant ($F(1, 109) = 27.53; p = .03$). Block 2 within the regression analysis explained approximately 27% of the variance of science teaching efficacy beliefs, $R^2 = .09$. The inclusion of the second Block did not explain a significant amount of variance to the model (an R^2 change of .03). The addition of the “Agreeableness” variable showed a significant predictive relationship to science teaching efficacy beliefs; therefore, H_{02} was rejected.

H₀₃: The BFI “Conscientiousness” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

Block 3 of the model included the addition of the BFI “Conscientiousness” factor. The addition of the “Conscientiousness” factor was statistically significant ($F(1, 108) = 24.45; p = .04$). Block 3 within the regression analysis explained approximately 24% of the variance of science teaching efficacy beliefs, $R^2 = .10$. The inclusion of the third Block did not explain a significant amount of variance to the model (an R^2 change of .01). The addition of the “Conscientiousness” variable showed a significant predictive relationship to science teaching efficacy beliefs; therefore, H_{03} was rejected.

H₀₄: The BFI “Extraversion” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

Block 4 of the model included the addition of the BFI “Extraversion” factor. The addition of the “Extraversion” factor was not statistically significant ($F(1, 107) = 20.27; p =$

.07). Block 4 within the regression analysis explained approximately 20% of the variance of science teaching efficacy beliefs, $R^2 = .10$. The inclusion of the fourth Block did not explain a significant amount of variance to the model (an R^2 change of .00). The addition of the “Extraversion” variable did not show a significant predictive relationship to science teaching efficacy beliefs; therefore, **H₀₄** was retained.

H₀₅: The BFI “Neuroticism” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

Block 5 of the model included the addition of the BFI “Neuroticism” factor. The addition of the “Neuroticism” factor was not statistically significant ($F(1, 106) = 19.91; p = .06$). Block 5 within the regression analysis explained approximately 19% of the variance of science teaching efficacy beliefs, $R^2 = .12$. The inclusion of the fifth Block did not explain a significant amount of variance to the model (an R^2 change of .02). The addition of the “Neuroticism” variable did not show a significant predictive relationship to science teaching efficacy beliefs; therefore, **H₀₅** was retained.

H₀₆: The BFI “Openness” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

Block 6 of the model included the addition of the BFI “Openness” factor. The addition of the “Openness” factor was statistically significant ($F(1, 105) = 37.37; p = .00$). Block 6 within the regression analysis explained approximately 37% of the variance of science teaching

efficacy beliefs, $R^2 = .22$. The inclusion of the sixth Block explained a significant amount of variance to the model (an R^2 change of .10). The addition of the “Openness” variable showed a significant predictive relationship to science teaching efficacy beliefs; therefore, **H₀₆** was rejected

H₀₇: Pre-service training does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

Block 7 of the model included the addition of the pre-service training variable based on the “Instructional Learning” sub-scale. The addition of the pre-service training variable was statistically significant ($F(9, 104) = 34.39; p = .00$). Block 7 within the regression analysis explained approximately 34% of the variance of science teaching efficacy beliefs, $R^2 = .23$. The inclusion of the seventh Block did not explain a significant amount of variance to the model (an R^2 change of .01). The addition of the pre-service training variable showed a significant predictive relationship to science teaching efficacy beliefs; therefore, **H₀₇** was rejected.

H₀₈: Professional development training does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

Block 8 of the model included the addition of the professional development training variable based on the two sub-scales - “Relative Integration” and “Collaborative Experience.” The addition of the professional development training variable was statistically significant ($F(11, 102) = 39.13; p = .00$). Block 8 within the regression analysis explained approximately 39% of the variance of science teaching efficacy beliefs, $R^2 = .30$. The inclusion of the eighth Block

did not explain a significant amount of variance to the model (an R^2 change of .07). The addition of the professional development training variable showed a significant predictive relationship to science teaching efficacy beliefs; therefore, H_{08} was rejected.

The predictor variables were examined as isolated factors to note which factors had the highest predictability of science teaching efficacy beliefs. The best predictors of science teaching efficacy were the BFI “Openness” factor ($\beta = .35$) followed by Professional Development Training ($\beta = .27$). Some of the variables did not individually contribute to the overall model. Table 4.13 reports the overall contribution of the predictor variables.

Table 4.13

Contribution of Predictor Variables

Variable	Zero-order r	Partial r	β	SEB	B
Control: Gender	.00	.00	2.50	.50	.05
Control: Years Experience	.24	-.03	-.01	-.22	-.02
Control: Classroom Setting	-.03	.24*	2.00	2.62	.24*
BFI "Agreeableness"	.18	.19	3.60	1.58	.16
BFI "Conscientiousness"	.15	.17	.47	.22	.02
BFI "Extraversion"	.07	.07	-.32	-.24	-.02
BFI "Neuroticism"	-.20	-.20	-1.45	-1.02	-.10
BFI "Openness"	.32	.36	5.82	3.33	.30
Instructional Learning (Pre-Service Training)	.16	.15	-.32	-.43	-.05
Relative Integration (Prof. Dev. Training)	.14	.15	.35	.73	.07
Collaborative Experience (Prof. Dev. Training)	.27	.26	2.20	2.58	.29

Note. * $p < .05$

Table 4.14 provides a summary of the hypotheses tested in the eight blocks of the hierarchical multiple regression.

Table 4.14

Summary of Hypotheses Tested

Hypotheses	Significance	Supported/Not Supported
H₀₁: The combination of the BFI factors, pre-service training, professional development training significantly predicted science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).	Controlled Demographic Variables, $p = .00$	Demographic Variables Not Supported
	Block 1, $p = .00$	Block Supported
H₀₂: The BFI “Agreeableness” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).	Block 2, $p = .03$	Block Supported
H₀₃: The BFI “Conscientiousness” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).	Block 3, $p = .04$	Block Supported
H₀₄: The BFI “Extraversion” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).	Block 4, $p = .07$	Not Supported
	Isolated Factors	
H₀₅: The BFI “Neuroticism” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).	Block 5, $p = .06$	Not Supported
H₀₆: The BFI “Openness” personality factor does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).	Block 6, $p = .00$	Block Supported
	“Openness” Isolated Factor	Supported
H₀₇: Pre-service training does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).	Block 7, $p = .00$	Block Supported

H₀₈: Professional development training does not significantly contribute to the model to predict science teaching efficacy beliefs while controlling for (gender, years of experience, and classroom setting).

Block 8,
 $p = .00$

Block Supported

“Prof. Dev.
Training”
Isolated Factor

Supported

CHAPTER FIVE: DISCUSSION

A discussion of the results with each variable is integrated into this chapter. This chapter is organized by a discussion of the findings, implications via the literature and SCT, study limitations, implications of methodology and practicality, recommendations for future research, and a summary.

Discussion of the Findings

The one survey consisting of a demographic survey, Big Five Inventory, Science Training Survey, and STEBI were administered in the spring of 2013 and analyzed soon after. Over time, educational policies, especially the NCLB mandate, have progressed. The NCLB mandate in effect for a decade has impacted many teachers' perceptions of training, resulting in their persistent expressions of frustration. Many experienced teachers have regarded NCLB as the overseer of all micro-educational teaching and learning, and they continue to feel overwhelmed and frustrated by the reform's reading and math priorities. However, as time has progressed, other teachers have just accepted the "fact" that science training and support has been deemphasized through the NCLB policy. Based on the teachers' survey responses, much of the frustration seems to be rooted in NCLB due to increased pressure of standardized achievement, lack of time to devote to science instruction and learning, limited professional development science training, and lack of financial support for science training at the district and state-levels.

The difference in novice teacher and experienced teacher perception was apparent. Experienced teachers with more than ten years of teaching experience seemed to regard professional development training as very poor and demanding because of NCLB. Novice

teachers who received their pre-service training under NCLB seemed to focus more on limited training and lack of funds for professional development as two primary deficiencies in professional development training. Novice teachers' pre-service training was designed with NCLB at the forefront so their programs may have placed greater emphasis on integrative teaching with reading, math, and science.

The Big Five Inventory rated teachers' perceptions, but it is necessary to note that social factors can contribute to teacher personality although this study targeted individual personality. Item 20 (*Is original, comes up with new ideas*) included 58% of agreeing teachers and 38% of strongly agreeing teachers. The teachers' valued their own individuality despite social reform of including educators and students under the NCLB umbrella of curriculum development. Under NCLB, curriculum leaders have been made responsible for knowing what our society needs in regards to environmental change, selection of worthy, teaching topics, and technological advancement. Unfortunately, the NCLB social reform has left many teachers feeling like they are not able to express their individuality, especially original thinking and teaching, due to reading and math emphasis, textbook scripted lessons, and preparation for standardized achievement testing. The BFI indicated that about half of the participating teachers preferred work that is routine. Routine could be regarded as a set schedule each day rotating to different work stations or allotted times for activities, or routine could include being accustomed to using the same resources in the same manner, such as a textbook script, without using original teaching ideas. Teachers have regarded lawmakers and curriculum leaders as two constraints for teacher originality. Many teachers may have become more accustomed to standardized pressures enough to just go into the classroom and teach by "routine."

With any policy, there are standards that may be stressors in one's profession. Based on the Big Five Inventory's results, half of the teachers felt that they couldn't handle stress well or that they were unsure about handling stress, and over a third of the teachers described themselves as tense. Could stress and tension result from limited training opportunities and overwhelming standardized pressures? Tense and stressful personality factors are primarily deemed as social factors, but one must not fully assume that a person may not be tense and stressed not only about experiences affecting them but also about the fear of trying new experiences. Tense and stressful are adjectives that could describe innate personality traits despite external stimuli.

Experienced teachers with many years of teaching experience may not have accurately rated their training due to elapsed time since pre-service training occurred. Not all pre-service training can be generalized to teachers in Alabama and Tennessee since some teachers may have received training outside Alabama and Tennessee. In regards to pre-service training, not all teachers have taught within the same school-district. Some teachers may have taught between city and county districts, which could constitute their teaching efficacy beliefs.

This study's findings indicated that the combination of the BFI and training variables was a significant predictor of science teaching efficacy belief. Three of the five BFI factors (Openness, Agreeableness, and Conscientiousness) significantly predicted science teaching efficacy beliefs as blocked variables, but "Openness" was the only BFI factor to significantly predict science teaching efficacy as an isolated variable. Professional development training was the second significant, isolated predictor variable of science teaching efficacy beliefs.

"Extraversion was the least significant factor of teaching efficacy beliefs. These results were in contrast via the literature since an extraverted personality has predicted teaching efficacy

beliefs (Costa & Mcrae, 1999; Mills & Huebner, 1998). These results could support how much teachers gain out of training opportunities (Henson & Chambers, 2003; Poulou, 2007). Some teachers may consider themselves as extraverts, but when they share their perception of training and science teaching efficacy or attempt to participate in science training opportunities, the results may contrast (Trapnell & Wiggins, 1990).

Implications via the Literature and Social Cognitive Theory

Bandura (1986) argues that a person's stronger self-efficacy beliefs will lead a person to select more challenging tasks while persevering to master the tasks. Researchers will have to examine just how much a person will take on challenging tasks despite limited training opportunities. Bandura defines self-efficacy in a social setting (1997), but self-efficacy could be attributed to a person's personality type to tackle certain self-created opportunities that may not be created otherwise. It must be known that teachers may only get out what they put in. For instance, there may be available, current science training opportunities, but if a teacher doesn't willingly participate, collaborate, and contribute to the overall task, then self-efficacy or even teaching efficacy may not budge. One must consider personality when examining training experiences because personality and training tend to go hand-in-hand with one probably influencing the other.

Teachers with high efficacy beliefs tend to create mastery experiences for themselves as well as their students, but teachers with low efficacy beliefs bypass students' cognitive processing and self-efficacy (Gibson & Dembo, 1984). It is necessary to examine how or if teachers with high-efficacy or low-efficacy implement mastery, challenging experiences inside and outside the classroom. Just because a teacher believes in himself as an effective teacher

denoted with higher teaching efficacy, it does not constitute for effective practices or higher students self-efficacy beliefs. Teaching efficacy beliefs are just what they are called “beliefs.” Teachers may not fully acknowledge that they are not truly as capable of effectively teaching science for student mastery despite any factors that they may believe contributes to their higher efficacy level. Teacher educators need to examine more factors contributing to varied levels of teaching efficacy, how teaching efficacy is affected across disciplines, and how teacher education programs are designed (Pajares, 2002; Tschannen-Moran & Hoy, 2007).

Bandura (1986) suggests that social constraints and limited resources can contribute to lower levels of self-efficacy. Researchers must explore the roles that schools and school districts’ leaders play in cultivating science training opportunities to expand teaching and learning opportunities despite lawmakers and curriculum leaders’ pressures (McReynolds, 2006; Shaul & Ganson, 2005). School-districts must expand the curriculum to include an integration of science, reading, and math without narrowing the scope solely for benchmark standards (Dillon, 2006; Marx & Harris, 2006).

Bandura (1983, 1997) emphasizes that a person’s efficacy beliefs are shaped by four sources – mastery experiences, vicarious experiences, social influence with verbal persuasion, and internal interpretation. Unfortunately these sources can lower teaching efficacy as well as increase it. Teachers must be provided with positive, reinforcing experiences where they are trained on how to teach effectively, build relationships, and reflect on instructional practices. Teachers must be given opportunities for success but also opportunities to learn from mistakes. Verbal persuasion and feedback are essential for targeting areas of weakness to transform into success. Many pre-service teachers do not observe, teach, or work in a science classroom or

even with a cooperating science teacher but yet we expect them to learn textbook and lecture content to apply to real-world class teaching. Twenty-eight percent of teachers did not work with a cooperating science teacher. Why were pre-service elementary teachers who are qualified to teach all subject matter not placed at least part of their internship time with a cooperating teacher? Did the pre-service teachers not see the cooperating teachers as science teachers because they did not teach science separately from other content? Did they see them more as reading and math teachers only?

The next concern is why did many of the teachers have only one science methods course in undergraduate training? More science methods courses should be made readily available where teachers are able to collaborate, use varied resources, and explore learning as a part of teaching. Science content as strategies can be introduced or integrated in varied ways for teachers to feel more comfortable teaching science, especially in a narrow block of time.

Most of the teachers were required to complete basic course work including the main sciences - Biology, Chemistry, Physical Science, yet many of the teachers may not feel capable teaching a first-grade unit on inclined planes. Why is this? There should more of a push for more methods courses with more focus on general elementary content that teachers should be required to know. More science content should be embedded into the Praxis test that exit-level pre-service teachers are required to take.

Implications of Methodology and Practicality

There are various methodological and practical implications of this research study. The first implication is the way a researcher obtains school-district research approval. Obtaining research approval across two states resulted in a compilation of extensive emails and some phone

calls. Only a handful of larger school districts had a research approval template to be filled out by the researcher. The researcher would then fill out the approval and email to the corresponding affiliate. Approval would then be granted by email with an appropriate school-district documentation email letter. It would be wise to have a generic school-district request template that could be completed and then sent as a mass email across the state. There is a lot of downtime when an email request is being sent to a superintendent, then wait time to hear yes, then more wait time to get the letter. If the general request letter would be sent upfront, more time could be devoted to research rather than waiting.

It would be important for designated research consultants to be active either at the district-level or regional level to oversee research being conducted in schools, especially with teachers. Research requests should be examined for significance to the field of education, especially to the state and school-district. The research consultant could forward research proposals to content-based committees that may understand particular research designs and/or content areas. It is essential for the research consultant, along with committee input, to grant permission for research with teachers to researchers can tap into the teachers' perceptions of science training, especially at the district-level. Teachers should feel comfortable participating in research opportunities, especially if research approval has been granted by a research consultant rather than individual school-district superintendents. Teachers should not be reprimanded because of honesty in research.

The next implication is that the BFI and STEBI-B should be administered at the onset and conclusion of pre-service level training. It would be important for the results to be shared between the university/college departments and the local school districts. Training opportunities

should include the BFI and STEBI results to guide the implementation of new courses, online training, field experience, and new resources. Training sessions could be designed with personality types in mind in that some teachers enjoy collaborative workshops and discussion boards while others prefer more isolated training. Training could be designed by a “gaming” approach as a differentiated model for teacher education instruction. Teachers could be trained in a more active, learner-centric environment as opposed to a passive, delivery-method approach.

Assumptions

There were some assumptions associated with this correlational study. The first assumption was the prediction of science school-district professional development training application significantly predicting science teaching efficacy beliefs, and the assumption was met. Research supports that interpersonal support from school leaders, faculty, and community members through professional development opportunities helps build teacher capability (Tschannen-Moran & Woolfolk, 2007). A second assumption was that teacher feedback on the surveys would be honest in nature and would factor into possible future changes to be made within undergraduate teacher training programs and school district professional development training opportunities. For example, if professional development training significantly predicts science teacher efficacy beliefs, then prospects for future professional development may be executed. Research stresses that teacher feedback pertaining to pre-service teacher training programs and school professional development will lead to training improvement at the undergraduate level and experienced teacher level (Poulou, 2007, p.191). A third assumption was that the results of this study with the targeted sample would represent the larger population of elementary teachers of science across Alabama and Tennessee extending to states across the

U.S. since the government federally mandates NCLB across the country's public city and county schools.

Limitations

This research study had some limitations regarding design, procedures, and analysis. One limitation was the focus of sample generalization. Although the states consisted of participating school-districts from various regions across the states, the implications of the findings may or may not generalize to other school-districts in the two states, or even other states. Given the school districts' pressures of NCLB and limitations of science training and teaching experiences, it is not surprising that most teachers felt disappointed in their pre-service training and ongoing professional development training. One must focus not only on lawmakers' pressures as a significant factor of pre-service and professional development training just because most teachers' regarded NCLB as a daunting box of standards. The standards are pre-set, but it is important to focus on what teachers know and can do based on these standards. Teachers can be effectively prepared to engage with mandated strategy making by becoming part of decision-making teams at the school-level, district-level, and state-level. Teachers can engage with strategy making by examining the mandates' standards while sharing how to interpret the standards, how to implement the standards, and how to contribute unique approaches to teaching and learning the standards.

Another limitation was that only 114 of 144 teachers' data could be analyzed. Thirty teachers were excluded from the data because they didn't qualify to participate even though they completed the demographic survey, or they didn't complete all four surveys. An attempt was made to target so teachers would not skip questions or just answer in a random order. At the end

of the survey, the teachers were prompted to answer any missed items denoted with a red asterisk. Misinterpretation of item readability was addressed by including clear directions and questions; however, 30 teachers' data was not usable since the teachers did not meet the participation criteria of having taught for at least one year; having obtained certification in an undergraduate teacher training program; or having been certified as a highly qualified teacher of K-4 science.

The third limitation was that the demographic survey did not show a distinction between Alabama and Tennessee teachers. It would be beneficial if the school location question would be listed as Alabama public/city school or Tennessee public-city school. Although Alabama and Tennessee public schools function by governing NCLB standards, the states may differ in amount of training, design of training, and funds for training, especially regarding use of hands-on science kits (HASP). It is critical to distinguish the teachers by state to possibly generalize more to the represented state.

The fourth limitation was that some teachers with many years of teaching experience could have difficulty recalling science pre-service training experiences as well as the number of participating school-district professional development training hours they have had over their teaching career. It was likely that some of the teachers may have guessed due to an extended amount of time teaching. Novice or early experienced teachers may have revealed a more accurate recollection of their pre-service training and professional development training experiences.

Another limitation was that it was not clear how much training a teacher had received based on school classroom context. For instance, a self-contained teacher could become a

departmentalized teacher during her career. She may teach science or social science all day to fourth-grade students. Therefore, she may have more science professional development training than another self-contained fourth-grade teacher. Also, a self-contained first-grade teacher who teaches second-grade may have more science professional development training compared to a departmentalized third-grade reading teacher who solely teaches reading all day.

Finally, the Science Training Survey was a researcher-developed survey with items based on current literature, researcher experience, and Principal Components Analysis. Although the survey was designed via the literature, it is more beneficial when a validated instrument is used. Unfortunately, there is no current evidence of a survey analyzing teachers' rating of their pre-service training design and professional development training application. The STEBI has been used for science teaching efficacy even in pre-service teachers, but it includes general questions reflecting training rather than specific questions targeting teachers' specific content area (science discipline). Furthermore, one might question the reliability of the Science Training Survey although it has shown good reliability through a statistician's check. It is critical that research be replicated with the survey.

There are some additional threats to validity in this study. First, the history of the targeted K-4 teachers may have had similar aspects of undergraduate training in the form of course composition and field experience teaching; yet, the history of experienced teachers may have been different in number of years taught, amount of professional development hours gained, and classroom teaching experiences. Teachers' years of teaching experience was clearly explained to participants in an informed, emailed consent letter and was clearly denoted in the demographic survey. Only teachers who had taught science for at least one year were included

in this study; however, it must not have been assumed that pre-service teachers and novice teachers' science teaching efficacy beliefs would align with experienced K-4 teachers' science teaching efficacy beliefs (Carre & Carter, 1990; Yilmaz-Tuzun, 2008; & Yoon, Pedreti, Hewitt, Perris & Van Oostveen, 2006).

A second limitation was that random assignment was not used resulting in sampling bias. In contrast, random sampling was used with K-4 teachers rather than middle-school and high school science teachers. This study's results may not have represented the entire population of K-4 teachers across Alabama and Tennessee or even the United States at large. The teacher population may have included teachers who may not use the Internet or email option or who would rather complete in-hand questionnaires and surveys (Gay & Airasian, 2003, p. 114).

Another limitation included teachers' self-reporting on the Science Training Survey. The survey was administered for teacher rating of science pre-service training and science school-district professional development training. The teachers may have overestimated or underestimated their training on the scaled survey (Poulou, 2007, p. 214). Teachers may have not finished the survey due to lack of time, understanding, or effort. Explicit instructions, shortened questioning, and a month's time span were included to target teachers' self-reporting.

In this study, the hierarchical regression was the best analysis for analyzing the data, but there were some limitations or internal threats to validity. The first internal threat was *omitted variable bias*, which is a research bias made when an omitted variable predicts an outcome variable and correlates with one or more regressors (Stock & Watson, 2007). The designated variables were researched as predictor variables, but another variable may have shown as a predictor or even a significant predictor of the outcome variable (teaching efficacy beliefs). If

there was a measurable additional variable, it would have been used as an additional regressor in the analysis (Stock & Watson, 2007).

The second internal threat was *errors-in-variables bias*, which constitutes for a measurement error in a predictor variable that dismantles a relationship between the predictor variable and the outcome variable (Stock & Watson, 2007). The survey questions used in this study may have included falsified pre-set questioning and vague questioning resulting in misrepresented responses or guessing (Stock & Watson, 2007). Directions, questions, and phrases were written with clarity and working definitions to aid the teachers' understanding to prevent misrepresented data (Hartley & Maclean, 2006).

The third internal threat was *sample selection bias*, which factors in the sample selection as a construct of what data will be retrieved (Stock & Watson, 2007). A larger sample size was needed because sample size and predictor variables go hand-in-hand. As more predictor variables are used, a larger sample size is needed (Gay & Airasian, 2003, p. 478). The sample included highly qualified K-4 science teachers from county and city schools with at least one year of teaching experience so the teachers would have had some time for professional development training.

The final internal threat was *simultaneous causality bias*, which targets a predictor variable as causing the outcome variable, and the outcome variable causing the predictor variable (Stock & Watson, 2007). In this study, different school districts could have responded differently based on pre-service training and school-district professional development training not only due to the economical downturn over the past few years, but also due to training design, training resources, and training application. The disadvantages of economical downtown and

limited resources could relate to varied levels of science teacher efficacy beliefs. It was critical that the questionnaire and survey questions be clearly written to address professional development training over the course of a teacher's years of experience and not solely based on a specific number of years. Also, teachers' efficacy could have been related to years of experience so that a more experienced teacher would or could have more professional development opportunities. Teachers' years of teaching experience was addressed in the demographic survey so that entry-level teachers would not merge recent pre-service training with current professional development training. Also the targeted teachers should have had some school-district professional development training as an experienced teacher so the teachers could have addressed their training perceptions related to science teaching efficacy beliefs.

Recommendations for Future Research

This research study has great potential for future research in a number of ways. First, this study could be replicated with experienced middle-school teachers who teach as departmentalized teachers. For example, a science teacher who teaches science all day could be targeted as a participant. It would be interesting to learn that some departmentalized middle-school science teachers may not have any more science professional development training experiences than a middle-school self-contained teacher. It would also be important to research secondary teachers who teach varied science disciplines such as 7th grade Life Science or 8th grade Physical Science.

The findings in this study could differentiate K-3 early childhood teacher training and K-4 elementary teacher training. Although K-3 and K-4 teachers were both considered as elementary teachers in this study, some of the K-3 teachers may have received training in an

early childhood teacher training program with a different focus than an elementary teacher training program. Teachers, district-leaders, and university/college department professors could identify pre-service training program design to add more methods courses, observations, tutoring sessions, field experience teaching, and cooperative programs with early childhood and elementary teachers.

This study's findings could also be conducted qualitatively with novice teachers and experienced teachers with extended teaching years. Interviews and questionnaires could be used to gain a more in-depth look into the lives of novice and experienced teachers' personality and training experiences before and after the implementation of NCLB. It might be surprising to note the differences between a novice teacher and experienced teacher. Research could integrate the five primary science disciplines (Physical Science, Life Science, Earth Science, Social Science). It is critical to examine teachers' perceptions regarding varied science discipline training, teaching experience, and ongoing professional development training. Is pre-service training and ongoing professional development training geared more toward certain science disciplines? Are training programs designed for experience in each science discipline, cognitive application to teaching opportunities, and supported in ongoing professional development not just as "general training?" If not, will future research be conducted to examine the integration of the five disciplines into teacher learning and application?

The study could be replicated with social science teachers to compare social science training compared to science training. Since NCLB prioritizes reading and math, social science teachers may or may not have the same perceptions of training as science teachers even though social science tends to be overlooked as much as science. It is critical to examine teachers'

perceptions of their training opportunities and teaching content in general. For example, have social science teachers had community-based involvement to create vicarious and mastery learning experiences beyond the textbook control? Will teachers who have not had active experiences in the social sciences learn to grasp concepts well enough not only to teach well, but also to embed in active learning beyond the textbook pages and classroom walls?

Finally, personality could be examined more in a social reform setting not only due to NCLB standards, but also due to current, evolving school-district, state-wide reform where teachers' true personalities are suppressed because of social reform occurring across many educational settings. Although Bandura (1982) emphasizes personality and experiences as related factors of life, it would be important to examine teachers' perceptions of how their expression through their personality is pushed aside. Teachers may feel so vulnerable to please curriculum leaders, administrators, and other colleagues, that the teachers' identities are lost in the mix of educational reform dominating freedom of expression and even freedom of rights as an educator. Teachers' personalities may undermine their abilities to challenge any leaders' voices of the NCLB or future educational reform practices, and teachers' may be trained to submit to various practices as pre-service teachers and experienced teachers. It is critical to make advancements of teaching training programs and ongoing professional development to interconnect personality and political reform movements so teachers can show their voices about their beliefs of education and their application of practices that work best for all students.

Conclusions

This research study's methodology and findings have great potential for future research opportunities. There are some limitations, but overall, the research was thoroughly organized

and conducted as planned. There are some implications in this study that regard a closer view of teaching efficacy beliefs, especially science teaching efficacy beliefs. It is critical that research be ongoing to support current findings and extend to university/college setting, school-districts, and individual schools to maximize teaching effectiveness and student learning.

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(Appendix A)

Validated Science Teaching Survey: IRB 1385 Research Approval



The Graduate School at Liberty University

September 20, 2012

Holly Holt Saint

IRB Exemption 1385.092012: Pre-Service Training and School District Professional Development
Training Predicting Elementary Science Teacher Efficacy: A Researcher Likert Scale Pilot Study

Dear Holly,

The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and that no further IRB oversight is required.

Your study falls under exemption category 46.101 (b)(2), which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:

- (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless:
 - (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Please note that this exemption only applies to your current research application, and that any changes to your protocol must be reported to the Liberty IRB for verification of continued exemption status. You may report these changes by submitting a change in protocol form or a new application to the IRB and referencing the above IRB Exemption number.

If you have any questions about this exemption, or need assistance in determining whether possible changes to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,



Professor, IRB Chair
Counseling

(434) 592-4054



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(Appendix B)

Validated Science Teaching Survey: IRB Teacher Consent Email Letter

Dear K-3 and K-4 Teachers Who Teach or Are Qualified to Teach Elementary Science:

I am a doctoral student at Liberty University and a teacher in Jackson County, Alabama. I am conducting a piloted research study to explore your science pre-service training and science teaching professional development training.

You have been selected because you are an Alabama or Tennessee public school elementary teacher who upholds the following:

- **Has qualification to teach elementary science at the K-3 or K-4 level**
- **Has taught for at least one year**
- **Has obtained teaching certification through an undergraduate elementary education teacher training program to teach in grades K-3 or K-4**

You can volunteer to participate in two surveys that will take 10-15 minutes to complete.

There is very minimal risk in that you can voluntarily provide your school email address to be randomly drawn for one of five \$20 Wal-Mart store gift cards to be given away at the conclusion of the research. If so, at the conclusion of the survey, just send a quick email to hsaint@liberty.edu to say “Enter me.” Your survey and email will be kept private in a password-protected computer. Your information will be accessed only by my dissertation chair, committee, and me. You may choose to withdraw from the research at any time without any penalty.

If you have any questions about the research, you may contact the researcher Holly Saint at 256-609-0994 or email at hsaint@liberty.edu or the dissertation chair, Dr. Connie McDonald, 1971 University Blvd. Lynchburg, VA 24502, 434-592-4365 or email at cmcdonald2@liberty.edu) If you would like to talk to someone other than the researcher, **you are encouraged** to contact the Institutional Review Board, 1971 University Blvd, Suite 1837, Lynchburg, VA 24502 or email at irb@liberty.edu.

Please click the following two links in order.

<https://www.surveymonkey.com/s/T2MCZWC>

<https://www.surveymonkey.com/s/DPHNHR8>

(Appendix C)

Demographic Survey

1. What is your gender?

- ☐ Male
- ☐ Female

2. Which race/ethnicity best describes you? (Please choose only one.)

- ☐ American Indian
- ☐ Alaskan Native
- ☐ Asian
- ☐ Pacific Islander
- ☐ Black/African American
- ☐ Hispanic
- ☐ Hispanic American
- ☐ White/Caucasian

3. How many years of professional teaching experience do you have?

- ☐

4. What grade(s) do you currently teach?

- ☐ Kindergarten
- ☐ 1st
- ☐ 2nd
- ☐ 3rd
- ☐ 4th

5. Which best describes your teaching setting?

- ☐ Self-Contained (All Subject Areas)
- ☐ Departmentalized

6. Which content do you predominantly teach?

- ☐ All General Subject Matter (Reading, English, Math, Science, Social Science)
- ☐ Reading
- ☐ Math
- ☐ Science
- ☐ Social Science (Social Studies/History)
- ☐ English Writing
- ☐ Other (Please Specify.)

7. Do you hold Highly Qualified teaching status to teach elementary science in grades K-3 or K-4?

- ☐ Yes
- ☐ No

8. In which school location do you teach?

- ☐ Public City School District
- ☐ Public County School District

9. What type of undergraduate educational training did you receive?

- ☐ Transfer into a two-year public college or university (teaching program)
- ☐ Transfer into a two-year private college or university (teaching program)
- ☐ Four year public college or university (basic course work and teaching program)
- ☐ Four year private college or university (basic course work and teaching program)

10. Which formatting describes your undergraduate (pre-service) teacher training?

(May select more than one answer.)

- ☐ Student presentations (individual and/or group)
- ☐ Field experience observation
- ☐ Field experience teaching
- ☐ Tutoring
- ☐ Internship teaching
- ☐ Other (Please Specify.)

11. In your pre-service internship teaching, did you teach science with a cooperating mentor teacher?

- ☐ Yes
- ☐ No

12. How many years have you taught elementary science at the K-3 or K-4 level?

13. Which best describes how you obtained teaching certification to teach elementary science?

- ☐ Undergraduate teacher training program (general subject matter)
- ☐ Alternative/add-on certification to teach K-3 or K-4 science
- ☐ Praxis test to teach K-3 or K-4 elementary science
- ☐ National Board Certification

14. Approximately how many school-district science professional development training hours have you participated in throughout your teaching career? (May include workshops, in-service projects, and online training related to district development.)

- ☐ 0-10
- ☐ 11-30
- ☐ 31-50
- ☐ 51-70
- ☐ 71-90
- ☐ 90 and above

15. What is the highest level of education you have completed?

- ☐ Graduated from high school
- ☐ 2 year college graduate
- ☐ 4 year college graduate
- ☐ Some graduate school
- ☐ Completed graduate school
- ☐ Post-graduate school

(Appendix D)

Initial Science Training Survey

Please rate your perception of your undergraduate science teacher training and ongoing school district level science professional development training.

Key:

1 = Strongly Disagree

2 = Disagree

3 = Moderately Disagree more than Agree

4 = Moderately Agree more than Disagree

5 = Agree

6 = Strongly Agree

1. In your opinion, what is science?
2. Learning by lecture during my undergraduate teacher training has aided my ability to teach elementary science.
3. Learning new instructional practices on my own during my undergraduate teacher training has aided my ability to teach elementary science.
4. Learning by doing or through hands-on learning opportunities has aided my ability to teach elementary science.
5. Collaboration with fellow classmates during my undergraduate teacher training has aided my ability to teach elementary science.
6. Collaboration with course professors during my undergraduate teacher training has aided my ability to teach elementary science.
7. The number of science content-based courses taken in my undergraduate training has provided me with a strong foundation for teaching elementary science.
8. The number of science teaching-based courses taken in my undergraduate teacher training has well-prepared me for teaching elementary science.
9. The assigned teaching-based resources (textbooks, CDs, etc.) in my undergraduate teacher training have been effective in helping develop my ability to teach elementary science.
10. Observing different teachers' practices in my undergraduate teacher training has aided my ability to teach elementary science.
11. Field experience teaching in my undergraduate teacher training has aided my ability to teach elementary science.
12. Tutoring in my undergraduate teacher training has aided my ability to teach elementary science.

13. Student teaching as a teaching intern during my undergraduate teacher training has aided my ability to teach elementary science.
14. Engaging with a fellow mentor cooperating teacher during my student internship teaching has aided my ability to teach elementary science.
15. Please provide additional insight related to science pre-service training, especially your science pre-service training.
16. Observing a district leader/coordinator teaching or using a professional development resource has aided my ability to teach elementary science.
17. Observing a colleague or teacher using a professional development resource or instructional practice has aided my ability to teach elementary science.
18. Collaboration with fellow teachers during district professional development training has been beneficial in developing my ability to teach elementary science.
19. Learning about a new teaching resource or instructional practice on my own has been beneficial in developing my ability to teach elementary science.
20. Learning by doing through hands-on opportunities with professional instructional practices or resources has aided my ability to teach elementary science.
21. School district science professional development over the course of my teaching career has been related to what I believe students should learn and be able to do.
22. School district science professional development over the span of my teaching career has been related specifically to what science content I teach.
23. The number of science district professional development hours that I have participated in over my teacher career has been beneficial in developing my ability to teach elementary science.
24. District science professional development training ideas and resources over the course of my teaching career have been integrated into my current teaching practices.
25. District professional training resources have been made readily available for teaching elementary science.
26. District professional training resources have aided my ability to teach specific elementary science content.
27. My use of district professional training instructional practices has made me feel more effective at teaching elementary science.
28. My use of district professional training resources has made me feel more effective at teaching elementary science.
29. Please provide any additional insight related to your science school-district training throughout your teaching career.

(Appendix E)

IRB 1390 Research Approval



The Graduate School at Liberty University

December 10, 2012

Holly Holt Saint
IRB Exemption 1390.121012: Personality, Science Pre-Service Training, and Science District
Professional Development Training as Predictors of Elementary Teachers' Science Teaching
Efficacy

Dear Holly,

The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and that no further IRB oversight is required.

Your study falls under exemption category 46.101 (b)(2), which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:

- (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless:
 - (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Please note that this exemption only applies to your current research application, and that any changes to your protocol must be reported to the Liberty IRB for verification of continued exemption status. You may report these changes by submitting a change in protocol form or a new application to the IRB and referencing the above IRB Exemption number.

If you have any questions about this exemption, or need assistance in determining whether possible changes to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,

[Redacted Signature]

[Redacted Name]

Professor, IRB Chair
Counseling

(434) 592-4054



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(Appendix F)

K-4 Teacher Consent Email Letter

Dear K-3 and K-4 Teachers Who Teach or Are Qualified to Teach Elementary Science:

I am a doctoral student at Liberty University and a teacher in Jackson County, Alabama. I am conducting a research study and am interested in exploring your personality, pre-service training, and science teaching professional development training.

You have been selected because you are an Alabama public school elementary teacher who upholds the following:

- **Has qualification to teach elementary science at the K-3 or K-4 level**
- **Has taught for at least one year**
- **Has obtained teaching certification through an undergraduate elementary education teacher training program to teach in grades K-3 or K-4**

You can volunteer to participate in one survey that has 110 short questions. It will take approximately 20-30 minutes to complete.

There is very minimal risk in that you can voluntarily provide your school email address to be randomly drawn for one of five \$20 Wal-Mart store gift cards to be given away at the conclusion of the research. If so, at the conclusion of the survey, just send a quick email to hsaint@liberty.edu to say “Enter me.” Your survey and email will be kept private in a password-protected computer. Your information will be accessed only by my dissertation chair, committee, and me. You may choose to withdraw from the research at any time without any penalty.

If you have any questions about the research, you may contact the researcher Holly Saint at 256-609-0994 or email at hsaint@liberty.edu or the dissertation chair, Dr. Connie McDonald, 1971 University Blvd. Lynchburg, VA 24502, 434-592-4365 or email at cmcdonald2@liberty.edu) If you would like to talk to someone other than the researcher, **you are encouraged** to contact the Institutional Review Board, 1971 University Blvd, Suite 1837, Lynchburg, VA 24502 or email at irb@liberty.edu.

I sincerely thank you for participating and completing the entire survey.

You may click the link below to begin the survey.

<https://www.surveymonkey.com/s/GLHPS5X>

(Appendix G)

BFI

Below are 44 phrases that may or may not apply to you. For example, are you a person who is full of energy? Please rate yourself on a scale of 1-5 on the extent that you agree or disagree with each phrase specific to you with 1 being “Strongly Disagree” and 5 being “Strongly Agree.”

- 1 = Strongly Disagree**
- 2 = Disagree**
- 3 = Neutral**
- 4 = Agree**
- 5 = Strongly Agree**

I see myself as someone who . . .

- 1. Is talkative.
- 2. Tends to find fault with others.
- 3. Does a thorough job.
- 4. Is depressed, blue.
- 5. Is original, comes up with new ideas.
- 6. Is reserved.
- 7. Is helpful and unselfish with others.
- 8. Can be somewhat careless.
- 9. Is relaxed, handles stress well.
- 10. Is curious about many different things.
- 11. Is full of energy.
- 12. Starts quarrels with others.
- 13. Is a reliable worker.
- 14. Can be tense.
- 15. Is ingenious, a deep thinker.
- 16. Generates a lot of enthusiasm.
- 17. Has a forgiving nature.
- 18. Tends to be disorganized.
- 19. Worries a lot.
- 20. Has an active imagination.
- 21. Tends to be quiet.
- 22. Is generally trusting.
- 23. Tends to be lazy.
- 24. Is emotionally stable, not easily upset.
- 25. Is inventive.
- 26. Has an assertive personality.
- 27. Can be cold and aloof.
- 28. Perseveres until the task is finished.

- 29. Can be moody.
- 30. Values artistic, aesthetic experiences.
- 31. Is sometimes shy, inhibited.
- 32. Is considerate and kind to almost everyone.
- 33. Does things efficiently.
- 34. Remains calm in tense situations.
- 35. Prefers work that is routine.
- 36. Is outgoing, sociable.
- 37. Is sometimes rude to others.
- 38. Makes plans and follows through with them.
- 39. Gets nervous easily.
- 40. Likes to reflect, play with ideas.
- 41. Has few artistic interests.
- 42. Likes to cooperate with others.
- 43. Is easily distracted.
- 44. Is sophisticated in art, music, or literature.

(Appendix H)

BFI Scoring Guide

BFI SCORING INSTRUCTIONS

To score the BFI, you'll first need to **reverse-score** all negatively-keyed items:

Extraversion: 6, 21, 31

Agreeableness: 2, 12, 27, 37

Conscientiousness: 8, 18, 23, 43

Neuroticism: 9, 24, 34

Openness: 35, 41

To recode these items, you should subtract your score for all reverse-scored items from 6. For example, if you gave yourself a 5, compute 6 minus 5 and your recoded score is 1. That is, a score of 1 becomes 5, 2 becomes 4, 3 remains 3, 4 becomes 2, and 5 becomes 1.

Next, you will create scale scores by *averaging* the following items for each B5 domain (where R indicates using the reverse-scored item).

Extraversion: 1, 6R 11, 16, 21R, 26, 31R, 36

Agreeableness: 2R, 7, 12R, 17, 22, 27R, 32, 37R, 42

Conscientiousness: 3, 8R, 13, 18R, 23R, 28, 33, 38, 43R

Neuroticism: 4, 9R, 14, 19, 24R, 29, 34R, 39

Openness: 5, 10, 15, 20, 25, 30, 35R, 40, 41R, 44

SPSS Syntax

***** REVERSED ITEMS**

RECODE

bfi2 bfi6 bfi8 bfi9 bfi12 bfi18 bfi21 bfi23 bfi24 bfi27 bfi31 bfi34 bfi35 bfi37 bfi41

bfi43 * (1=5) (2=4) (3=3) (4=2) (5=1)

INTO:

bfi2r bfi6r bfi8r bfi9r bfi12r bfi18r bfi21r bfi23r bfi24r bfi27r bfi31r bfi34r bfi35r bfi37r bfi41r
bfi43r.

EXECUTE .

***** SCALE SCORES**

COMPUTE bfia = mean(bfi2r,bfi7,bfi12r,bfi17,bfi22,bfi27r,bfi32,bfi37r,bfi42).

VARIABLE LABELS bfia "BFI Agreeableness scale score"

EXECUTE .

COMPUTE bfi3 = mean(bfi3,bfi8r,bfi13,bfi18r,bfi23r,bfi28,bfi33,bfi38,bfi43r).

VARIABLE LABELS bfi3 "Conscientiousness scale score"

EXECUTE .

COMPUTE bfie = mean(bfi1,bfi6r,bfi11,bfi16,bfi21r,bfi26,bfi31r,bfi36).

VARIABLE LABELS bfie "BFI Extraversion scale score"

EXECUTE .

COMPUTE bfin = mean(bfi4,bfi9r,bfi14,bfi19,bfi24r,bfi29,bfi34r,bfi39).

VARIABLE LABELS bfin "BFI Neuroticism scale score"

EXECUTE .

COMPUTE bfio = mean(bfi5,bfi10,bfi15,bfi20,bfi25,bfi30,bfi35r,bfi40,bfi41r,bfi44).

VARIABLE LABELS bfio "BFI Openness scale score"

EXECUTE

John, O. P., Donahue, E. M., & Kentle, R. L. (1991). The Big Five Inventory--Versions 4a and 54. Berkeley, CA: University of California, Berkeley, Institute of Personality and Social Research.

John, O. P., Naumann, L. P., & Soto, C. J. (2008). Paradigm shift to the integrative Big Five trait taxonomy: History, measurement, and conceptual issues. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), *Handbook of personality: Theory and research* (pp. 114-158). New York, NY: Guilford Press.

(Appendix I)

Validated Science Training Survey (Revised Survey with Extracted Items)

Please rate your perception of your undergraduate science teacher training and ongoing school district level science professional development training.

Key:

1 = Strongly Disagree

2 = Disagree

3 = Moderately Disagree more than Agree

4 = Moderately Agree more than Disagree

5 = Agree

6 = Strongly Agree

1. In your opinion, what is science?
2. Learning new instructional practices on my own during my undergraduate teacher training has aided my ability to teach elementary science.
4. Learning by doing or through hands-on learning opportunities has aided my ability to teach elementary science.
5. Collaboration with fellow classmates during my undergraduate teacher training has aided my ability to teach elementary science.
6. Collaboration with course professors during my undergraduate teacher training has aided my ability to teach elementary science.
7. The number of science content-based courses taken in my undergraduate training has provided me with a strong foundation for teaching elementary science.
8. The number of science teaching-based courses taken in my undergraduate teacher training has well-prepared me for teaching elementary science.
9. The assigned teaching-based resources (textbooks, CDs, etc.) in my undergraduate teacher training have been effective in helping develop my ability to teach elementary science.
10. Observing different teachers' practices in my undergraduate teacher training has aided my ability to teach elementary science.
11. Field experience teaching in my undergraduate teacher training has aided my ability to teach elementary science.
15. Please provide additional insight related to science pre-service training, especially your science pre-service training.
18. Collaboration with fellow teachers during district professional development training has been beneficial in developing my ability to teach elementary science.

19. Learning about a new teaching resource or instructional practice on my own has been beneficial in developing my ability to teach elementary science.
20. Learning by doing through hands-on opportunities with professional instructional practices or resources has aided my ability to teach elementary science.
21. School district science professional development over the course of my teaching career has been related to what I believe students should learn and be able to do.
22. School district science professional development over the span of my teaching career has been related specifically to what science content I teach.
23. The number of science district professional development hours that I have participated in over my teacher career has been beneficial in developing my ability to teach elementary science.
24. District science professional development training ideas and resources over the course of my teaching career have been integrated into my current teaching practices.
25. District professional training resources have been made readily available for teaching elementary science.
26. District professional training resources have aided my ability to teach specific elementary science content.
27. My use of district professional training instructional practices has made me feel more effective at teaching elementary science.
28. My use of district professional training resources has made me feel more effective at teaching elementary science.
29. Please provide any additional insight related to your science school-district training throughout your teaching career.

(Appendix J)

STEBI

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

SA = Strongly Agree

A = Agree

UN = Uncertain

D = Disagree

SD = Strongly Disagree

1. When a student does better than usual in science, it is often because the teacher exerted a little extra effort.
2. I am continually finding better ways to teach science.
3. Even when I try very hard, I don't teach science as well as I do most subjects.
4. When the science grades of students improve, it is most often due to their teacher having found a more effective teaching approach.
5. I know the steps necessary to teach science concepts effectively.
6. I am not very effective in monitoring science experiments.
7. If students are underachieving in science, it is most likely due to ineffective science teaching.
8. I generally teach science ineffectively.
9. The inadequacy of a student's science background can be overcome by good teaching.
10. The low science achievement of some students cannot generally be blamed on their teachers.
11. When a low achieving child progresses in science, it is usually due to extra attention given by the teacher.
12. I understand science concepts well enough to be effective in teaching elementary science.
13. Increased effort in science teaching produces little change in some students' science achievement.
14. The teacher is generally responsible for the achievement of students in science.
15. Students' achievement in science is directly related to their teacher's effectiveness in science teaching.
16. If parents comment that their child is showing more interest in science at school, it is probably due to the performance of the child's teacher.
17. I find it difficult to explain to students why science experiments work.
18. I am typically able to answer students' science questions.
19. I wonder if I have the necessary skills to teach science.
20. Effectiveness in science teaching has little influence on the achievement of students with low motivation.

21. Given a choice, I would not invite the principal to evaluate my science teaching.
22. When a student has difficulty understanding a science concept, I am usually at a loss as to how to help the student understand it better.
23. When teaching science, I usually welcome student questions.
24. I don't know what to do to turn students on to science.
25. Even teachers with good science teaching abilities cannot help some kids learn science.

Riggs, I., & Knochs, L. (1990). Towards the development of an elementary teacher's science teaching efficacy belief instrument. *Science Education*, 74, 625-637.

(Appendix K)

STEBI Scoring Guide

SCORING INSTRUCTIONS FOR THE "STEBI"

Step 1. Reverse Selected Response Values

The following items must be reverse scored in order to produce consistent values between positively and negatively worded items. Reversing the scores on these items will produce high scores for those high and low scores for those low in efficacy and outcome expectancy beliefs.

item1 item9 item15 item2 item11 item16 item4 item12 item18 item5 item14 item23 item7

In SPSS, this reverse scoring is easily accomplished with the "RECODE" command. For example, recode item 1 with the following command:

RECODE ITEM 1 (5=1) (4=2) (2=4) (1=5)

Step 2. Sum Scale

Items scales are scattered randomly throughout and designed to measure efficacy beliefs. The scale consists of:

item2 item12 item21 item3 item17 item22 item5 item18 item23 item6 item19

item24 item8

The scale for outcome expectancies consists of:

item1 item10 item15 item4 item11 item16 item7 item13 item20 item9 item14 item25

Step 3: Computation

In the computer program, do not sum scale scores before the RECODE procedures have been completed. In SPSS, this summation may be accomplished by the following COMPUTE commands:

COMPUTE OF SCALE =

ITEM2+ITEM3+ITEM5+ITEM6+ITEM8+ITEM12+ITEM17+ITEM18+ITEM19+
ITEM21+ITEM22+ITEM23+ITEM24

COMPUTE OF SCALE =

ITEM1+ITEM4+ITEM7+ITEM9+ITEM10+ITEM11+ITEM13+ITEM14+ITEM15+
ITEM16+ITEM20+ITEM2