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THE PRESERVICE ELEMENTARY TEACHER AFFECT SCALE FOR SCIENCE:
A VALIDATION STUDY

by

OTIS WILDER

B.A. University of South Florida Saint Petersburg, 2012

A thesis submitted in partial fulfillment of the requirements
for the degree of Master of Arts
in the School of Teaching, Learning, and Leadership
in the College of Education and Human Performance
at the University of Central Florida
Orlando, Florida

Spring Term
2016

Major Professor: Michele Gill

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ABSTRACT

The current study details the creation of a new scale for measuring preservice teachers' positive affect for science, the Preservice Elementary Teacher Affect Scale for Science (PETAS-S). This new instrument is designed specifically to measure the level of positive affect towards the subject of science in preservice elementary teachers. Confirmatory factor analysis reveals the instrument loads on the single factor, positive affect. Reliability is robust, with Cronbach's alpha of .96. Positive affect has shown to predict future levels of engagement in domain specific academic subjects (Ainley & Ainley, 2011) and is expected to aid preservice teachers in understanding the complex relationship between their students' interest and enjoyment of science with their own. This research contributes to the important role of emotion in preservice teachers' attitudes toward the subject of science and how it may affect the way they teach it to their future students.

ACKNOWLEDGMENTS

I would like to offer my sincere thanks to my thesis chair, Dr. Michele Gill, and my committee, Dr. Malcolm Butler and Dr. Kay Allen. Thank you Dr. Butler for continuing to support this research since we started working together in 2010. I would like to thank my wife Elaine Morse, whose love and support have made this thesis possible. I would also like to acknowledge the psychology faculty from the University of South Florida St. Petersburg who also provided significant support to me throughout my education. Specifically, I would like to thank Dr. Vikki Gaskin-Butler, Dr. Christina Salnaitis, and Dr. Mark Pezzo. Lastly, thank you to my work family and OLITS team members.

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INTRODUCTION

Currently, there is a considerable amount of time, effort and research devoted to improving the teaching of science, technology, engineering, and mathematics (STEM) fields in education. The continued funding of President Obama's Educate to Innovate plan (The White House, Office of the Press Secretary, 2015), which has contributed over \$1 billion dollars in support of STEM education programs in the United States, is one example of the commitment to STEM education. The precedence of improving STEM education, and specifically improving the expertise and knowledge of science teachers, is not a new endeavor. The push to improve science teaching and learning in the United States began in earnest with Dewey (1910) and has continued to present, albeit with marginal improvement in student interest and pursuit of science-based careers (Ainley & Ainley, 2011). In order to begin to address these shortcomings, recent research has begun to focus on teacher emotions as a promising field of endeavor to increase student interest in the subject of science, improve student outcomes, and positively affect educational productivity (Pekrun & Linnenbrink-Garcia, 2014, p. 1).

The goal of this study is to contribute to the field of research on teacher emotions by validating a new instrument designed to measure preservice teachers' positive affect towards science, the Preservice Elementary Teacher Affect Scale for Science (PETAS-S). The PETAS-S will focus on an important population in STEM education, preservice elementary teachers. A preservice elementary teacher is defined for the purposes of this paper as a current student in a college or university who is enrolled in an elementary education program. Preservice elementary teachers occupy an important role in the pantheon of science education in the United States. Preservice elementary teachers are a self-selected group. When choosing a career in elementary

education, preservice teachers know they are expected to teach all subjects to their primary students, including science, without high levels of expertise in science education or domain specific science knowledge (Choi & Ramsey, 2003; Epstein & Miller, 2011). Preservice elementary teacher attitudes may differ from preservice secondary teachers who choose to teach science as their primary function in middle and high schools. The differences between these two teacher groups would indicate that preservice elementary teachers may not have the same level of interest, enjoyment, or positive affect toward the subject of science when compared to preservice secondary teachers, who choose science as the primary subject of their teaching career (Riegle-Crumb, Morton, Moore, Chimonidou, Labrake, & Kopp, 2015). The importance of preservice teachers' affective emotions is indicated through a growing body of evidence that identifies emotions as critically important in student learning (Pekrun & Linnenbrink-Garcia, 2014, p. ix). Specifically, there are four key areas of research that highlight how a preservice teacher's level of positive affect toward the subject of science may play a role in their future students' interest toward science.

First, despite over 100 years of research and changes to teaching methods beginning with Dewey (1910) to present, elementary students' enthusiasm toward science shows marked declines over time beginning in their primary grades (Alexander, Johnson, & Kelley, 2012; Turner & Ireson, 2010), and science still remains one of the least favorite subjects by elementary teachers to teach (Wilkins, 2009). Second, a preservice teacher's level of affect toward domain specific subjects, like science, have an impact on how they will eventually teach their own elementary students science (Jesky-Smith, 2002; Pajares, 1992; Wilkins, 2009). Third, positive affect is well-established construct in education psychology research, which can be associated

with specific domains such as science (Goetz, Frenzel, Pekrun, & Hall, 2006; Pekrun, Goetz, Titz, and Perry, 2002). Lastly, positive affect is a key component of many constructs that have shown to positively correlate with improved performance such as: enjoyment (Ainley & Ainley, 2011), intrinsic motivation (Isen & Reeve, 2005), effortful cognitive processing (Pekrun et al., 2002), and creative problem solving (Isen, 2008).

To date, there is no known instrument designed specifically to explore preservice elementary teachers' positive affect toward science as a subject. The purpose of this study is to provide initial validity and reliability evidence for the PETAS-S instrument. The PETAS-S is designed for researchers and science educators to measure the level of positive affect toward the subject of science in their preservice teachers. The PETAS-S is projected to help preservice teachers understand how their emotions toward science may affect the way they teach science to their future students.

Definitions

There can be substantial differences in the applications of terms in education psychology and psychology in general. The terms listed below will serve as the operational definitions throughout this paper and represent the basis for the conceptual foundations used herein. When affect is studied specifically, affect is generally defined as the larger category of feelings, with emotion being a more specific type of affect. However, much of the research and scholarly writing on emotion tends to reverse the hierarchy of affect and emotion, referring to emotions as a generic term for human feelings. For example, two of the major texts referenced in this study refer to emotion as the larger umbrella term and use emotions in their titles. In other words, there

are books on emotion that have a chapter about affect, but there are no books on affect that have a chapter on emotion. To maintain continuity with many of the references in this study, I referred to emotion as the generic umbrella term for that aspect of being human that includes feeling and thinking.

Affect: A non-cognitive feeling toward an object or subject that has valence; which is defined as a positive/negative, like/dislike aspect (Pekrun & Linnenbrink-Garcia, 2014).

Attitude: An evaluation of an object or subject which includes affective, cognitive, and behavioral aspects that have a positive/negative, approach/avoid appraisals which includes clusters of beliefs (van Aalderen-Smeets, van der Molen, & Asma, 2012; Wilkins, 2009).

Beliefs: A group of knowledge concepts concerning an object which one believes to be true or not true (Gill & Hardin, 2015).

Competence/Self-efficacy: An individual's perceived capability to attain an outcome in a specific domain (Bandura, 1977).

Emotion: Emotion is referred to as the umbrella term for research on human feelings. Its operational definition is not used here as this study focuses on affect. For a comprehensive review of teacher emotion see Schutz, Aultman, & Williams-Johnson (2009).

Preservice teacher: An undergraduate student enrolled in a college or university with the intention of entering the vocation of teaching in a K-12 school environment.

LITERATURE REVIEW

The Problem of Interest in Elementary Science

Over the last hundred years there has been a considerable effort to improve science education in the United States of America (Patrick, Hisley, & Kempler, 2000) with the hope of increasing student interest and bolstering the ranks of young scientists (Osborne, Simon, & Collins, 2003; Sinatra, Broughton, & Lombardi, 2014, p. 415). Research in science education on student and teacher populations has focused mainly on improving curriculum, teacher knowledge (Riegle-Crumb et al., 2015), and teacher self-efficacy (Schiefele & Schaffner, 2015). Despite the long history of research in science education, little gains have been made in improving student interest in the sciences, and student interest in science continues to decline from elementary through secondary education (Minger & Simpson, 2006). The issue of declining interest is problematic due to the critical importance of interest in science as a determinant of a student's future engagement in science activities and career choices (Osborne et al., 2003).

The loss of interest in science among K-12 students is a long-standing phenomenon which has been persistent over a number of years. A report from the UK noted the loss of science interest in the 1960's, in which it was described as the "swing from science" (Dainton, 1968). A recent analysis of the longitudinal decline in student science interest by Potvin and Hasni (2014) noted the significance of the trend. The results of their study showed marked declines in interest for science from 5th through 11th grades by a full point on a six point Likert-type scale. Evidence of declining interest in science is also reflected in other recent studies on K-12 student populations (George, 2006; Kirikkaya, 2011; Osborne et al., 2003). As the search for answers to

the dilemma of declining interest has been explored, the role of teachers received the focus of many researchers.

The connection between elementary science education and teachers is a frequently studied subject that has focused on content knowledge, subject matter expertise (Riegle-Crumb et al., 2015), quality and type of instruction (Krapp and Prenzel (2011), along with self-efficacy (Cartwright & Atwood, 2014; Dewey, 1910; Hechter, 2011; Jarrett, 1999; Riggs & Enochs, 1990; Tschannen-Moran & Hoy, 2001; Westerback, 1982). The findings from these studies are important; however, researchers have had a tendency to see positive attitudes in students as a byproduct of high quality instruction from teachers. The perception that quality instruction leads to better attitudes to is belied by evidence that students in the countries that typically perform at the top of the international achievement scores in science also have the most negative attitudes (Tytler & Osborne, 2012, p. 604). In general, the summary conclusion from a large body of research on teachers' science knowledge, pedagogy practices, and self-efficacy has assumed that if teachers develop the confidence to teach science through acquiring science knowledge and pedagogical tactics that their own interest will rise, and the problem of student interest will abate. Yet, the problem persists.

More recently, research on teacher interest has begun to yield new insights into the problem of long-term student interest. A significant finding lies in the definition of interest itself. According to Krapp and Prenzel (2011), one of the central tenets of interest is its domain specificity. As Gardner (1996 as cited in Krapp & Prenzel, 2011) so aptly noted, "One cannot simply have an interest: one must be interested in something" (p. 6). The concept of domain

specificity is important because it provides evidence that interest can vary between the subjects one is taught or one teaches (Ainley & Ainley, 2011).

Elementary teachers do not, on the whole, enjoy teaching science (Westerback, 1982). Wilkins' (2009) study on elementary teacher attitudes toward different subjects revealed that the subject of science is often considered one of the least favorite subjects to teach. A connection to the finding that elementary teachers generally do not like teaching science was observed decades earlier when Soy (1967, in Jarret, 1999) concluded that the primary reason preservice teachers did not elect to take science classes during their training was a lack of interest in science. But, interest is not just about the relationship between person and object; it is formed through experience (Long & Hoy, 2006). For many teachers, their science experiences as a student were negative (Liang & Gabel, 2005); which tends to stay with them over time and can have an effect on their teaching practices (Riegle-Crumb et al., 2015).

A lack of interest in a subject has mediating effects on the individual teacher that may affect their students. Cartwright and Atwood (2014) noted that, "When teachers lose interest, their attitudes about that subject also begin to decrease, which lowers the likelihood that their students will choose to pursue that course of study" (p. 2424). Teacher and student experiences are laden with emotion (Pekrun & Linnenbrink-Garcia, 2014, p. 1). In the last two decades a shift has occurred as researchers began to look at the significance of teacher emotions and how they may relate to the problem of student interest (Osborne et al., 2003). A number of researchers have begun to focus on teacher's attitudes and emotions as a major factor driving student interest in science (Ainley & Ainley, 2011; Krapp & Prenzel, 2011; Milner, Sondergeld, Demir, Johnson,

& Czerniak, 2012; Osborne et al., 2003; Pekrun & Linnenbrink-Garcia, 2014, p. 1; Schutz & Zembylas, 2009).

Emotion Research in Teachers

Teacher emotions are important. They impact teachers' lives in many facets and are central to the role of the teacher (Cross & Hong, 2012, Frenzel, Goetz, Lüdtke, Pekrun, & Sutton, 2009; Sutton & Wheatley, 2003). Research on teacher emotions has accelerated in the last ten years and a number of books have emerged on the subject, both of which illustrate the importance of teacher emotions. Two books of note provide a critical overview of the field and its current state: *International Handbook of Emotions in Education* (Pekrun & Linnenbrink-Garcia, 2014) and *Advances in Teacher Emotion Research: The Impact on Teachers' Lives* (Schutz & Zembylas, 2009).

The first page of Pekrun and Linnenbrink-Garcia's (2014) book solidifies the significance of emotions in educational settings by stating the breadth of their impact. The authors state the importance of emotion as "*instrumental* for academic achievement and personal growth" (Pekrun & Linnenbrink-Garcia, 2014, p.1). The importance of emotion in education is also reflected by Schutz and Zembylas (2009) by describing teacher emotions as, "inextricably linked to teachers' work, development, and identity" (p. 4). The instrumental and inextricably linked aspects of emotion, and specifically positive affect, are of key importance to the research on the PETAS-S, for they form the foundation of its reason for being.

Teacher emotion research has also tackled the problem of student interest. Hidi (2006) noted that interest began to gain importance in the last 25 years as a "critical motivational

variable that influences learning and achievement” (p. 69). The critical nature of student interest is rooted in earlier work on basic emotional states, which began to differentiate between interest and enjoyment (Ainley & Hidi, 2014, p. 206). While both interest and enjoyment are affective states that often occur together, they are distinctive in how they are experienced.

Feeling interested is defined as being engrossed, absorbed, engaged, and curious with an object or subject (Izard, 1977, p. 216). Interest is contrasted with the affective state of enjoyment, which is to be pleased with, and satisfied with the engagement in an activity (Izard, 1977, p. 216). The definitions for interest and enjoyment serve as the starting point to understand the role of positive affect, which is the single core factor measured by the PETAS-S.

As each of these definitions indicates, interest and enjoyment are experienced. They are feelings rooted in a lived moment. The experience of interest and enjoyment is important because experience shapes affective preferences (Fiedler & Beier, 2014, p. 39). The end result of preferences gained through experience is to have an affective association to the object or activity, as in the subject of science (Patrick & Mantzicopoulos, 2015). In summary, interest and enjoyment are discrete emotions that are often experienced together, though not always, and contribute to a teacher’s preference toward each different subject they teach. The key to both of these emotions is positive affect; a valenced appraisal of like or dislike for a unique subject, like science.

Positive Affect

Affect is part of the pantheon of human emotion. Affect is generally referred to as a non-cognitive diffuse set of feelings separated into positive (enjoyment, pride, hope) and negative

(boredom, shame, anxiety) aspects (Pekrun & Linnenbrink-Garcia, 2014, p. 2). This modest definition belies its importance in human experience. Jaak Panksepp (2008) boldly stated, “Without affect, we humans would have little to talk about and no special reason to reach out to others” (p. 47). Panksepp’s powerful declaration is underscored by evidence which shows positive affect regularly influences everyday thought, even in mild amounts (Isen, 2008, p. 548). Affect colors our cognition by providing the energy to fuel our endeavors. The power of affect is illustrated in the number of constructs in which it is featured.

Positive affect is a key component of many constructs studied in psychology, education psychology, and teacher performance such as: interest (Hidi & Renninger, 2006), enjoyment (Ainley & Ainley, 2011), intrinsic motivation (Isen & Reeve, 2005), effortful cognitive processing (Pekrun et al., 2002), achievement goals (Elliot, 1999), and creative problem solving (Isen, 2008). These constructs, which include affective components, have shown to be correlated to a number of desirable outcomes when positive affect is present, including teacher wellbeing (Deci & Ryan, 2000; Kunter, Frenzel, Nagy, Baumert, & Pekrun, 2011), teacher effectiveness (Long & Hoy, 2006), and positive student outcomes (Pintrich, 2003).

There are two common conceptual models of affect that appear in education research. The first model is based on affective attitudes toward and object or subject. These studies often use self-report measures to measure participants’ feelings about a subject, or their affective state during an activity. Examples include items such as, “I like science,” and “I feel happy when engaged in science activities” (van Aalderen-Smeets et al., 2012). The second model uses quasi-experimental methods to induce affective states. Positive affect is induced by creating a scenario in which participants are exposed to a typically positive stimulus. Once induced, their behavior is

measured to see if higher levels of positive affect had an effect (Chiew & Braver, 2011). One example, which studied the relationship between positive affect and working memory, induced positive affect in participants by giving the experimental group a surprise gift (Yang, Yang, & Isen, 2012). Participants in the experimental group are then compared to a control group without the surprise gift to test the independent variable.

It is important to differentiate between affective states about scientific attitudes, and affective states about the subject of science, which are distinct concepts (van Aalderen-Smeets, & van der Molen, 2015). For example, one can have an affinity for the subject of science but report low levels of positive affect for theories of evolution, or climate change. The goal of this study is to measure positive affect about a preservice teacher's attitude toward science, not scientific attitudes.

Based on the collective research listed above, it becomes apparent that teachers' positive affect takes a central role in many of the positive outcomes, which address the problem of student interest. Positive affect does this by improving teachers' access to memory (Yang et al., 2012), helping to organize their thoughts (Erez & Isen 2002), helping to seek new and novel ideas (Liu & Wang, 2014), and maintain motivation during the often challenging work of teaching science as an elementary school teacher (Pekrun, 2006).

Positive Affect and Teaching Elementary Science

The number of studies on emotion in science teaching is comparatively small, but the findings have been significant. One key study looked at cultural differences when applying the four-phase model of interest to different groups (Hidi & Renninger, 2006). The four-phase interest model subdivides the construct of interest into two distinct forms. The first is situational

interest, in which a temporary feeling of concentration and attraction to a subject as it is experienced. The second form is individual interest which is cultivated over time and remains relatively stable toward the subject. The four-phase model also emphasizes that interest of both types is not about the subject, but the ongoing relationship between the person and subject. The distinguishing factor between situational and individual interest then is the addition of positive affect to accrued knowledge and perceived value of the subject.

A study by Ainley and Ainley (2011) looked at data taken from the Programme for International Student Assessment (PISA) 2006 (OECD, 2007). The authors identified two lines of research that informed their models. The first line hypothesized that the relationship between knowledge, affect, and value components of student interest would predict their individual interest (as described above) by their willingness to participate in science activities (Ainley & Ainley, 2011). The second line of research proposed that participants with an individual interest in science would have the intention of engaging in science activities in the future. Items from the PISA content included general interest in learning science, enjoyment of science, general value of science, and the future motivation to pursue science into adulthood. The participants were 400,000 15-year-old students from 57 countries. Results from the study showed that a general interest in science does predict current and future interest in science-related activities. More significantly, the authors concluded the enjoyment of science (positive affect) showed greater influence in students' current participation in science activities and also in the likelihood that they would participate in science-related activities and careers in the future. The authors go on to recommend that science educators begin to recognize how student enjoyment of science is linked to increased participation in science activities (Ainley & Ainley, 2011, p 69).

An even more recent study looked specifically at preservice elementary teachers' attitudes toward the subject of science and gauged their change in attitude after an educational intervention (Riegle-Crumb et al., 2015). The intervention included in the Riegle-Crumb et al. (2015) study exposed the preservice teacher participants to an inquiry-based, hands-on teaching practicum over the course of one 16-week semester. Participants were compared to a control group, which took an introductory-level biology or chemistry course over the same period. Pre- and post-testing questionnaires included items on confidence, enjoyment, anxiety, and relevance toward science. Participants included 238 preservice elementary teachers enrolled in a science education curriculum in comparison to 263 non-science and non-education majors enrolled in undergraduate science courses. Questions on the enjoyment of science section were co-opted and adapted from other measures. Example items for science enjoyment included, "I enjoy learning science," "I look forward to going to science courses," "Science is fun," and "I like science" (Riegle-Crumb et al., 2015, p. 828). Results indicated that the intervention improved attitudes in multiple dimensions, including enjoyment. Further the authors suggest the intervention disrupted a cycle of elementary teachers transmitting their negative views toward their students. Again we see the central role of positive affect as the key factor in improving the problem of student interest in science.

Another important aspect of positive affect, as indicated by enjoyment, is the phenomenon of emotional transmission (Frenzel et al., 2009). The concept of emotional transmission is based on social learning theory (Bandura, 1977), constructivist approaches to learning (Vygotsky, 1962), and modeling behavior (Bandura & McDonald, 1963). The Frenzel et al. (2009) study provided evidence of emotional transmission specifically for math enjoyment,

although the discrete nature of emotions toward a subject of study would be expected to apply to science as well (Frenzel, Becker-Kurz, Pekrun, & Goetz, 2015; Wilkins, 2009). Frenzel et al. (2009) found when a teacher holds high levels of positive affect towards a subject; they are more likely to exhibit enthusiasm when teaching. Enthusiasm is defined by Frenzel et al. (2009) as an observable, external phenomenon in which teachers exhibit varied intonation, multiple hand gestures, frequent eye contact, and emotive facial expressions. With enthusiasm as the mediating variable, the students' enjoyment and value of that subject thereby increases. The link between teacher enjoyment and student enjoyment provides further evidence that a higher level of positive affect for a subject can effect change in the problem of student interest, especially when demonstrated through enthusiastic teaching of the subject.

Preservice Elementary Teachers

In university settings, preservice elementary teachers undergo training in a variety of subjects for which they will eventually teach their students. Elementary school teachers occupy a unique space in education as they are generally required to teach students multiple subjects (Davis & Smithey, 2009; Wilkins, 2009). Preservice teachers are educated to teach fine arts, language arts, social studies, math, and science. With regard to science in particular, preservice teachers must learn to teach specialties like physical science, earth science, and life science in the classroom. Having the content knowledge and confidence to teach all of these science subject can be a daunting expectation considering most preservice teachers have minimal science education themselves prior to entry into their elementary education programs (Davis & Smithey, 2009; Epstein & Miller, 2011). It is also the case that most elementary education curricula at the

university level require minimal science education (van Aalderen-Smeets et al., 2012). Low levels of science education for preservice teachers has led to an increase in research on preservice teacher training, which has focused mainly on improving pedagogy practices and science knowledge to boost subject competence (Riegle-Crumb et al., 2015) without putting the same level of focus on improving attitudes (van Aalderen-Smeets & van der Molen, 2015).

It is important to recognize affect as a separate construct to be studied outside of the confines of teacher competency. The constructs of affect and competence (self-efficacy) are positively correlated, but they are discrete. The separation of competence and affect is a noteworthy distinction mentioned frequently in the research on preservice teacher attitudes (Arens, Yeung, Craven, & Hasselhorn, 2011; Marsh, Craven, & Debus, 1999; Pinxten, Marsh, De Fraine, Van Den Noortgate, & Van Damme, 2014). The separation is significant because negative attitudes toward science can alter behavior even over substantial content expertise (Beilock, Gunderson, Ramirez, & Levine, 2010) and high self-efficacy reports (Tosun, 2000). A negative attitude toward the subject of science in teachers has also shown an increased likelihood of altering the type and amount of science instruction their students receive (Minger & Simpson, 2006). In some cases, teachers avoid teaching the subject of science or resort to using highly predictable activities that are easy to manage and avoid the use of inquiry-based methods (Appleton & Kindt, 2002). While improving science knowledge and pedagogy practices for preservice teacher does show improvement in student outcomes, the gains are minimal (Diamond, Maerten-Rivera, Rohrer, & Lee, 2014, van Aalderen-Smeets & van der Molen, 2015).

Preservice teachers do not enter their training as a blank slate but carry with them a long history as a student (Davis & Smithey, 2009). Their experiences and attitudes toward the subjects

they learned as students will continue to frame their future experiences during training and as inservice teachers (Schutz, Aultman, & Williams-Johnson, 2009). The emotional transmission imparted on them by their teachers will continue to affect them, whether positively or negatively.

Preservice teachers are an important part of the cycle of learning. They come to the profession believing that being student-centered and having an enthusiasm for teaching are the two most important characteristics an elementary teacher should possess (Keller, Neumann, & Fischer, 2013). With these aspirations also comes a bevy of experience as a student in which they developed their concepts of teaching (Choi & Ramsey, 2003). Science educators have the privilege of engaging with preservice teachers and creating new experiences to help them enjoy science and break the cycle of negative attitude transmission. New experiences that promote positive affect are essential to breaking the cycle of negative attitude transmission because teaching habits become entrenched early in a teacher's career and become difficult to change (Appleton & Kindt, 1999). Science educators must raise awareness in preservice teachers that their attitudes toward the subjects they teach can have consequences for their students. Based on the research in this study, improving preservice teacher skill and knowledge in science is not enough to effectively address the long-term problem of the decline in science interest.

Problems with Other Measures

The study of teacher emotions in education has been largely underrepresented until as recently as the 1990's, with research on preservice teachers' emotions representing an even smaller subset (Pekrun & Linnenbrink-Garcia, 2014, p. 1). The limited amount of research becomes apparent when reviewing the number of uses for the term "preservice teacher" in the

two books of note mentioned in this study, the *International Handbook of Emotions in Education* (Pekrun & Linennbrink-Garcia, 2014) contains 18 uses throughout, and *Advances in Teacher Emotion Research: The Impact on Teachers' Lives* (Schutz & Zembylas, 2009) includes a total of 24 uses. These two books contain hundreds of citations, yet the low number of references on preservice teachers points to the limited amount of studies focusing on this important population.

As a result of small representation, many studies on preservice teachers use items adapted from other instruments. While adapted items are not always problematic, the issue lies in the items selected, which often contain confounding variables and are not consistent across measures. Examples include items such as, "I look forward to going to science courses" (Riegle-Crumb et al., 2015). This type of item on an instrument confounds positive affect toward the subject of science and the external experience of a science course. The participants' science courses may have teachers or other students they do not like, or have a room that smells funny. Any number of external factors can make going to a science course have a negative influence on the question and distort the central question of the liking for science as a subject.

Other instruments tend to include multiple factors, and do not focus on the single factor of positive affect. The use of multi-factored instruments often results in instruments varying the type and number of questions measuring affect. Instruments are also frequently created on an ad hoc basis and used only a single time. A recent analysis of psychometric instruments used to measure science attitudes found significant methodological issues in a number of attitude studies from 1935 through 2005 (Blalock, Lichtenstein, Owen, Pruski, Marshall, & Toepperwein, 2008). Among the problems were a lack of validity and reliability testing, and a large number of studies

appeared only once. In fact, of the 66 published instruments evaluated, 28 of them had these fundamental flaws.

When instruments contain multiple factors, it raises issues of practical use by science educators because they tend to be lengthy and difficult to score (Tytler & Osborne, 2012). Since nearly all instruments measuring attitudes toward science include multiple factors, a simple total score can bear no meaning. In order for a unitary score to have meaning, the instrument must have a single factor (Gardner, 1975, p. 12, in Tytler & Osborne, 2012). Without a single factor, many instruments are lengthy, difficult to score and interpret, and therefore more challenging for science educators to use in classroom settings. As of this writing, there is no known instrument to specifically measure positive affect toward the subject of science in preservice elementary teachers that has been tested for reliability and validity.

Summary

The purpose of the literature review in this study was to present a compelling argument that new information on preservice teachers' attitudes toward the subject of science is needed. Preservice teachers represent a unique opportunity to address the issue of declining science interest in K-12 students by interrupting a cycle of negative attitudes toward science. Yet, preservice elementary teachers are a largely understudied population, especially in comparison to inservice teachers and students. Most preservice teacher research has focused on teaching competence and science knowledge as a precursor to positive affect, instead of seeing positive affect as a subject worthy of independent study. Positive affect has been studied in preservice elementary teachers, but not in a focused manner, and often with instruments that are long, difficult to interpret and score, and which frequently contain poor methodological approaches.

The purpose of this study is to present a new valid and reliable instrument to measure the level of positive affect toward science in preservice elementary teachers, the PETAS-S. A preservice teacher's level of positive affect toward science is expected to be trait-like, and therefore, remain relatively stable over time in the absence of intervention. The expectation that positive affect toward science is trait-like is based in research that shows students' attitudes toward science tend to decline over time and become fixed by the age of 14 (Potvin & Hasni, 2014; Tytler & Osborne, 2012). Preservice teachers arrive at the university level with a long history of experience as a student with a preexisting attitude toward the subject of science. The PETAS-S is expected to aid in predicting a distinct motivational component of a preservice teacher's attitude toward science, positive affect. The level of positive affect toward science is

expected to be an important indicator of a preservice elementary teachers' future behavior as an inservice teacher responsible for teaching science.

METHOD

Purpose of the Study

Various instruments have measured positive affect in the past, but none has been designed specifically to measure positive affect in preservice elementary teachers as a stand-alone instrument. The purpose of this study is to create a new instrument to measure the level of positive affect in preservice elementary teachers and present evidence of its reliability and validity. The PETAS-S is designed to measure positive affect as a stand-alone instrument and need not be used with other measures.

Participants

Study participants consisted of individuals in two state universities. Participants were enrolled in courses designed for students majoring in elementary education during the fall 2014 semester in both face-to-face and online modes of instruction. Access to students was obtained through faculty permission. The study targeted a total of 311 students of which 151 (48.5%) agreed to participate. Response rate for face-to-face was 112 of 116 (96.5%) and 39 of 195 (20%). All respondents ($n = 151$) reported they were at least 18 years old. Student participants were predominately female (90%).

Procedure

Data were collected using a single instrument that consisted of three individual scales: the Science Teaching Efficacy Belief Instrument (STEBI-B; Riggs & Enochs, 1990), the Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988), and the PETAS-S. The

full instrument included 53 total items and was issued to both in-person and online participants. Participation in the survey was voluntary and respondents received neither direct benefit nor remuneration.

In-person participants ($n = 112$) were administered the instrument at the beginning of their normally scheduled class and were given verbal instructions and a brief description of the purpose for the survey. Online participants ($n = 39$) were asked to participate by their course instructor through university-based electronic communications. The invitation included the purpose for the survey along with written instructions and a link to take the survey online. Informed consent for both online and in-person respondents was by voluntary participation in the study.

Item Development

Items for the PETAS-S were created based on the description of positive affect provided by Marsh, Craven, & Debus (1999) and Watson, Clark, & Tellegen (1988). Items include respondents' interest, if they looked forward to, liked and or enjoyed the subject of science. Item development for the PETAS-S is consistent with positive items in the PANAS scale described as, "the extent to which a person feels enthusiastic, active, and alert. High Positive Affect (PA) is a state of high energy, full concentration and pleasurable engagement" (Watson et al., 1988, p. 1063).

Scale Development

Items on the PETAS-S were scored on a five-point Likert-type rating scale from A (completely agree) to E (completely disagree). Letter designations were used to facilitate scoring

on a standard bubble-field answer sheet for in-person survey administration. In order to retain consistency, the online version used the same letter designations. All data were converted to numerical scores (e.g., A = 5 and E = 1) to assess the data quantitatively.

Face and Content Validity

Face validity for the PETAS-S was confirmed via a single question included on the pilot survey questionnaire, “Did the statements on this form appear relevant to your feelings about the subject of science from the perspective of a preservice teacher?” Content validity was assessed by a panel of science educators and psychology professors at two public universities. Each panel member agreed that the items in the PETAS-S appeared to represent positive affect toward the subject of science. The panel’s assessment is corroborated with research on positive affect as noted in the literature review for this study.

Convergent and Discriminant Measures

Two additional scales were used in the total instrument for this study in order to provide evidence of convergent and discriminant validity for the PETAS-S, the PANAS scale (Watson et al., 1988), and the STEBI-B (Enochs & Riggs, 1990). Each of these two scales contained subscales used to confirm and or differentiate that the items in the PETAS-S measured positive affect.

PANAS Scale

The PANAS scale contains two subscales which measure positive affect (PA) and negative affect (NA) using a list of terms that loaded heavily for each factor (.40 or greater) but

loaded at or near zero with each other (.25 or lower). Each subscale (PA and NA) included ten items. Examples of PA include: interested, excited, and enthusiastic. Examples of NA include: afraid, nervous, and guilty. Alpha reliabilities were calculated from this sample to compare with previously published data. The PA subscale alpha scores were .87 and the NA subscale alpha scores were .86 which were consistent with previously published data of .88 and .87 respectively (Watson et al., 1988). Participants were directed to associate the terms in the PANAS scale with their general feelings toward the subject of science. It was anticipated that the PETAS-S would positively correlate with PA. It was also expected that the items in the PETAS-S would either negatively correlate with NA or correlate positively at a very low level. The PANAS items in the PA and NA subscales are orthogonal and not opposite which allows for feelings of both positive affect and negative affect to occur simultaneously (Watson et al., 1988)

STEBI-B Scale

Participants also completed the STEBI-B which was designed to assess preservice teacher self-efficacy and included two subscales (personal science teaching efficacy and outcome expectancy). The scale consists of 23 statements, each describing a self-report measure of efficacy (Examples: “I know the steps necessary to teach science concepts effectively.”; “I will typically be able to answer students’ science questions.”) Each of these subscales consisted of items that were positively and negatively worded. Negatively worded items were reverse scored as directed by the authors. It was expected that the PETAS-S would positively correlate with both of the subscales in the STEBI-B, although it was projected that personal science teaching efficacy would have a strong correlation with the PETAS-S and outcome expectancy would be positive but weakly correlated. Reliability analyses were run for both of the subscales, the

personal science teaching efficacy alpha scores were .86 and the outcome expectancy subscale .66. The alpha scores for the personal science teaching efficacy scale were consistent with previously published data of .90 (Enochs & Riggs, 1990). Alpha scores for the outcome expectancy subscale in this study were lower than previously published data of .76.

Data Analysis

Initial data were collected from participants in two separate methods: physical and electronic. Physical data were compiled by running Scantron scoring sheets through a mechanical reader providing an electronic data file of comma separated values (CSV). Electronic data from online participants were gathered via Google Forms automatically to a CSV file. All CSV files were then compiled in the Microsoft Excel for statistical analysis. Statistical analyses were run using the software SPSS Version 22. Cronbach's alpha was used to determine internal consistency of each subscale in the full instrument. Confirmatory factor analyses were run to confirm the hypothesis that the PETAS-S measures a single factor after removal of the two items included in the PETAS-S as a concept check for self-efficacy. Maximum likelihood was used to determine goodness of fit.

RESULTS

Confirmatory Factor Analysis

Of the total participants, 9 cases were removed due to incomplete data for a net total of 142 cases used in the factor analysis. Confirmatory factor analysis (CFA) was conducted to affirm the underlying factor structure of the set of items in the questionnaire. The data in this study was consistent with a pilot study of the PETAS-S in fall 2014 ($n = 38$). The four groups of participants (UCF - face-to-face & online; USFSP - face-to-face & online) revealed no inter-group differences, although the individual groups were not large enough to achieve statistical significance. An analysis of the STEBI-B and the PANAS scales was completed to compare the data in this sample to existing published data. Results for all scales were consistent with previous published samples.

The identity of each factor was determined after a review of which items correlated the highest with that factor. Items that correlated the highest with a factor define the meaning of the factor as judged by what conceptually ties the items together. Initial examination of the descriptive statistics revealed that the variables were relatively normally distributed. Maximum likelihood was used as the factor extraction method due to its support of a broad spectrum of indexes for the goodness of fit model (Fabrigar, Wegener, MacCallum, & Strahan, 1999). Varimax was used as the rotation method because the items are theoretically correlated. Scree plot helped in examining the graphical plot of eigenvalues and in determining the number of factors to be retained. Small coefficients that had values less than .10 were suppressed.

Kaiser's rule was used to determine which factors were most eligible for interpretation because this rule requires that a given factor is capable of explaining at least the equivalent of

one item's variance. This is not unreasonable given that the objective of factor analysis is to reduce several variables into fewer factors. Communalities were used to indicate the degree to which the factors explain the variance of the items. In a proper solution, the values of one or more communalities cannot exceed 1.00 because explaining more than 100% of a variable is theoretically impossible. The structure matrix helps to understand the alignment of items under a particular factor in a theoretically understandable manner (Tabachnick & Fidell, 1996).

The instrument, as presented, included 10 items for consideration in the final instrument. Of the ten items, two were included as concept checks against self-efficacy (I have generally received good grades in science, I can learn new things in science easily) and were removed for final analysis. One item (I find science uninteresting) did not load with the other items in the scale ($\alpha = .24$) as was also removed for the final analysis. The item, I think science is boring, was negatively scored to achieve a total score for the instrument. Using the Kaiser's rule, one factor was extracted for the PETAS-S items (Table 1).

Table 1: PETAS-S Factor Loadings

	Factor 1
1 I like science	.936
2 I enjoy learning new things in science	.921
3 I enjoy science	.920
4 I am enthusiastic about science as a subject	.910
5 I think science is an exciting subject	.896
6 As a future teacher, I am looking forward to teaching science.	.894
7 I think science is boring	.881

The initial examination of the eigenvalues shows that this factor explained approximately 83.0% of the total variance. Examination of the scree plot (Figure 1) revealed one factor where the

break point in the data occurred and the curve flattened out. The values of communalities do not exceed 1.00 for any of the items indicating that maximum likelihood converged to a proper solution and the results are appropriate for interpretation. The presence of a single factor did not allow for a rotation.

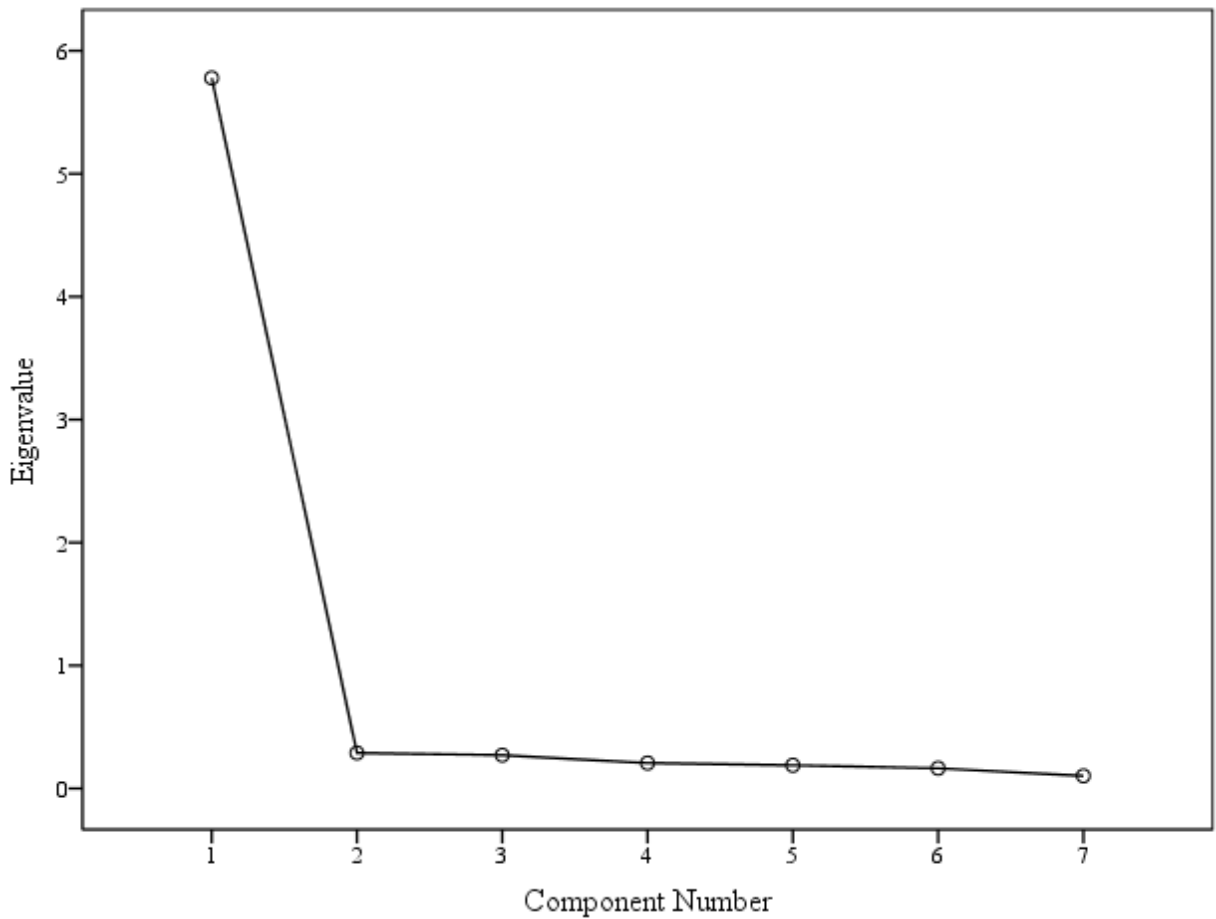


Figure 1: PETAS-S Factorial Analysis Scree Plot

PETAS-S Reliability

Reliability for PETAS-S after “I find science uninteresting” removed achieved high alpha scores as expected ($\alpha = .96$). Internal consistency for the PETAS-S showed high reliability between items with correlations ranging between .72 and .87 (Table 2).

Table 2: PETAS-S Inter-item Correlation Matrix

	1	2	3	4	5	6	7
1 I like science	-						
2 I enjoy learning new things in science	.871	-					
3 As a future teacher, I am looking forward to teaching science.	.814	.800	-				
4 I think science is an exciting subject	.791	.836	.757	-			
5 I am enthusiastic about science as a subject	.811	.793	.806	.773	-		
6 I think science is boring	.808	.758	.720	.757	.775	-	
7 I enjoy science	.851	.798	.792	.786	.830	.790	-

The PETAS-S had positive correlations with the Personal Science Teaching Efficacy Belief subscale ($r = .65, p < .01$), the Outcome Expectancy subscale ($r = .25, p < .01$), the PANAS PA subscale ($r = .32, p < .01$), and the PANAS NA subscale ($r = .18, p < .05$). All of these findings met predicted expectations based on previously published data. Results from the analyses for the PETAS-S indicate that it is a consistent and reliable instrument that measures a single factor based on the sample in this study. The PETAS-S also performed as predicted when compared to the additional subscales included in the study instrument. A full analysis of the PETAS-S scale internal consistency and reliability is shown in Table 3.

Table 3: PETAS-S Internal Consistency and Reliability

	N	Mean	Variance	SD		
Statistics for Scale	142	26.11	49.9	7.06		
	Mean	Minimum	Maximum	Range	Max/Min	Variance
Item Means	3.73	3.6	3.88	0.28	1.08	0.015
Item Variances	1.24	1.05	1.45	0.4	1.38	0.022
Item Total Statistics	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item Total Correlation	Squared Multiple Correlation	Alpha if Item Deleted	
I like science	22.5	35.56	0.91	0.85	0.96	
I enjoy learning new things in science	22.25	37.65	0.89	0.82	0.96	
As a future teacher, I am looking forward to teaching science	22.49	36.1	0.86	0.75	0.96	
I think science is an exciting subject	22.23	37.76	0.86	0.76	0.96	
I am enthusiastic about science as a subject	22.51	36.9	0.88	0.78	0.96	
I think science is boring	22.29	37.53	0.84	0.72	0.96	
I enjoy science	22.37	36.65	0.89	0.8	0.96	

Construct Validity

The seven final items selected for use in the PETAS-S are designed to measure positive affect toward the subject of science in preservice elementary teachers. These items were compared with the four separate subscales included in the instrument from this study as shown in Table 4.

Table 4: Inter-scale Correlations

	1	2	3	4	5
1 PETAS-S	-				
2 Personal Science Teaching Efficacy - STEBI-B	.646**	-			
3 Outcome Expectancy - STEBI-B	.249**	.218**	-		
4 Total Positive Affect Scale Score - PANAS	.318**	.356**	.216**	-	
5 Total Negative Affect Scale Score - PANAS	.176*	.344**	.030	.287**	-

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

Two of the subscales were from the STEBI-B (Personal Science Teaching Efficacy and Outcome Expectancy) and two from the PANAS (Total Positive Affect and Total Negative Affect). It was expected that the PETAS-S would positively correlate with these measures to varying degrees. Correlations with the Total Positive Affect Scale and the Personal Science Teaching Efficacy scale were expected to be higher, while the Outcome Expectancy Scale would be lower and the Total Negative Affect Scale being lowest and or negatively correlating.

Results were consistent with expectations based on previously published data. Levels of positive affect correlated to a greater degree with the Total Positive Affect Scale as well as the Personal Science Teaching Efficacy scale. The authors of the PANAS scale submit that positive and negative affect are not opposite, but orthogonal (Watson et al., 1988). For example, it is

possible for a preservice teacher to enjoy teaching science, but still have a level of anxiety toward the activity at the same time. Discriminant validity was determined by the low positive correlation found between the PETAS-S scale and the PANAS NA scale. The results of the PETAS-S provided strong evidence that this instrument produced a valid and reliable measure of the positive affect toward the subject of science in the sample of preservice elementary teachers included in this study.

DISCUSSION

This study sought to open a line of research to address the problem of declining interest in science by K-12 students by creating a new instrument to measure the affective component of a preservice teacher's attitude toward science. For over 100 years most research on declining interest in science has focused on inservice teachers and students. While some progress has been made, declining interest in science is still considered to be a pressing and ever-present concern in the minds of science educators (Dierks, Höffler, Blankenburg, Peters, & Parchmann, 2016). A majority of research is still focused on the process of teaching and the content of what is being taught, with a lesser focus on attitudes, and an even smaller focus on the attitudes of preservice teachers (Riegle-Crumb et al., 2015).

Research indicates preservice teachers bring their attitudes toward science with them from prior experience as a student (Czerniak & Chiarelott, 1990; Minger & Simpson, 2006; Tosun, 2000). Research has also shown that the decline in science interest begins as early as year two in elementary school and becomes fixed by year six (Turner & Ireson, 2010). These two findings would indicate that preservice elementary teachers' attitudes toward science have been with them a long time indeed, and that the cycle of negativity begins early in elementary education. It then becomes apparent that addressing the attitude of an elementary education teacher must begin prior to entering service.

I believe that self-reported positive affect toward science shows promise as a powerful indicator of a preservice teacher's future behavior as a teacher in the classroom, based on the literature review in this study. This belief is based on the number and quality of the constructs that use positive affect as a key indicator in their own assessments. Consistently, the presence of

positive affect toward a subject is a crucial component of interest (Hidi, 2006), intrinsic motivation as outlined in self-determination theory (Deci & Ryan, 2000), and cognitive engagement (Fredricks, Blumenfeld, & Paris, 2004).

Positive affect also works as an implicit motivator with the selection of non-conscious behavioral goals (Custers & Aarts, 2005). While this thesis study focuses specifically on an explicit self-report of positive affect, the study by Custers and Aarts (2005) is an additional piece of evidence to indicate the power of positive affect in the interplay between behavior and positive preferences for a subject.

The goal of this study, and the creation of the PETAS-S instrument, was to broaden the scope of research on declining student interest by focusing on preservice teachers' attitudes toward science before they enter the ranks of inservice teachers. In this study, I have provided initial evidence of the reliability and validity of the PETAS-S for measuring the degree of positive affect in preservice elementary teachers. The instrument is simple to administer, taking less than ten minutes from start to finish, and easy to score by a simple summed result. The PETAS-S is offered as a new and valuable tool in the research on, and education of, preservice elementary teachers.

Limitations

While confidence is high that future research will support the findings of this study, our sample size is small ($n = 151$) compared to the latest population report from 2013 data ($N = 17.5$ million) (Kena, Musu-Gillette, Robinson, Wang, Rathbun, Zhang, Wilkinson-Flicker, Barmer, &

Velez, 2015). The small sample size in this study and the limited use of the PETAS-S in field studies brings to light some limitations of note.

The PETAS-S has shown to be valid and reliable with this sample, but it is unknown exactly what behaviors it may predict. To date, the PETAS-S has not been used in pre- post-test studies, nor has it been correlated with any specific outcome or behavior. Also, the PETAS-S has not been used to confirm that positive affect toward the subject of science is trait-like and remains relatively fixed. While a number of studies have indicated that an individual's attitude toward science becomes relatively fixed at an early age (Potvin & Hasni, 2014; Turner & Ireson, 2010; Tytler & Osborne, 2012), the PETAS-S has not been used to corroborate these findings.

The PETAS-S is also a self-report measure. It is therefore limited by the participants' conscious appraisal of their level of positive affect toward science. The greatest threat toward the reliability of the PETAS-S is expected to be impression management where participants may alter their answers according to their perceived standards of social desirability (Pekrun & Bühner, 2014, p. 563).

Future Research

The questions central to the formation of the PETAS-S are ones that opens the doors to many other questions. Based on the research presented in this study, it is proposed that positive affect is a core emotional component of an individual's attitudes, which is in turn a core component of many favorable psychological conditions for optimal performance and well-being. Yet, the vast majority of this research does not address positive affect toward a subject of interest as a stand-alone concept for study. In fact, as of this writing, I have not found a single instrument

that focuses on positive affect as a single construct. Positive affect is, to my knowledge, consistently studied as part of a multi-factored construct. The PETAS-S will allow research to move forward to answer the questions of how positive affect, as a single factor of study, can predict behavior both in near-term and long-term scenarios.

A value of the PETAS-S in future research lies in its ability to assess the trait like quality of positive affect toward science after students have completed their undergraduate science education course(s). Typically, these courses seek to improve the confidence and competence of preservice teachers through the introduction of inquiry-based methods of instruction (Riegler-Crumb et al., 2015). A pre- and post-test method of administering the PETAS-S will indicate if varying methods of instruction can improve an individual's positive affect toward science.

It was not the goal of this study to produce or confirm any particular intervention during the instruction of preservice elementary teachers. However, based on the literature reviewed in this study, it would be recommended to include specific discussions about the role of attitude toward science and how it has been shown to affect teaching practices and student outcomes, especially during the teaching of a specific subject like science (Frenzel et al., 2009; Frenzel et al., 2015). The PETAS-S is expected to be a valuable tool in this type of intervention as it can be administered and measured in classroom settings. It would also be recommended that any intervention provide consistent and repeated goal attainment, as it has shown to cultivate positive affect and goal pursuit (Custers & Aarts, 2005). Science educators could then develop activities to help their preservice teachers set and attain personal goals. The positive experiences with science may then lead to long-term positive affect toward science.

There are many reasons that one chooses to become an elementary teacher, but the most salient one reported by students in an international study is to make a positive difference in the lives of children (Bastick, 2000). Assuming this to be true, how important might it be for a future teacher to know that their poor experiences and negative attitudes toward science means they are inclined to transmit that attitude toward their own students and reduce their students' love of science and possibly alter their career choices?

APPENDIX A: UCF IRB APPROVAL



University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Exempt Human Research

From: **UCF Institutional Review Board #1
FWA00000351, IRB00001138**

To: **Otis Wilder and Co-PIs: Malcolm B. Butler, Parul Acharya**

Date: **September 17, 2014**

Dear Researcher:

On 9/17/2014, the IRB approved the following minor modification to human participant research that is exempt from regulation:

Type of Review: Exempt Determination
Modification Type: An online version of the survey is being added to the study. A revised protocol and recruitment e-mail have been uploaded in iRIS. A revised consent document has been approved for use.
Project Title: Preservice Elementary Teacher Affect Scale for Science - Instrument Validation
Investigator: Otis Wilder
IRB Number: SBE-14-10496
Funding Agency:
Grant Title:
Research ID: n/a

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 09/17/2014 03:33:06 AM EDT

IRB Coordinator

APPENDIX B: USF IRB APPROVAL



RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX (813) 974-7091

8/9/2013

Otis Wilder, B.A.
USF St. Petersburg - College of Arts and Sciences
140 7th Avenue South
St. Petersburg, FL 33701

RE: **Exempt Certification**

IRB#: Pro00014035

Title: Preservice Elementary Teacher Affect Scale for Science – New Instrument Pilot Study

Study Approval Period: 8/9/2013 to 8/9/2018

Approved Items:

Protocol Document:

[PETAS-S - Study Protocol Rev.1 2013.08.05](#)

Consent Script:

[PETAS-S Pilot - IC - Rev.1 - 2013.08.07](#)

Dear Mr. Wilder:

On 8/9/2013, the Institutional Review Board (IRB) determined that your research meets USF requirements and Federal Exemption criteria as outlined in the federal regulations at 45CFR46.101(b):

(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.

Your study qualifies for a waiver of the requirements for the documentation of informed consent as outlined in the federal regulations at 45CFR46.117(c) which states that an IRB may waive the requirement for the investigator to obtain a signed consent form for some or all subjects.

As the principal investigator for this study, it is your responsibility to ensure that this research is conducted as outlined in your application and consistent with the ethical principles outlined in the Belmont Report and with USF IRB policies and procedures. Please note that changes to this protocol may disqualify it from exempt status. Please note that you are responsible for notifying the IRB prior to implementing any changes to the currently approved protocol.

The Institutional Review Board will maintain your exemption application for a period of five years from the date of this letter or for three years after a Final Progress Report is received, whichever is longer. If you wish to continue this protocol beyond five years, you will need to submit a new application at least 60 days prior to the end of your exemption approval period. Should you complete this study prior to the end of the five-year period, you must submit a request to close the study.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

A handwritten signature in black ink that reads "John A. Schinka, Ph.D." The signature is written in a cursive style.

John Schinka, Ph.D., Chairperson
USF Institutional Review Board

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