ABSTRACT

EXAMINING TEACHER SELF-EFFICACY ABOUT BEST PRACTICES IN SCIENCE
DURING A PROFESSIONAL DEVELOPMENT SERIES

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Using extant data that were collected as part of a larger project, the current study examined teacher self-efficacy and the teachers’ intentions to implement workshop content throughout the course of a six-week professional development workshop focused on enhancing science motivation for students through the adoption of specific instructional strategies. There were a total of 20 middle and high school teacher participants. Results indicated teacher self-efficacy changed significantly from pre to post. Teachers showed higher teacher self-efficacy after the professional development, in particular for influencing student engagement. In addition, we found a moderate correlation between the level of confidence after the implementation of a strategy and teachers intention of trying the strategy again. Finally, new direction for future research topics made possible by this study are presented.
EXAMINING TEACHER SELF-EFFICACY ABOUT BEST PRACTICES IN SCIENCE DURING A PROFESSIONAL DEVELOPMENT SERIES

By:

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DEDICATION

This thesis is dedicated to my family, in particular to my parents, Eligio and Antonia Menez, for their unconditional love and support. Thank you for teaching me to work hard for the things I aspire to achieve. To my siblings, for always being there. Finally, a special feeling of gratitude to my life partner Andres Moreno, who has been a constant source of strength, support and encouragement during this process. Thank you for always believing in me.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>LIST OF TABLES</th>
<th>vii</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF APPENDICES</td>
<td>viii</td>
</tr>
</tbody>
</table>

### Chapter

<table>
<thead>
<tr>
<th>1. INTRODUCTION</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem Statement</td>
<td>1</td>
</tr>
<tr>
<td>Research Questions</td>
<td>3</td>
</tr>
<tr>
<td>Operational Definitions</td>
<td>4</td>
</tr>
<tr>
<td>Overview of Method</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. CONCEPTUALIZING TEACHER SELF-EFFICACY</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact of Teacher Efficacy on Practice</td>
<td>12</td>
</tr>
<tr>
<td>Is Teacher Self-Efficacy Malleable?</td>
<td>14</td>
</tr>
<tr>
<td>Four Sources of Self-Efficacy</td>
<td>16</td>
</tr>
<tr>
<td>Professional Development as Means of Influencing Teacher Self-Efficacy</td>
<td>20</td>
</tr>
<tr>
<td>Measuring Teacher Self-Efficacy</td>
<td>23</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. METHOD</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context for Professional Development</td>
<td>24</td>
</tr>
<tr>
<td>Setting</td>
<td>25</td>
</tr>
<tr>
<td>Participants</td>
<td>26</td>
</tr>
<tr>
<td>Instruments and Measures</td>
<td>27</td>
</tr>
</tbody>
</table>
Chapter | Page
--- | ---
Overall Teacher Self-Efficacy | 27
Weekly Self-Efficacy, Reflection, and Intentions to Implement Strategies | 28
Procedure | 29
Analysis | 31
Coding Instructional Strategies | 33
Coding Potential Sources of Teacher Self-Efficacy | 34

4. RESULTS | 37
Change in Teacher Self-Efficacy: Pre/post Comparisons | 38
Change in Confidence to Implement Strategies- Weekly Surveys | 39
Overall Confidence after Implementation and Likelihood of Trying Strategy Again | 40
Potential Sources of the Change in Teachers’ Self-Efficacy | 41
Overall Results | 45
Weekly Examination of Strategy Choice, Confidence, Intention to Implement, and Sources of Efficacy | 45
Implementation of Strategies to Increase Value (Week 1) | 46
Implementation of Strategies to Increase Autonomy (Week 2) | 47
Implementation of Strategies to Increase Challenge and Emotion (Week 3) | 47
Implementation of Strategies to Increase Goal Orientation (Week 4) | 47
Implementation of Strategies to Increase Mindset (Week 5) | 48

5. DISCUSSION | 49
Types of Teacher Self-Efficacy: Efficacy for Instructional Strategies and Engaging Students | 49
Weekly Confidence as a Predictor of Future Intention to Implement Strategies | 54
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential Sources of Teacher Self-Efficacy</td>
<td>55</td>
</tr>
<tr>
<td>Mastery</td>
<td>56</td>
</tr>
<tr>
<td>Affect</td>
<td>56</td>
</tr>
<tr>
<td>Vicarious Experiences</td>
<td>57</td>
</tr>
<tr>
<td>Persuasion</td>
<td>57</td>
</tr>
<tr>
<td>Implications for Delivery of Professional Development</td>
<td>58</td>
</tr>
<tr>
<td>Future Research</td>
<td>61</td>
</tr>
<tr>
<td>Limitations</td>
<td>61</td>
</tr>
<tr>
<td>Concluding Remarks</td>
<td>62</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>63</td>
</tr>
<tr>
<td>APPENDICES</td>
<td>66</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table ........................................................................................................................................ Page
1. Professional Development Structure...................................................................................... 34
2. Means, Standard Deviations, and Cronbach’s Alphas for All Measures Used in Analysis ..... 38
3. Comparison of Weekly Confidence Before and After the Implementation of a Strategy ....... 40
4. Weekly Confidence After Implementation of a Strategy and Trying the Strategy Again........ 41
5. Weekly Strategies Discussed and Implemented................................................................. 42
6. Examples of Comments Coded Using the Four Sources of Self-Efficacy......................... 44
7. Potential Exposure to the Four Sources of Self-Efficacy by Week.................................... 45
## LIST OF APPENDICES

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. PROFESSIONAL DEVELOPMENT SURVEY (PRE AND POST)</td>
<td>66</td>
</tr>
<tr>
<td>B. PROFESSIONAL DEVELOPMENT WEEKLY GOAL</td>
<td>68</td>
</tr>
<tr>
<td>C. PROFESSIONAL DEVELOPMENT WEEKLY GOAL AND REFLECTION</td>
<td>70</td>
</tr>
<tr>
<td>D. QUALITATIVE DATA WEEK# 1- VALUE</td>
<td>72</td>
</tr>
<tr>
<td>E. QUALITATIVE DATA WEEK# 2- AUTONOMY</td>
<td>74</td>
</tr>
<tr>
<td>F. QUALITATIVE DATA WEEK# 3- CHALLENGE AND EMOTION</td>
<td>76</td>
</tr>
<tr>
<td>G. QUALITATIVE DATA WEEK# 4 - GOAL ORIENTATION</td>
<td>78</td>
</tr>
<tr>
<td>H. QUALITATIVE DATA WEEK# 5- MINDSET</td>
<td>80</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

The purpose of this study was to examine the impact of professional development (PD) on teacher self-efficacy. The professional development workshop aimed at providing middle- and high school science teachers’ with instructional practices to enhance adolescents’ motivation for science. Using extant data that were collected as part of a larger project, the current study examined teacher self-efficacy and the teachers’ intentions to implement workshop content throughout the course of a six-week PD focused on enhancing science motivation for students through the adoption of specific instructional strategies.

Problem Statement

According to Shumow and Schmidt (2014), numerous studies have found that motivation for academics declines during adolescence and declines most steeply for science relative to other subject areas. Declining motivation is a concern among many educators. One way to address the problem of low motivation is to educate teachers about how to enhance adolescents’ motivation for science (Shumow & Schmidt, 2014). This can be done through teacher professional development.

There has been a recent proliferation of professional development offered to teachers; however, we know relatively little about whether and how professional development models are
effective. According to Guskey (1986), an effective professional development model should 1) offer teachers practical ideas that can be directly applied in their classroom to enhance desired learning, 2) allow teachers time to apply these strategies in their classroom or practice, and 3) recognize that change is a process and that based on the experiences teachers have with the strategies implemented, we can see changes in teachers’ beliefs and attitudes. Guskey recommended that all professional developments should be followed with guidance and support for successful implementation. In addition, he found that teachers who experienced positive outcomes with the implemented strategies are more likely to express changes in beliefs and attitudes about their teaching practices. Researchers have argued that efficacious teachers are more open to new practices and more willing to try new ideas (Friedman & Kass, 2001; Pajares, 1996; Tschannen-Moran & Woolfolk Hoy, 2001). If a major goal of most professional development is to positively impact teacher behavior, professional development facilitators should make sure it enhances teachers’ beliefs about their ability to implement such behaviors. Consequently, it is imperative to see how professional development impacts teachers’ self-efficacy beliefs, as self-efficacy may be a mechanism to influence teacher behavior.

The current study analyzed extant data collected as part of a larger project to investigate the impact of a professional development workshop on teachers’ self-efficacy beliefs and behaviors. The study further examined whether participation in the workshop led to individual teachers’ willingness to adopt new strategies in his/her classroom. Another goal was to expand the research on teacher self-efficacy in middle and high school science classrooms.

The professional development observed in this research followed all of the guidelines for an effective teacher experience. For instance, during the professional development workshop offered by this study, teachers were asked to identify a strategy they wanted to implement for the
upcoming week. Once teachers selected a strategy, they were asked to implement the strategy in their classrooms. The following week, teachers were asked to report on their in-classroom experiences, at which time they received feedback from the professional development facilitators.

Many resources are being poured into professional development for teachers, and many schools value teachers’ efforts to continue attending professional developments as a way to acquire skill development (Goldschmidt & Phelps, 2010). But because professional development expends valuable teacher time and limited district resources, it is important to assess whether these activities are effective at changing teachers’ beliefs and behaviors about classroom practice.

Research Questions

The purpose of this study was to examine the effect of a six-week professional development (PD) workshop that utilized research based best practices to help middle- and high school science teacher participants engage students and enhance science motivation through researched-based instructional strategies. In particular, analysis focused on examining changes in the science teachers’ self-efficacy and their teaching practices as a result of their professional development experiences. The existing literature has shown that teachers who attend well-designed professional development, that is teacher-centered, are more likely to adopt new instructional practices (Guskey, 1986). In addition, previous research has demonstrated that teachers’ sense of efficacy affects the effort they invest in teaching, the adoption of new instructional practices and their persistence when students have a hard time with learning (Tschannen-Moran & Woolfok Hoy, 2001; Ross, 1998). This study examined whether teachers’
self-efficacy is associated with their intention to adopt new strategies from the offered professional development. Two specific questions guided my research:

1. To what extent, if any, does teachers’ self-efficacy to implement instructional strategies and engage students change over the course of a six-week professional development workshop in science pedagogy?
2. How are teachers’ self-efficacy beliefs related to their intention to implement best practices in their classroom?

Operational Definitions

The operational definitions used in this study are as follows:

**Instructional Strategies:** In this study, this term refers to research based practices and strategies discussed by Shumow and Schmidt (2014) that can increase student engagement, motivation and learning in science. The instructional strategies referred to in this study include simple practices that teachers can implement immediately, such as highlighting the value of science content, increasing student confidence in science, and offering praise.

**Personal Teaching Efficacy (PTE):** According to researchers (Klassen et. al., 2010; Tschannen-Moran & Woolfolk Hoy, 2001), PTE is a reflection of teachers’ own practice related to their confidence, training, experience and skills to develop or use strategies that overcome challenges to student learning and can lead to higher student motivation and engagement. Unlike, General Teacher Efficacy (GTE), which refers to the external factors that extend beyond the teachers own capabilities to teachers in general, PTE is more specific to the individual experience with students. PTE refers to a teacher’s belief or perception of his/her own abilities to achieve certain
outcomes related to students and classroom practice. According to a RAND study (as cited in Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998), this construct is more context specific to the individual teacher.

**Pre-Implementation Efficacy:** The confidence or belief teachers report about their ability to implement a strategy that was presented to them as part of the professional development.

**Post-Implementation Efficacy:** The confidence or belief teachers report about their abilities after implementing a strategy they chose to try in their classrooms from those presented to them during the previous week of the professional development.

**Professional Development:** Continuing education for professionals about best practices related to teaching. The professional development in this study was a six-week workshop about strategies that teachers can use in their classrooms to enhance student motivation for science.

**Instructional Strategies:** In this study, this term refers to research-based practices and strategies discussed by Shumow and Schmidt (2014) which can increase student engagement, motivation and learning in science. The instructional strategies referred to in this study include simple practices that teachers can implement immediately, such as highlighting the value of science content, increasing student confidence in science and offering praise.

**Weekly Goal:** Refers to a specific instructional strategy that the teacher has agreed to implement during the week following a professional development class, which is based on class readings and discussion. The teachers were required to identify a weekly goal in each week of the professional development workshop.
**Weekly Reflection:** Teachers’ written thoughts about their successes, challenges, and concerns regarding their implementation of a specific strategy suggested in the workshop. It also includes expression of intention to adopt the strategy in the future.

**Four Sources of Self-Efficacy:** According to Bandura’s (1986) model there are four main sources that affect self-efficacy:

- **Mastery experiences (Performance accomplishments):** Any teacher expression of success in the implementation of the strategy identified in the weekly goal.
- **Vicarious experiences:** Any expression or verbal response of intent to implement a strategy that was previously successfully implemented by another colleague.
- **Verbal persuasion:** Gained confidence through verbal encouragement from professional developmental facilitators and colleagues to attempt administering an activity that was previously viewed as difficult.
- **Emotional arousal:** Expression shared about how they felt about implementing a strategy and how did it go while doing so.

**Overview of Method**

The data for this study were collected from a professional development workshop offered to middle and high school teachers. The professional development was designed to share research-based instructional strategies to engage and enhance student motivation for science. The workshop was delivered using a face-to-face format. The professional development was offered over the course of six weeks. Teachers were given a 12-item Teacher’s Sense of Efficacy Scale (TSES) created by Tschannen-Moran and Woolfolk Hoy (2001) before and after the professional development series to measure pre-post changes in self-efficacy. The measure assessed two
factors of self-efficacy (1) implementing instructional strategies and (2) fostering student engagement. Each of the factors contained four items for a total of eight items.

In addition, two other instruments were used to collect data on the teachers’ weekly goals and reflections (a weekly goal survey and a weekly reflection survey). The weekly goal survey asked participants to choose a strategy or practice discussed in that week’s reading or web content the teacher would like to try in his/her classroom for the following week. Participants were asked to rank how confident they felt about their ability to implement their chosen strategy or practice in their classroom for the upcoming week. The second part (the weekly reflection survey) asked participants to reflect on the strategy or practice that was previously implemented in their classrooms. Three questions related to the teachers’ implementation of the strategy or practice. The first question asked participants to describe “How did it go?” Participants were also asked to report their level of confidence and how likely were they to adopt the strategy. Results from the surveys provided an indication of the effectiveness of the professional development on the participants’ instructional practices and engagement.
CHAPTER 2
CONCEPTUALIZING TEACHER SELF-EFFICACY

The theoretical foundation of self-efficacy is found in Bandura’s (1977) social cognitive theory. Bandura recognized teacher efficacy as a type of self-efficacy and alluded to it in his article “Self-Efficacy: Toward a Unifying Theory of Behavioral Change.” Bandura defines self-efficacy as people’s “beliefs about their capabilities to successfully carry out a particular course of action and produce given attainments successfully” (Bandura, 1977, p. 3). When this theory is applied to education, teacher self-efficacy has been found to be a good indicator of teacher effectiveness and a predictor of positive teaching performance in the classroom (Tschannen-Moran & Woolfolk Hoy, 2001). Teacher self-efficacy has been defined in different ways, one definition by Tschannen-Moran and Woolfolk Hoy (1998) is “the extent to which the teacher believes he or she has the capacity to affect student performance” (p. 202). Tschannen-Moran and Woolfolk Hoy (2001) defined teacher efficacy as a “judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated” (p. 783). For the purpose of this study, the Tschannen-Moran and Woolfolk Hoy (2001) definition will be used.

Many researchers have found that teacher self-efficacy impacts students (Friedman & Kass, 2002; Ross, 1994; Tschannen-Moran & Woolfolk Hoy, 2001). The big question is how is it measured? Teacher self-efficacy has not suffered from a lack of effort to find the perfect measure (Tschannen-Moran & Woolfolk Hoy, 2001). The current literature reflects two primary strands of thinking regarding the definition and measurement of teacher self-efficacy. The first
attempt to measuring teacher self-efficacy dates back to the RAND researchers who based their work on Rotter’s social learning theory (Tschannen-Moran, Hoy, & Hoy, 1998). According to Tschannen-Moran et al. that research gave precedence to the concept that self-efficacy is “the extent to which teachers believe that they could control the reinforcement of their actions that is whether control lay within themselves or the environment” (p. 202). The RAND researchers developed two items on a 5-point Likert scale (from strongly agree to strongly disagree) that produced compelling results when measuring teacher self-efficacy. The two items were related to two factors: General Teacher Efficacy (GTE) and Personal Teacher Efficacy (PTE). General Teacher Efficacy referred to external factors that might influence the student beyond the specific teachers’ control and capability. Personal Teacher Efficacy (PTE) referred to the factors tailored to be more specific and related to the individual teacher as well as to the teachers’ internal confidence and ability as a teacher (Tschannen-Moran et al.). This instrument drew attention to many questions about the reliability due to its reliance on only two items to measure teacher-efficacy. Intrigued by the results but concerned with the reliability of the instrument, researchers’ decided to develop more comprehensive measures. Some of the challenges of teacher self-efficacy measures were: including various levels of tasks; proving the opportunity for respondents to indicate their perceived efficacy beliefs in light of a variety of obstacles; and finding the optimal level of specificity for measurement.

The current study uses the Teacher’s Sense of Efficacy Scale (TSES) created by Tschannen-Moran and Woolfolk Hoy (2001) to address those concerns. This instrument was modified by the researcher to include eight items on a 9-point scale anchored at “1- nothing,” “3- very little,” “5- some influence,” “7- quite a bit,” and “9- a great deal” due to the focus of the professional development.
The second strand of theory and research came out of Bandura’s work (1977). Bandura introduced the idea of “outcome expectancy” (p. 193). Outcome expectancy is a person’s perception and estimate that if he/she performs a behavior at the expected level of competence, it will lead to or cause certain consequences, whereas, efficacy expectation is a person’s perception about his/her ability to perform certain tasks that are required to produce the outcomes. Bandura clarifies that self-efficacy differs from the other self-concepts (self-esteem, self-worth, etc.) in that self-efficacy is a context-specific judgment of competence to perform a particular task. Self-concept is measured more globally. In addition, he noted that self-efficacy has to do more with self-perception of competence rather than actual level of competence (Bandura, 1997). This is important because, based on Bandura’s (1977, 1993) explanation, people tend to overestimate or underestimate their actual abilities, which can influence their future actions and behaviors.

Bandura argued that self-efficacy differs from Rotter’s (1966) locus of control in that self-efficacy is the perception that one can produce certain task, whereas locus of control is more focused on the extent to which one believes that actions affect outcomes. In his 1997 book, Bandura demonstrated that these two concepts were very different and showed no relationship. He explained that self-efficacy was a strong predictor of behavior and locus of control was not. Schunk (1991) also contended that self-efficacy is distinct from learned helplessness in that learned helplessness is focused on perceived control over outcomes rather than on the individuals’ perceived abilities to achieve specific results.

Many researchers tried incorporating different findings, such as those by RAND Corporation (Woolfolk Hoy, 2001) and Bandura (1997), into the development of sophisticated measures. Despite these efforts, the instruments that have been developed have undergone scrutiny due to the interpretation and measurement of the construct. Studies examining teacher
self-efficacy have consistently found two common factors, personal teaching efficacy (PTE) and general teaching efficacy (GTE). Generally, researchers agree that PTE has to do with teachers’ personal feelings of their own competence as teachers; however, the meaning of GTE is not as simple and has been called into question. This has made finding the right instrument highly difficult due to the confusion and debate of the meaning of these factors (Tschannen-Moran & Woolfolk Hoy, 2001).

Researchers and theorists alike agree that teacher self-efficacy (TSE) is situational; however, what is not really clear is the level of specificity needed to measure this construct. These two issues have been a topic of debate among researchers studying this construct (Tschannen-Moran et al., 1998). Numerous instruments overlooked the specificity aspect of the process when measuring TSE. However, researchers, including Bandura (1997), have emphasized the importance of the level of specificity when measuring teacher self-efficacy, stating that teacher self-efficacy is not uniform across tasks. Bandura created a self-efficacy scale that seemed to reflect his concept of not too narrow nor too specific. He determined that teacher self-efficacy presented many issues such as those of measuring this construct in either a highly-specific or general way, in which the data may not be externally valid or may lose practical relevance beyond the specific skills. However, one of the shortcomings of Bandura’s scale identified by researchers was that the tasks in the seven subscales were not representative of a “typical teachers work life” (Tschannen-Moran et al., 2001, p. 795).

In light of the two theoretical strands and the extensive body of research about teacher-efficacy, a new teacher self-efficacy scale (TSES) was created and validated by Tschannen-Moran and Woolfolk Hoy (2001). Because this scale closely aligns to Bandura’s self-efficacy theory, it is considered to be a good measurement of this construct. In addition, many researchers
have investigated the validity and reliability of this measure and have found it to be adequately authentic (Klassen & Ming Chiu, 2010; Klassen et al., 2009).

Teacher self-efficacy in this study refers to the judgment of one’s own capabilities to successfully carry out tasks that can impact student learning and engagement (Tschannen-Moran & Woolfolk Hoy, 2001). Thus, the TSES, which combines personal competence and analysis of the task and has been highly correlated to Personal Teaching Efficacy (PTE), was used to measure teacher self-efficacy. Personal competence is measured by questions that are targeted toward perceptions of current abilities and strategies. (Tschannen-Moran & Woolfolk Hoy). Analysis of the task is measured by asking questions that produce inferences of the difficulty of a task and the skills it will take to succeed. Things that are normally considered in analysis of task are student abilities and motivation, in addition to instructional strategies (Tschannen-Moran & Woolfolk Hoy, 2001). The sum of these two concepts measures teacher efficacy. Teachers have to take into consideration their abilities and strategies when making a judgment of whether or not they are capable of successfully completing a task, which makes this tool relevant to the current study. In addition, since many researchers, including Bandura (1977, 1997), agreed that personal teacher efficacy (PTE) is important and needs to be directed toward a specific task. We measured this construct utilizing weekly surveys about their level of confidence with a given strategy as it pertains to teaching and engaging students in science.

Impact of Teacher Efficacy on Practice

According to Woolfolk Hoy (1998), teacher self-efficacy was identified over 25 years ago as one of the few teacher characteristics that had an influence on student achievement. This finding was reported in a study conducted by the RAND Corporation (as cited in Woolfolk Hoy,
The challenging task of creating an environment conducive to learning lies with teachers, and many researchers agree that self-efficacy affects teachers’ behaviors (Bandura 1997, 1993; Woolfolk & Hoy, 1990, 2001; Gibson & Dembo 1984; Guskey and Passaro, 1994; Klass & Ming Chiu, 2010). Therefore, it is important to acknowledge the influence that efficacy has on teacher behaviors as it relates to students and the classroom.

Several researchers have agreed that teacher self-efficacy is linked to the level of effort that a teacher puts into their classroom activities and work, as well as, how they behave with students who show difficulty learning. Bandura (1997) argued that self-efficacy beliefs affect a teacher’s choice of activities and the time frame of those activities, in addition to the effort expended planning and persisting when confronted with difficult situations. In particular, teachers who are highly efficacious are more likely to influence and persist in the presence of adverse situations with students who are difficult and have low learning motivation (Friedman and Kass, 2002). Tschannen-Moran, Woolfolk Hoy and Hoy (1998) found that teachers with high-efficacy display a greater sense of organization and planning as it relates to classroom and students; in addition, they also show a better sense of keeping an open mind about new instructional strategies and ideas that can benefit student learning. Likewise, Gibson and Dembo (1984) found that teachers who have high-efficacy devote more time to academic learning, are better able to guide students to find the correct responses through their questions rather than asking someone else for the response, and communicate higher expectations by providing less criticism to students. According to Woolfolk and Hoy (1990), teachers with a sense of high-efficacy are more likely to encourage student autonomy, intrinsic interest, trust and responsibility. In this study, teacher self-efficacy was assessed as an indicator of the effectiveness of the professional development.
Is Teacher Self-Efficacy Malleable?

Although we know the impact that teacher efficacy has on teaching practice, research on teacher self-efficacy has found that efficacy beliefs of experienced teachers are difficult to change. Many experienced teachers have a set sense of efficacy even when they are exposed to different workshops (Ross, 1994). This makes it difficult for teachers to see the value of integrating new practices into their teaching. According to Bandura (1997), producing positive changes in already established efficacy beliefs requires constructive and convincing feedback that forces one to question their preexisting capabilities. Bandura explained that when people gain a new skill they first hold their current efficacy beliefs in a provisional status to analyze the acquire knowledge and skills before judging what they are able to do. This means that for the most part many teachers have a set way of thinking about their capabilities. The result of these firmly held beliefs suggests that the actual process of change has to originate with compelling evidence that the change has benefited student learning and needs.

According to Tschannen-Moran, Hoy and Hoy (1998), changes are difficult and at times uncomfortable and stressful for teachers. Research has shown that initial implementation of change has a negative effect on personal teaching efficacy because many teachers have to learn and understand the change before it can be implemented. However, when teachers are able to witness the improvements of such changes the personal teaching efficacy increases. Guskey (1988) found that the more efficacious teachers exposed to training tend to rate the new methods as more important. He also argued, similar to Tschannen-Moran, Hoy and Hoy (1998), that when teachers first implement changes from training, their self-confidence decreases. Those individuals who choose to not implement any changes after training had greater confidence than
those who did. According to Guskey (1984), one explanation for this can be that teachers who have a high level of confidence do not feel the need to incorporate a new strategy, especially if they think they are already doing what they perceived to be their best.

According to Tschannen-Moran, Hoy and Hoy (1998), higher personal teaching efficacy is related to the willingness to make use of a teaching network, which in turn has been related to increases in student achievement. Researchers (Guskey, 1988; Tschannen-Moran, Hoy & Hoy, 1998) found that when teachers try to implement a new strategy, their initial efficacy beliefs will be lowered due to the interruption of the existing practices. However, those beliefs will soon increase when the strategy is found to be effective and the improvement of the changes is consistent and positive. As a result, enhanced efficacy of teachers can potentially motivate educators to search for new skill development opportunities and allow them to be open minded to new strategies.

Tschannen-Moran, Hoy and Hoy (1998) state that teachers need evidence of increased student learning before new higher efficacy beliefs take effect. They also stated that helping teachers feel a greater sense of control over their professional lives in education setting will increase their sense of teacher efficacy and make for greater effort, persistence, and resilience.

According to Bandura (1997), people tend to distribute their efforts based on the effect they expect their actions to have. Therefore, peoples’ behaviors are better predicted from their self-efficacy beliefs than from the consequence of their actions. According to Bandura’s theory, efficacy beliefs are developed by four main sources of influence. The four sources are mastery experiences, vicarious experiences, verbal persuasion and emotional arousal (Bandura, 1997).
Four Sources of Self-Efficacy

According to Bandura (1997), people’s beliefs about their efficacy are influenced by four main sources. These sources help inform and develop one’s own efficacy through the outcomes of a wide variety of experiences, tasks, and situations. The first source is mastery experiences, which are critical for self-efficacy. According to Bandura (1997), mastery experience or experiences in which one was successful contribute to a strong belief in one’s personal efficacy. Success increase self-efficacy while a failure lowers it. After self-efficacy has been strongly developed through repeated personal successes, the impact of failures on efficacy is likely to be reduced. However, if self-efficacy has not been successfully developed the impact of failures are more likely to decrease self-efficacy. The effects of failures on self-efficacy are partly dependent on timing and the total amount of experiences. For instance, if the failures come after many successes, the individual is more like to persist in adverse situations and understand that even the most difficult situations can be overcome with sustained effort (Bandura). According to Bandura, when a person is able to overcome failure and enhance self-efficacy, this behavior can be transferred and applied to different situations. For instance, increased self-efficacy gained through mastery of a specific skill can increase coping efforts for other situations. The current study analyzed self-efficacy for implementing an instructional strategy before and after the teacher had the chance to implement the strategy. Opportunities for mastery were provided through asking teachers’ to select one instructional or engagement strategy that was identified in Shumow and Schmidt (2014). The professional development entailed allowing participants to apply strategies in their classroom and providing opportunities for reflection, practice, and feedback. Mastery experience in this study was any successful implementation of a strategy that
was previously identified by the teacher. The teacher expressed their success during the discussion section of the workshop or in their written reflection. It was hypothesized that experiences of successfully implementing the strategy would help inform their efficacy.

Vicarious experiences, as described by Bandura (1994), are experiences provided by social models. Bandura (1977) suggested that witnessing people who appear to be similar to oneself succeed in activities that may be perceived by the observer as threatening without negative consequences increases the belief that the observer is also capable of succeeding in similar activities. On the other hand, observing others similar to the observer fail increases the belief that the observer is not capable of carrying out similar activities. This effect tends to lower observer efficacy and undermine their efforts (Bandura, 1994). Vicarious experiences have a high effect on self-efficacy only when the models are perceived to be similar to the observer. The greater the similarities, the more the observer associates with the model’s successes and failures. For instance, if the observer identifies with the model, the observer also identifies with the outcome of the activity whether it is successful or a failure. When there are successes, the observers’ self-efficacy may increase, and when there is a failure, self-efficacy may decrease, especially when the observer’s self-efficacy is developing and not yet strengthen (Bandura, 1977). During the professional development workshops, teachers were able to experience vicarious experiences through discussion. One example of this was through group sharing. For instance, if a teacher shared his/her success or failure of a certain activity, other teachers might feel that they would also be able to experience such an outcome, whether a success or a failure. When a teacher expresses interest or confidence to implement a strategy due to someone else’s success and vice-versa, this will be a sign of vicarious experiences. In addition, the professional
development included videos of experienced teachers demonstrating strategies because models are more credible when they share the same characteristics with the learners.

Verbal persuasion is the act of influencing human behavior by strengthening their beliefs about their success. According to Bandura (1977), people are likely to try hard and persist when someone verbally persuades them about their own ability to master or be successful in given activities or situation. However, Bandura (1977) suggested that verbal persuasion is not enough at times and that it is a relatively weak source of efficacy information. Verbal persuasion should be coupled with conditions that would facilitate effective performance. Otherwise the persuaders’ credibility can be questioned or discredited. On the other hand, Bandura (2005) explained that it is difficult to impart high beliefs of personal efficacy by social persuasion alone. An unrealistic boost of motivation with disappointing results can disconfirm beliefs and tends to decrease efficacy. Social persuasion used negatively can undermine people’s capabilities; therefore, people who have been told that they do not possess certain skills are less likely to avoid activities that require the capabilities in question. These individuals are also likely to avoid challenging activities. Bandura (1977) suggested that for these reasons social persuasion should be complemented with opportunities and experiences that show and achieve successful results. Bandura was clear in the fact that social persuasion has a more powerful effect on decreasing rather than increasing efficacy (Bandura, 1994). In the current study, teachers were able to experience social persuasion from their colleagues and professional development facilitators during the workshops. Teachers were provided with different resources (website and videos) and activities (worksheets) that illustrated the success of certain activities and structures that could work with different strategies to bring the teacher success in addition to encouragement and
verbal persuasion. Moreover, facilitators offered frequent assurances that implementers would be successful.

Emotional arousal is the individual’s personal interpretation of his/her physical and emotional state. People tend to consider this internal feedback when they are making judgments about self-efficacy. According to Bandura (1993), people tend to rely partly on their emotional arousal (either anxiety or excitement) when making judgment about their capabilities. Attribution plays a role in this source of information due to the individuals’ perception of their emotional and physical state. For instance, according to Bandura (1977), if an individual attributes their success to internal factors such as ability or efforts, self-efficacy can be strengthened. However, if the individual attributes success to external factors out of the persons’ control (such as luck), then self-efficacy can weaken. During the professional development workshops, the teachers were asked “how confident they feel” about the strategy before and after implementation. In addition, teachers were also given the chance to reflect on “How it went” when they implemented the strategy. These questions provided information about the state of the teacher before and after the implementation and gave information about the way they felt, which could have impacted the outcome of the activity. Furthermore, the professional development for the most part sequenced the introduction of strategies from least threatening (storytelling, making content relevant) to more threatening (sharing control of the classroom through autonomy). Facilitators also constantly minimized the fears of implementation by addressing what could go wrong and highlighted examples of how to best implement certain strategies to create success.
Professional Development as Means of Influencing Teacher Self-Efficacy

Historically, professional development has been a central component to improving practice (education). Professional development has been described as a continuous inquiry to practice (teaching) (Posnanski, 2002). Teacher self-efficacy has been linked to professional commitment. For instance, Tschannen-Moran, Hoy and Hoy (1998) notes that the more efficacious a teacher is the harder they will try to overcome obstacles faced by students and seek ways to improve instruction. Usually, teachers use professional developments to change practice due to the implication it has on education. Educational institutions rely heavily on professional developments offered to teachers as a way to continue providing professional training. But according to Guskey (1986), professional development has suffered from lack of quality.

Many teachers seek professional development as a way to enhance their current skills and continue to meet their students’ needs. One of the important reasons educational leaders should pay close attention to teacher self-efficacy is the impact that it has on implementing new instructional strategies presented through a professional development. It is commonly believed that professional development can lead to changes in teachers’ practice, perception, and affective characteristics that ultimately influence student learning (Guskey, 1984). Previous research shows a positive effect between training (professional development) and teacher-efficacy (Watson, 2006). Specifically, Guskey’s (1984) research has suggested that professional development done right can contribute to higher teacher efficacy and higher efficacy has been related to the likelihood of integrating new instructional strategies in the classroom that can impact learning. One of the biggest pitfalls of professional development is failing to consider one’s audience by ignoring things such as “what motivates teachers to engage in professional
development” (Guskey, 1986, p. 6) and failing to consider that change is a process that takes time and effort (Guskey 1984; Tschannen-Moran & McMaster, 2009).

Although we understand the need for teachers to continue developing professionally, previous research has suggested that the form a professional development takes is an important indicator of whether or not teachers will implement and adopt the introduced instructional strategies in their classroom (Tschannen-Moran & McMaster, 2009). Many professional development models have focused on changing teachers’ perspectives (beliefs and attitudes) from the beginning, which seems to be almost impossible. Researchers (Guskey, 1984, 1986; Tschannen-Moran & McMaster) agree that in order for teachers to change their practice or have any impact on teaching practice, professional development should focus on the following: providing support and feedback; being relevant to teacher’s subject of interest; providing opportunities for practical application; and building in mastery experiences, which can help with building confidence and success.

In light of all the research that pointed out that professional development needed to be reinvigorated, Guskey (1986) proposed a new model that provided a different way of designing professional development. He suggested that designers need to take into consideration that change is a difficult process for anyone let alone teachers. Finding something new that is meaningful and becoming proficient at it require time and effort. This means that teachers may find themselves resistant to the amount of work it can take to change their practices, at least in the beginning. Guskey (1984) found that for the most part teachers are reluctant to adopt new practices unless they are certain and feel confident that they can make them work in their classroom.
For professional development to be successful, it must provide guidance on how the new strategies can be implemented incrementally without too much disruption or extra work. In addition, it should be presented in a clear and explicit way, should be explained in concrete rather than abstract theoretical terms, and should be aimed at specific rather than global skills (Guskey, 1986). Guskey’s model of the process of teacher change, suggested that in order for change to happen, professional development materials and substance has to have a good rationale for teachers to change classroom practices. The result can lead to change in student learning outcomes and ultimately to change in teacher beliefs and attitudes, if successful results are to be acquired. Thus, he pointed out that it was necessary to acknowledge that change is a difficult process that requires teachers to receive regular feedback on student learning and continued support and follow-up after the initial training.

In accordance with Bandura’s (1977, 1997) social cognitive theory, powerful professional development should integrate an authentic mastery experience in the teacher’s regular teaching context. The professional development in the current study examined the mastery experience through having teachers’ use a chosen strategy in the classroom. Previous studies have suggested that this often increases self-efficacy when it is accompanied by verbal persuasion and feedback (Tschannen-Moran & McMaster 2009).

Research (Guskey 1984, 1986; Tschannen-Moran & McMaster, 2009; Watson, 2006) has indicated that providing a one-time professional development opportunity is not sufficient to change practice. Instead they emphasized the need to continue to guide teachers through the desire course of action to have a long-term impact in teaching and learning, due to the fact that it really does not matter if a teacher thinks he/she can implement strategies from a professional development into the classroom. It is when they actually try to implement a new approach that
questions, concerns and doubts rise to the top, and if there is no guidance, it is likely that they
will not persist (Guskey, 1984, 1986). Despite all of this, a professional development series of
workshops can change the way teachers think about their students and their practice in ways that
will impact their practice in the long-term. As a result, the current study examined the impact not
just on practice but also on efficacy by looking at the impact on overall efficacy and efficacy for
implementing specific practices introduced in the professional development.

Measuring Teacher Self-Efficacy

The selection of the particular professional development course (Enhancing Science
Motivation) was a sample of convenience. Yet the topic being addressed was an important one
for educators. In this ex post facto study, I examined the impact of professional development on
teacher self-efficacy as well as personal teacher self-efficacy before and after the implementation
of a new strategy introduced in the professional development course. To do this, a teacher self-
efficacy scale (TSES), created and validated by Tschannen-Moran and Woolfolk Hoy (2001),
was used to measure efficacy. Because this scale closely aligns to Bandura’s self-efficacy theory,
it is said to be a good measurement of this construct. In addition, the validity and reliability of
this measure has been found to be highly valid and dependable (Klassen & Ming Chiu, 2010).
CHAPTER 3

METHOD

The current project was a secondary analysis of extant evaluation data collected as part of a project focused on disseminating research findings. This project is described briefly below.

Context for Professional Development

A large university in the Midwest received a grant from the National Science Foundation (NSF) to create the Science in the Moment (SciMo) project. SciMo focused on documenting, describing, and understanding students’ momentary levels of cognitive and engagement while learning high school science (NIU Science in the Moment, n.d.).

The purpose of the SciMo project was to investigate and provide a descriptive account of what a variety of high school science contexts feels like from the student’s perspective. This project served as a platform for the creation of the Empowering Teachers to Enhance Adolescents’ Motivation for Science (E-TEAMS) Project. The E-TEAMS project was also funded by the National Science Foundation (NSF). It resulted in a book and resources that teachers used to understand and influence student motivation for science (Northern Illinois University, n.d.).

The goal of E-TEAMS was to provide large numbers of science teachers with the resources they needed to understand and influence motivation for science among their students.
The E-TEAMS project led to the creation of a book, *Enhancing Adolescents' Motivation for Science, Research-Based Strategies for Teaching Male and Female Students* (Shumow & Schmidt, 2014), that contains foundational knowledge, practical applications, and self-study materials on how to enhance motivation for science among males and females in high school. In addition, E-TEAMS also shared supporting materials that complemented the book through a website dedicated to this project. The website contains many resources such as handouts (surveys, and reflection exercises), reading materials, selected web links, and presentation materials to be used by the science educators and for teachers to share with parents as well as. It also includes over 80 documentary video clips of the teaching practices and activities discussed in the book as they unfolded in classrooms and of practicing scientists talking about influential people in their career choice. While the book and resources were created with funding from the National Science Foundation, the professional development workshop was funded through a grant awarded to the participant school district. The data analyzed for this thesis were collected as part of the evaluation that was required for the grants that funded both parts of this project.

**Setting**

During Spring 2014, the professional development took place in a large school district in the Midwest. According to the U.S. Census data (2010), this school district had a population of more than 150,000, and approximately one quarter of this area’s families lived below the poverty level, compared to the state average of around 13%. The unemployment rate for this district was 12%, which is higher than the states’ average of only 10% (U.S. Census Data, 2010).

The district had a partnership with a large area university, which created the opportunity for this project to take place. According to the District-Schools’ Report Card website, as of 2013,
this Public School District had an enrollment of approximately 27,000 students. The student population for the district consisted of 34% White, 30 percent Black, 26% Hispanic, 4% Asian, and 6% Multiracial. Based on the District-Schools Report Card nearly 80% of students are considered low income. The student mobility rate for 2013 was 15% (District Report card, 2012).

In 2013, the district reported that nearly 1,700 teachers worked in this district. In 2012, the teachers’ demographics were such that the vast majority are white and approximately 12 percent were minority. In 2012, nearly three-quarters of the teacher population (74.4%) were women (Interactive School Report Card, 2012-2013).

Participants

The principal investigators of the NSF project solicited science teachers from public middle and high schools in the district to participate in the professional development workshop through a variety of methods, including recruitment fliers, an informational meeting, and electronic messages. The fliers asking for volunteers to participate in a professional development to encourage student engagement and motivation in science were distributed by the professional development coordinators. An informational meeting was held with teachers from the district schools to create a cohort for the professional development. Participants were asked to sign-up before the informational meeting by contacting the professional development coordinator. The first 20 people to sign-up were guaranteed a spot in the professional development. The announcement advertised that this was a first-come first-served basis. A stipend was paid to teachers who participated in all of the professional development modules.
A total of 20 participants were recruited. Teacher participants consisted of 30% males and 70% females. Sixteen teachers self-reported background information; of those 16, 44% reported having a bachelor’s degree and 56% reported having a master’s degree. Participants were asked about the number of years of experience teaching. Of the 17 participants who responded, 59% reported having between 1-10 years of experience, 29% reported having between 11-20 years of experience, and 12% reported more than 20 years of experience. The major teaching assignments of these teachers were in the area of science (e.g. physics, general, STEM, biology, chemistry, and anatomy).

Instruments and Measures

This ex post facto study conducted secondary analysis of surveys collected as part of the evaluation procedures that were required by the two grants that funded the professional development. All surveys as well as the scales are presented in Appendixes A-C.

Overall Teacher Self-Efficacy

Pre-and post-surveys were administered to provide measures of self-efficacy from the 12-item Teacher’s Sense of Efficacy Scale (TSES) created by Tschanne-Moran and Woolfok Hoy (2001). The original TSES contained 12 items with four items in each of the three factors. The three factors were instructional strategies, student engagement, and classroom management. For the purpose of this study, items pertaining to classroom management were not included because the professional development did not address this topic. The two factors that were measured are instructional strategies and student engagement. Each of the factors contained four items for a total of eight items. Participants were asked to rate how confident they felt about each of the
tasks in their classrooms. The questions (tasks) pertained to instructional strategies and student engagement. For example, one item asked, “How much can you do to craft good questions for students?” Teachers were asked to rate these tasks using a 9-point response scale, ranging from 1-Nothing, 3-Very little, 5-Some Influence, 7-Quite a Bit, and 9-A Great Deal (see appendix A).

Recent studies have found that the 12-item TSES used in this study showed convincing evidence of invariance and strong consistency among American teachers as well as international teachers (Bong, Chong, Georgiou, Huan, Klassen, Usher, & Wong, 2009). According to the creators of the 12-item TSES, the reliability for the 12-item scale is 0.90, demonstrating high internal consistency. Construct validity of this short form was examined by assessing its correlation to other measures that assess teacher self-efficacy. It was concluded that this measure is the most valid when assessing personal teaching efficacy. In sum, Tschannen-Moran and Woolfok Hoy’s (2001) study found that the TSES was considered to be both valid and reliable. According Tschannen-Moran and Woolfok Hoy, the tool was thought to be a useful measure for researchers interested in exploring teacher self-efficacy.

**Weekly Self-Efficacy, Reflection, and Intentions to Implement Strategies**

In addition, two other instruments were used to collect data on the teachers’ weekly goals and reflections (the weekly goal survey and the weekly reflection survey). These instruments were created to measure teacher confidence before and after the implementation of a strategy. The weekly goal survey asked participants to choose a strategy or practice discussed in that week’s reading or web content that the teacher would like to try in his/her classroom for the week ahead. In addition, participants were asked to rank their confidence to implement their chosen strategy or practice in their classrooms for the upcoming week (see Appendix B). The
second part (the weekly goal and reflection survey) asked participants to identify the strategy or practice that was previously implemented in their classrooms. In addition, three questions were asked related to teachers’ implementation of the strategy or practice. The first question asked participants to describe “How did it go?” The other two questions asked teachers to rank the following: How confident do you feel about your ability to implement this strategy in your classroom now? And how likely are you to use this strategy again? The survey used a 5-point scale, ranging from 1= not at all, 2= slightly confident, 3= moderately confident, 4= very confident, and 5= completely confident (see Appendix C).

In addition, participants completed a survey that asked personal information such as: demographic information, background education and teaching experience prior to the first professional development. This information was gathered by the National Science Foundation grant director, and as a result, information was excluded from the professional development workshops’ pre and post survey and weekly surveys.

Procedure

In mid-January 2014, a pre-survey of teacher self-efficacy was administered to all participants registered for the professional development workshops. A link to pre-survey was emailed to the participants using Survey Monkey. All participants had to complete the survey prior to the first face-to-face meeting. The professional development consisted of one to two hour meetings once a week for six consecutive weeks. The professional development was conducted by the two researchers from a large area university who had authored all of the professional development materials used. The teacher participants met with the two researchers conducting the professional developments in a district office building after school. The primary
sources used in the professional development were the book that was written based on the research done by the two researchers conducting the professional development and on the corresponding website. The book chapters cover motivational constructs such as value, confidence, success, ability beliefs, challenge and emotion. Each class session covered one or two of these chapters/topics. The website had additional resources that related to each chapter of the book. Additional resources included, but were not limited to, handouts, reading materials, selected web links, and informational videos of best practices in science classrooms. Participants were expected to read relevant book chapters prior to coming to the professional development meetings. Meeting time was spent elaborating on book content, discussing applications, showing video exemplars from the website, identifying small suggestions from the book for teachers to implement in the upcoming week, and planning longer term changes in instruction.

The Weekly Goal Survey was administered to participants at the end of the first session and every session thereafter. Each participant selected a strategy or practice, based on the professional development discussion, to implement in their classrooms in the upcoming week. Once the teachers selected a strategy, they rated their confidence in implementing such using a 5-point scale, ranging from 1= not at all, 2= slightly confident, 3= moderately confident, 4= very confident, and 5= completely confident. The teachers were asked to try that method in their classrooms the following week.

The Weekly Reflection Survey was administered at the beginning of the second session of the professional development and every session thereafter. The questionnaire asked participants to identify the strategy or practice that was previously implemented in their classroom and to reflect on how it went. At that point, teachers rated their confidence level in
implementing the strategy. Likewise, the teachers rated the likelihood of repeating the strategy in their classroom using the same 5-point scale described above.

The pre-survey was emailed, and all responses were documented using an Excel spreadsheet. In addition, participants were monitored using the same method (attendance and weekly surveys). After the teachers who participated in the workshop had the opportunity to use mastery learning in their classes for six weeks, all teachers were again asked to complete the post survey. The post-survey was collected during the last professional development session. Both of these surveys were compared to identify if professional development had an effect on the teachers’ efficacy.

Each professional development session consisted of a series of best practices to better understand and enhance student motivation for science. The idea was to investigate if teachers’ self-efficacy levels were impacted by the professional development. Similarly, we wanted to know if the teachers were able to successfully implement the strategy they had selected and if their level of comfort had changed from when they first selected the strategy to when they had to actually implement.

Analysis

The data collected as part of the evaluation procedures for this professional development was analyzed to answer the research questions for this study. This was a secondary analysis of existing data. The demographic survey administered to all participants was used to provide demographic information. Quantitative comparisons and thematic comparison methods were used for analysis. Analysis further examined the teachers’ self-efficacy beliefs pre and post professional development through comparing mean scores of the total Teacher Self-Efficacy
Scale before and after the professional development. This was done using a dependent sample t-test to compare the person’s responses with across all of the data collection instruments.

To answer Research Question 1 (To what extent, if any, does teacher self-efficacy to implement instructional strategies and engage students, change over the course of a six-week professional development workshop in science pedagogy?), a dependent samples t-test was used to analyze the impact of the professional development workshops on the teachers’ self-efficacy beliefs and their teaching practice using a pre and post-survey. More specifically, a calculation of the overall efficacy scores in the pre and post surveys allowed for a comparison to identify any changes. A dependent sample t-test was also used to gauge statistical significance (e.g., p< .05). The effect size was calculated and interpreted using the coefficient of determination. The analysis of the surveys pre and post-data were processed using Microsoft Excel and SPSS. Tabulation and charts were provided for the ease of comparison between different surveys and categories. The results from the pre and post-surveys were used to estimate the impact of the professional development on the teachers’ self-efficacy.

To answer Research Question 2 (How are teachers’ self-efficacy beliefs related to their intention to implement best practices in their classroom?), weekly survey scale questions were analyzed by computing the average confidence score before and after each professional development. A dependent samples t-test was used to analyze any changes in confidence and level of significance (e.g., p< .05). The effect size was calculated and interpreted based on the coefficient of determination. A Pearson correlation between the confidence level after implementing a strategy and the likelihood of using the strategy again was also computed to identify any relationship. The level of confidence before and after implementation of each strategy was compared and coupled with the qualitative data. Thematic comparisons were
conducted using the open ended questions from the weekly surveys (weekly goal and the weekly goal and reflection).

Qualitative data from weekly surveys were categorized by strategies and comments provided by the teachers. Specifically, topics covered during the professional development were compared to topics selected and implemented by the participants each week. Furthermore, a qualitative collection of data via audio recording and descriptions enriched the statistical analysis of these surveys. Analysis of these surveys allowed elaboration on the analysis of how teachers’ self-efficacy beliefs are related to their intention to implement best practices in their classroom.

Coding Instructional Strategies

Participants’ responses to open-ended questions from weekly surveys were coded to reflect the particular instructional strategies chosen for implementation each week. A list of a priori categories for strategies was developed based on the strategies recommend by the book, Enhancing Adolescents’ Motivation for Science Research- Based Strategies for Teaching Male and Female Students (Shumow and Schmidt, 2014). The recommended strategies highlighted in each chapter were also the strategies presented to the teachers during the professional development. Table 1 shows a sample of the topics covered during each week. Teachers were asked to select a strategy from that particular week to implement. The professional development was offered for six weeks; however, teachers were only asked to implement during five of the six weeks due to time constraints. For a full list of strategies covered and implemented see Appendix D. These data were used to provide a descriptive account of the types of strategies implemented by the participants.
Table 1

Professional Development Structure

<table>
<thead>
<tr>
<th>Week</th>
<th>Chapter(s)</th>
<th>Sample Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2- Value</td>
<td>Model enthusiasm, inquiry and Problem Based learning.</td>
</tr>
<tr>
<td>2</td>
<td>4- Autonomy</td>
<td>Opportunities for students to take responsibility.</td>
</tr>
<tr>
<td>3</td>
<td>9-10 Challenge and Emotion</td>
<td>Monitor students challenge.</td>
</tr>
<tr>
<td>4</td>
<td>7- Goal Orientation</td>
<td>Make mistakes and ask students to catch them.</td>
</tr>
<tr>
<td>5</td>
<td>8- Mindset</td>
<td>Teach students that intellectual skills can be acquired.</td>
</tr>
</tbody>
</table>

Coding Potential Sources of Teacher Self-Efficacy

Qualitative data from teachers’ weekly reflection surveys and weekly class discussions were coded to identify references to any of the four potential sources of self-efficacy identified by Bandura (1997). The four a priori categories of mastery, persuasion, vicarious experience, and affect were used as the primary means of data reduction. Data reduction is one of several strategies discussed by Miles and Huberman (1994). Qualitative data reduction and analysis was used to support the quantitative analysis (which are the focus of this study) by “quantizing” teachers’ discussions of their experience to validate, explain, and elaborate on the quantitative findings (Miles & Huberman, 1994). In other words, the qualitative data provided a general sense of the prevalence of various sources of self-efficacy through the professional development experience but were not sufficient to support detailed qualitative analysis.

First, teachers’ responses to the question on the Weekly Reflection Survey “how did it go?” were coded to identify two potential indicators of sources of information, mastery experience and affective experiences. Mastery experiences were classified as positive (indicating successful strategy implementation) or negative (indicating unsuccessful strategy
Mastery experiences were coded positive if responses to the question “how did it go?” indicated a positive experience (e.g. “It went well,” “great,” or “fine”). However, if the response indicated a negative experience (e.g. “It didn’t go well,” “It was hard,” “students did not understand”), it was coded as a negative experience. Any cases in which the response was unclear (e.g., “one part went well, one didn’t,” or “it is not clear whether the implementation was successful or not”) were coded as ambiguous. Similarly, affective descriptions in teachers’ responses were coded. More specifically, if a response contained language such as “I enjoyed this activity” or “this activity was fun,” this was coded as positive. Conversely, if a response contained language such as “I did not like this activity,” “I felt uncomfortable” or “nervous,” the response was coded as negative. If the response is unclear (e.g., “it worked”), this was coded as ambiguous. Cases in which there was no discernable reference to affect were coded as not applicable.

Researcher notes from teachers’ weekly observations and discussions about strategy implementation were coded for vicarious exposure to success and failure and for verbal persuasion. These discussions took place during the first 5-10 minutes of each session. These discussions were audiotaped, and the researcher took supplementary field notes by recording any observations about potential sources of teacher self-efficacy. The audiotaped data was transcribed and included into the researchers’ field notes. It is not possible to ascertain the identities of the speakers for most comments, so these data were used to gauge participants’ vicarious exposure (to what degree were they exposed to other teachers’ success or failure stories about implementing the suggested strategies?). Each time a participant described a success story in discussion, this was counted as an instance of a positive vicarious experience. Stories of failure or struggle that were not resolved were counted as instances of negative vicarious

experience. For each class session, a tally count was taken for exposure to positive and negative vicarious experiences. In addition, through the observation and notes taken based on the conversations during the professional development, evidence of verbal persuasion (from facilitators, and colleagues) were included. Verbal persuasion from the session leaders included “you did great” or “I am sure your students enjoyed your enthusiasm.” Examples from peers included “that is a great idea, I never thought about doing that.” Examples of verbal persuasion in which the session facilitators or peers expressed positive encouragement and persuasion were coded as positive. If the verbal persuasion contained a tone of negativity or criticism “you did not implement correctly,” this was coded as a negative experience of verbal persuasion. This coding also resulted in a tally count representing the degree of exposure to vicarious success and failure and to persuasion in each class session.
CHAPTER 4

RESULTS

Prior to conducting the planned analysis, I computed descriptive statistics for all measures, and calculated indicators of internal consistency for all composite measures. This descriptive information is displayed in Table 2. Looking across the measures, mean scores for overall teaching self-efficacy fell in the range of 5.72 and 7.32 on a 9-point scale, indicating that teachers’ believed that they had some influence (5) to quite a bit of influence (7) on their use of instructional strategies and engagement of students. Teachers’ average score before the professional development ($M_{pre} = 6.38, SD = .94$) was closer to “some influence.” Teachers’ average score after the professional development ($M_{post} = 6.87, SD = .86$) measured closer to a 7 indicating that they believed they had “quite a bit of influence”.

The Teacher Self-Efficacy Survey included two subscales, efficacy for instructional strategies and efficacy for student engagement. The mean score before the professional development of efficacy for instructional strategies was at 7.03 ($SD = 0.88$) on a 9-point scale, while after the professional development the mean score increased to a 7.32 ($SD = 1.02$). The mean score before the professional development of efficacy for student engagement was at 5.72 ($SD = 1.11$) on a 9-point scale, while after the professional development the mean score increased to 6.42 ($SD = 1.09$). Internal consistency as measured by Cronbach’s alpha was at acceptable levels for all measures except the pre-measure for efficacy for instructional strategies ($\alpha = .594$). Despite the low alpha, this measure was retained because of its prior use in research and comparability to the post-measure, which had acceptable internal consistency. Turning to the
weekly measures, the mean score for teachers’ level of confidence before the implementation of a strategy was 3.59 ($SD= 0.70$) on a 5-point scale, falling between “moderately confident” and “very confident.” The mean confidence score after the implementation of a strategy was 3.79 ($SD= 0.70$). The mean of participants’ weekly ratings of their intention to implement a strategy again was 4.17 ($SD= 0.74$) on a 5-point scale, indicating that teachers believed that they were very likely to implement the strategy again, once they had tried it once.

<table>
<thead>
<tr>
<th>Instrument</th>
<th>$M$</th>
<th>$SD$</th>
<th>Cronbach’s alpha</th>
</tr>
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<tbody>
<tr>
<td>Teacher self-efficacy (pre)</td>
<td>6.38</td>
<td>0.94</td>
<td>.865</td>
</tr>
<tr>
<td>Teacher self-efficacy (post)</td>
<td>6.87</td>
<td>0.86</td>
<td>.826</td>
</tr>
<tr>
<td><strong>Subscale 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-efficacy for Instructional Strategies (pre)</td>
<td>7.03</td>
<td>0.88</td>
<td>.594</td>
</tr>
<tr>
<td>Self-efficacy for Instructional Strategies (post)</td>
<td>7.32</td>
<td>1.02</td>
<td>.832</td>
</tr>
<tr>
<td><strong>Subscale 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-efficacy for Student engagement (pre)</td>
<td>5.72</td>
<td>1.11</td>
<td>.863</td>
</tr>
<tr>
<td>Self-efficacy for Student engagement (post)</td>
<td>6.42</td>
<td>1.09</td>
<td>.859</td>
</tr>
<tr>
<td>Confidence (Pre)</td>
<td>3.59</td>
<td>0.70</td>
<td></td>
</tr>
<tr>
<td>Confidence (post)</td>
<td>3.79</td>
<td>0.70</td>
<td></td>
</tr>
<tr>
<td>Intention to implement (post only)</td>
<td>4.17</td>
<td>0.74</td>
<td></td>
</tr>
</tbody>
</table>

Notes: for measures of teacher self-efficacy $n= 19$ teachers. The scale range on all self-efficacy scales was 1 to 9. For measures of weekly confidence and intention to implement strategies in the future $n=74$ responses generated by 18 teachers. The scale range on weekly indicators of confidence and intention to use strategies in the future was 1 to 5.

**Change in Teacher Self-Efficacy: Pre/post Comparisons**

Dependent sample $t$-tests were used to compare teachers’ scores on the overall teacher self-efficacy measure as well as the subscales measuring efficacy for instructional strategies and efficacy for influencing student engagement. The results of the $t$-test examining the 8-item measure of overall teacher self-efficacy showed that overall teacher self-efficacy changed significantly over the course of a six-week professional development workshop in science.
pedagogy, with an average increase of .49 (SD=.72) ($M_{pre} = 6.38$, $SD = .94$, $M_{post} = 6.87$, $SD = 0.86$, $t (18) = -2.98$, $p < .05$). The coefficient of determination ($r^2$) indicated a medium effect size ($r^2=.33$).

A dependent sample $t$-test was used to compare teacher scores measuring teacher self-efficacy for instructional strategies. The results of the $t$-test examining the 4-item measure of teacher self-efficacy for implementing instructional strategies showed that this subcomponent of overall teacher self-efficacy did not change significantly over the course of the professional development workshop, with an average increase of 0.29 ($SD= 1.11$) ($M_{pre} = 7.03$, $SD = 0.88$, $M_{post} = 7.32$, $SD = 1.02$, $t (18) = -1.13$, $p > .05$). Additionally, a dependent sample $t$-test was used to compare teacher scores on the 4-item measure of teacher self-efficacy for influencing student engagement. The results showed that teacher self-efficacy for influencing student engagement changed significantly, with an average increase of 0.69 ($SD= 0.72$) ($M_{pre} = 5.72$, $SD = 1.11$, $M_{post} = 6.42$, $SD = 1.09$, $t (18) = -4.16$, $p < .05$). The coefficient of determination ($r^2$) indicated a medium to large effect size ($r^2=0.49$).

Change in Confidence to Implement Strategies- Weekly Surveys

A dependent sample $t$-test was used to compare teachers’ scores on overall teacher confidence before and after their weekly strategy implementation ($n= 74$ responses gathered from 18 teachers over 5 weeks). Results showed that, in general, confidence did not change significantly from before implementation to after implementation of a strategy ($M_{pre} = 3.59$, $SD = 0.70$ $M_{post} = 3.79$, $SD = 0.70$, $t (73) = -1.78$, $p > .05$).

Teachers’ pre-post implementation scores were examined separately for each week, to determine whether there were certain weeks in which confidence changed significantly. Table 3
shows that there was no significant difference between confidence before and after the implementation of a strategy in weeks 1 to 4. The topics covered during these weeks were: (1) Value, (2) Autonomy, (3) Challenge and emotion, and (4) Goal Orientation. However, there was a statistically significant change between confidence before and after implementation of strategies during week 5, when the topic covered was Mindset ($M_{before} = 3.55, SD = 0.61, M_{After} = 4.11, SD = 0.47, t(17) = -3.828, p < .05$). The coefficient of determination ($r^2$) indicated a medium to large effect size ($r^2 = .46$).

Table 3

Comparison of Weekly Confidence Before and After the Implementation of a Strategy

<table>
<thead>
<tr>
<th>Week</th>
<th>Confidence Before</th>
<th>Confidence After</th>
<th>95% CI</th>
<th>$r^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>1- Value</td>
<td>3.66</td>
<td>0.76</td>
<td>3.83</td>
<td>0.78</td>
</tr>
<tr>
<td>2- Autonomy</td>
<td>3.61</td>
<td>0.86</td>
<td>3.84</td>
<td>0.37</td>
</tr>
<tr>
<td>3- Challenge and Emotion</td>
<td>3.20</td>
<td>0.78</td>
<td>3.50</td>
<td>1.17</td>
</tr>
<tr>
<td>4- Goal Orientation</td>
<td>3.80</td>
<td>0.41</td>
<td>3.46</td>
<td>0.51</td>
</tr>
<tr>
<td>5- Mindset</td>
<td>3.55</td>
<td>0.61</td>
<td>4.11</td>
<td>0.47</td>
</tr>
</tbody>
</table>

Note. *Statistically significant; CI= Confidence Interval; LL= Lower Limit; UL= upper limit.

Overall Confidence after Implementation and Likelihood of Trying Strategy Again

Pearson Product Moment Correlation tests were used to examine the relationship between teachers’ scores on the overall confidence after the implementation of a strategy and their intention to implement the strategy again (n= 74 responses gathered from 18 participants over 5 weeks). First, I computed the correlations for the pooled data (n= 74). Next, correlations were computed separately by week. Results indicate a moderate positive correlation across 5 weeks, $r(72) = .539, p < .05$ with $r^2 = .29$, with a linear relationship between the two variables. This means that confidence after implementation can partially predict that participants will try the
strategy again. Twenty-nine percent of the variance in the likelihood of trying the strategy again can be explained by the level of confidence after the implementation of a strategy.

The relationship between teachers’ post-implementation scores and intention scores were examined separately for each week, to examine the strength of this relationship by week. Table 4 shows that there was a significant positive correlation between confidence post implementation and intention to try the strategy again, in weeks 1 (value), 3 (Challenge and Emotion), 4 (Goal Orientation), and 5 (Mindset). However, there was no statistical significance found in week 2 (Autonomy) between these two variables. Week 2 (Autonomy) had a weak correlation and week 5 (Mindset) had a strong correlation; the other weeks had a moderate correlation.

Table 4

Weekly Confidence After Implementation of a Strategy and Trying the Strategy Again

<table>
<thead>
<tr>
<th>Week</th>
<th>N</th>
<th>Correlation</th>
<th>$r^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Value</td>
<td>18</td>
<td>.581*</td>
<td>0.34</td>
</tr>
<tr>
<td>2- Autonomy</td>
<td>13</td>
<td>.234</td>
<td>0.05</td>
</tr>
<tr>
<td>3- Challenge and Emotion</td>
<td>10</td>
<td>.674*</td>
<td>0.45</td>
</tr>
<tr>
<td>4- Goal Orientation</td>
<td>15</td>
<td>.573*</td>
<td>0.33</td>
</tr>
<tr>
<td>5- Mindset</td>
<td>18</td>
<td>.748**</td>
<td>0.56</td>
</tr>
</tbody>
</table>

Notes. * $p < .05$, ** $p < .01$ (two tailed test)

Potential Sources of the Change in Teachers’ Self-Efficacy

To understand what conditions were present in the professional development experience that may have contributed to the observed increase in teacher self-efficacy, teachers’ reflections about their successes and challenges in implementing their chosen weekly strategies were examined. Prior to the presentation of these results, it is necessary to provide a brief overview of the strategies teachers chose to implement. There were a total of approximately 29 distinct
instructional strategies suggested by the workshop leaders throughout the professional development. Of the 29 strategies suggested 69% (or 20) strategies were implemented by one or more teachers. The other 31% (or 9) strategies were not implemented. In Weeks 1-4 (Value, Autonomy, Challenge & Emotion, and Goal Orientation), some, though not all of the strategies were chosen by one or more teachers for implementation. Week 5 (Mindset) was the only week in which all of the suggested strategies were chosen by one or more teachers. The specific strategies that were recommended and subsequently implemented by week are reported in Table 5.

Table 5
Weekly Strategies Discussed and Implemented

<table>
<thead>
<tr>
<th>Week (n Surveys)</th>
<th>Strategies Discussed</th>
<th>Strategies Implemented</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Value (18)</td>
<td>• Model enthusiasm&lt;br&gt;• Connect content with student interest, everyday life or other subjects&lt;br&gt;• Story telling&lt;br&gt;• Engage parent through information&lt;br&gt;• Inquiry and PBL*</td>
<td>• Model enthusiasm (5)&lt;br&gt;• Connect content with student interest, everyday life or other subjects (3)&lt;br&gt;• Story telling (8)&lt;br&gt;• Engage parent through information (2)</td>
</tr>
<tr>
<td>2- Autonomy (13)</td>
<td>• Opportunities for student to take responsibility&lt;br&gt;• Give students choices in class activities&lt;br&gt;• Provide students with materials to solve problems themselves, not answers to problems&lt;br&gt;• Use inquiry methodology&lt;br&gt;• <strong>Student ownership of the learning process</strong>*</td>
<td>• Opportunities for student to take responsibility (3)&lt;br&gt;• Give students choices in class activities (4)&lt;br&gt;• Provide students with materials to solve problems themselves, not answers to problems (1)&lt;br&gt;• Use inquiry methodology (5)</td>
</tr>
<tr>
<td>3- Challenge and Emotion (10)</td>
<td>• Monitor students challenge&lt;br&gt;• Be aware of attribution&lt;br&gt;• Study skills&lt;br&gt;• Use praise and verbal persuasion&lt;br&gt;• Use visuals and models&lt;br&gt;• <strong>Provide “low cost” challenges</strong>*&lt;br&gt;• Use role models <em>&lt;br&gt;• Treat mistakes as challenges AND chance to learn</em>&lt;br&gt;• Differentiate (discuss barriers &amp; opportunities)*</td>
<td>• Monitor Students challenge (1)&lt;br&gt;• Attribution (1)&lt;br&gt;• Visuals (6)&lt;br&gt;• Study skills (1)&lt;br&gt;• Verbal persuasion (1)</td>
</tr>
</tbody>
</table>

Table continued on next page
Table 5 cont. from previous page

<table>
<thead>
<tr>
<th>Week (n Surveys)</th>
<th>Strategies Discussed</th>
<th>Strategies Implemented</th>
</tr>
</thead>
</table>
| 4- Goal Orientation (15) | - Make mistakes and ask students to catch them  
- Permit revision & Respond to error as a learning experience.  
- Directly Teach about Mastery Goal Orientation.  
- Provide reassurance, feedback, and instrumental support. *  
- Tell about scientists who failed before succeeding*  
- Be a role model for mastery learning * | - Make mistakes and ask students to catch them (5)  
- Permit revision & Respond to error as a learning experience. (2)  
- Directly Teach about Goal Orientation. (8) |
| 5- Mindset (18)  | - Teach students that intellectual skills can be acquired.  
- Recognize effort not Intelligence  
- Encourage process rather than simple right answers.  
- Teach Study Skills, Have them choose: BRAIN | - Teach students that intellectual skills can be acquired. (1)  
- Recognize EFFORT not Intelligence (9)  
- Encourage PROCESS rather than simple right answers. (3)  
- Teach Study Skills, Have them choose: BRAIN (5) |

*Indicate strategies not implemented by any teachers. Numbers in parentheses indicate the number of teachers who implemented the strategy.

Teacher responses to open-ended questions in the weekly reflection survey and researcher field notes were coded in order to produce rough indicators of exposure to the four potential sources of self-efficacy specified by Bandura (1997). Indicators of teachers’ mastery experiences (“students enjoyed it and they were engaged”) and affect (“the more I tried the strategy the more I enjoyed it”) were generated from teachers’ responses to the weekly reflection survey. Indicators of vicarious experience (“students were engaged and responded well to the strategy, I had good results”) were heard by everyone in the in-class discussions. Thus, vicarious experiences included any time teachers heard other teachers talk about their own mastery experience. In addition, verbal persuasion (“it sounds like the strategy worked and students were engaged, you did a great job”) was generated by both facilitators and colleagues in the context of weekly group discussions about teachers’ mastery experiences. Examples of the types of stated coded as each source are displayed in Table 6. Using the coding procedures described in chapter...
3, and exemplified in Table 6, weekly counts were generated for exposure to each of the four sources of self-efficacy. These counts are displayed in Table 7.

Table 6
Examples of Comments Coded Using the Four Sources of Self-Efficacy

<table>
<thead>
<tr>
<th>Source of Efficacy</th>
<th>When</th>
<th>By who</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Mastery Experience</td>
<td>Written response</td>
<td>Teacher</td>
<td>“students were engaged, it went well”</td>
</tr>
<tr>
<td>Negative Mastery Experience</td>
<td>Written response</td>
<td>Teacher</td>
<td>“students didn’t seem to get it and did not try it again”</td>
</tr>
<tr>
<td>Ambiguous Mastery Experience</td>
<td>Written response</td>
<td>Teacher</td>
<td>“only had two days due to weather”</td>
</tr>
<tr>
<td>Positive Affect</td>
<td>Written response</td>
<td>Teacher</td>
<td>“At first I felt off but then I enjoyed it more and more”</td>
</tr>
<tr>
<td>Negative Affect</td>
<td>Written response</td>
<td>Teacher</td>
<td>“Due to tech issues, I struggled”</td>
</tr>
<tr>
<td>Positive verbal Persuasion</td>
<td>In-class discussion</td>
<td>facilitator</td>
<td>“that is an excellent example of recognizing effort, you did good”</td>
</tr>
<tr>
<td>Positive vicarious exposure</td>
<td>In-class discussion</td>
<td>Teacher</td>
<td>“I told stories and my students were really interested and engaged, they even started sharing stories related to the material”</td>
</tr>
<tr>
<td>Negative vicarious exposure</td>
<td>In-class discussion</td>
<td>Teacher</td>
<td>“I tried using visuals but I had issues with the computer in the room, I felt that I wasted time, maybe I will try it again once IT fixes the problem.”</td>
</tr>
</tbody>
</table>
Table 7
Potential Exposure to the Four Sources of Self-Efficacy by Week

<table>
<thead>
<tr>
<th>Sources of Information</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Value</td>
<td>Autonomy</td>
<td>Challenge &amp; Emotion</td>
<td>Goal Orientation</td>
<td>Mindset</td>
</tr>
<tr>
<td>Self-efficacy sources from Weekly Reflection Survey- Open ended question</td>
<td>18</td>
<td>13</td>
<td>10</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>Number of teachers submitting weekly reflection.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive Mastery Experiences</td>
<td>12</td>
<td>12</td>
<td>8</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>Negative Mastery Experiences</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ambiguous Mastery Experiences</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Positive Affect</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Negative Affect</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Self-efficacy sources observed during in-class discussions

| Positive Verbal Persuasion | 2 | 3 | 3 | 2 | 4 |
| Negative Verbal Persuasion | 0 | 0 | 0 | 0 | 0 |
| Positive Vicarious Exposure | 3 | 2 | 2 | 2 | 3 |
| Negative Vicarious Exposure | 0 | 0 | 1 | 0 | 0 |

Overall Results

The results across all weeks indicated that positive mastery experiences were most prevalent. On the contrary, only a few (2) instances of affect were reported. Moreover, verbal persuasion was observed consistently across all weeks and teachers were also consistently exposed to vicarious success of their peers. In addition, negative experiences were very infrequent.

Weekly Examination of Strategy Choice, Confidence, Intention to Implement, and Sources of Efficacy

Weekly reflection data were examined to determine if there was a link between teacher reflections and the specific strategies they chose. To provide the most comprehensive view of
teachers’ experience with each strategy, I also considered their survey ratings of confidence (before and after implementation) and the likelihood that they will implement the strategy in the future. This information is presented in Appendices E through I.

The observed sources of efficacy appeared to be well distributed across the various strategies implemented. In other words, there was not a particular strategy that related to a specific source of self-efficacy.

There were no discernable patterns in level of confidence and intention to implement that were attached to specific strategies though there were some exceptions to this, which will be described below. However, this review helped to highlight that a number of teachers gravitated toward certain strategies more so than others. In the following sections an analysis will be provided by week, giving a brief description of the most common strategies implemented, highlighting any striking evidence about the efficacy sources, level of confidence, and intention to implement.

**Implementation of Strategies to Increase Value (Week 1)**

Among the 18 participants present for reflection on this week, all reported implementing one of the recommended strategies. Four (or 80%) of the five strategies recommended in the workshop were attempted by one or more teachers. The most popular strategies chosen for implementation were Storytelling (8 participants implemented this strategy) and Modeling Enthusiasm (5 participants implemented this strategy). There was no implementation of inquiry and Problem Based Learning (PBL). The potential sources of self-efficacy did not appear to be related to particular strategies. See Appendix E for more details.
Implementation of Strategies to Increase Autonomy (Week 2)

Of the 13 participants present for reflection on this week, all reported implementing one of the recommended strategies. Four (or 80%) of the five strategies recommended in the workshop were attempted by one or more teachers. The most popular strategies chosen for implementation were the use of inquiry methods (5 participants implemented this strategy) and give choices to students in class (4 participants implemented this strategy). The potential sources of self-efficacy did not appear to be related to particular strategies. See Appendix F for more details.

Implementation of Strategies to Increase Challenge and Emotion (Week 3)

Across the 10 participants present for reflection on this week, all reported implementing one of the recommended strategies. Five (or 56%) of the nine strategies recommended in the workshop were attempted by one or more teachers. The most popular strategy chosen for implementation was the use of visuals and models (6 participants implemented this strategy). The potential sources of self-efficacy did not appear to be related to particular strategies. See Appendix G for more details.

Implementation of Strategies to Increase Goal Orientation (Week 4)

Among the 15 participants present for reflection on this week, all reported implementing one of the recommended strategies. Three (or 50%) of the six strategies recommended in the workshop were attempted by one or more teachers. The most popular strategies chosen for implementation was directly teaching about goal orientation (8 participants implemented this
strategy). Results indicated a slight decline in confidence after the implementation of a strategy. Predominantly with two strategies “make mistakes and ask students to catch them” and “Permit revision and respond to error as a learning experience.” See Appendix H for further details.

**Implementation of Strategies to Increase Mindset (Week 5)**

Of the 18 participants present for reflection on this week, all reported implementing one of the recommended strategies. Four (or 100%) of the four strategies recommended in the workshop were attempted by one or more teachers. The most popular strategy chosen for implementation was recognizing effort not intelligence (9 participants implemented this strategy). Results indicated a significant increase in confidence after implementation of these strategies. See Appendix I for further details.

Table 7 includes a few examples gathered from participants’ responses to the open ended question included in the weekly reflection survey. These responses were coded for mastery experiences and affect. In addition, examples of vicarious exposure and verbal persuasion during the in-class discussion are also included.
CHAPTER 5
DISCUSSION

The professional development was offered to any middle or high school science teachers who were interested in learning about how to engage students and enhance science motivation through research based instructional strategies. The main focus of the professional development was to help teachers better understand how the use of particular classroom strategies can increase student motivation and engagement. The results from participant’s responses to the pre teacher self-efficacy survey indicated that teachers’ mean scores were slightly above the midpoint on the response scale with a mean of 6 on a 9 point scale. A reason for this above average mean may be that those who volunteer for professional development are likely to feel pretty competent and confident as teachers (Guskey, 1984; Tschannen-Moran & McMaster, 2009). While these results suggest that teachers were fairly confident about their teaching abilities prior to the professional development, a ceiling effect was not a concern given that there was room for improvement across the six-week professional development.

Types of Teacher Self-Efficacy: Efficacy for Instructional Strategies and Engaging Students

Pre and post survey results indicate that the professional development increased teachers’ self-efficacy to motivate and engage students about science. This finding is important because several researchers (Bandura 1997; Tschannen-Moran, Woolfolk Hoy and Hoy 1997) have linked teacher self-efficacy to the effort that teachers put into classroom activities, greater levels of planning and organizing and how they behavior with students who show difficulty learning. In
addition, teacher self-efficacy has been linked to giving student autonomy in the classroom and student self-efficacy (Woolfolk and Hoy, 1990). While the overall self-efficacy measure showed significance over the course of the professional development, analysis of the 2 subscales indicate that this improvement was due primarily to teachers’ increased self-efficacy to engage students. Their self-efficacy for implementing instructional strategies did not change significantly. There are several possible reasons that a change was observed in efficacy to engage students and not in efficacy for instructional strategies. First, the purpose of the professional development workshop was to help science teachers enhance student motivation and engagement in science. So perhaps, it’s not surprising that there was an increase in teachers’ self-efficacy scores to engage students. These results are consistent with the stated purpose of the workshop. It is possible that the logistics of implementing particular strategies were not as much of a focus as the effects on student engagement.

Second, the data show that teachers started the professional development workshop with much higher efficacy for implementing instructional strategies than for impacting student engagement. Given that teachers started out high in the efficacy scale for instructional strategies it may have been difficult to improve this particular kind of efficacy. According to Bandura (1997) once self-efficacy beliefs are established they become relatively stable even through different experiences. Meaning that once a teacher established teacher self-efficacy beliefs it is difficult to change. As a result, teacher self-efficacy for instructional strategies did not show a significant change.

A third reason why teachers’ self-efficacy for instructional strategy implementation may not have changed is that they were fairly familiar with most of the strategies being advocated in the professional development sessions. By and large, the strategies themselves were not new to
teachers. Given their familiarity, teachers probably felt that they already do a pretty good job with instructional strategies and did not feel like they became more capable of implementing these strategies per se. In this way, teaching experience could have also influenced their beliefs about instructional strategies given that the participants had a lot of prior teaching experience. According to Klassen and Chiu (2010) there is a relationship between teachers’ self-efficacy and years of experience. The more experience teachers have in the field, the more exposure to instructional strategies they may have developed through teaching and the less they felt they had to learn. What they did learn, however, was how strategic implementation of these strategies (with which they were already familiar) could influence student engagement. This was something they may not have considered previously. As such, gaining an understanding of how these strategies could influence student motivation and engagement may have helped them to feel more efficacious in engaging students.

One pattern in the data that supports the interpretation that teachers’ self-efficacy for strategy use did not change because they were familiar with the strategies, was observed with the workshop content on mindset presented in Week 5. In contrast to content presented in other weeks, this content appeared to be entirely new to most of the teacher participants. They had not been exposed to the idea of mindset previously and had not previously considered many of the strategies that were suggested for this week. Some of the advice that was included in this week may have seemed counter-intuitive to teachers: For example, consistent with the theory about the development of a growth mindset, the professional development facilitators encouraged teachers to avoid praising students for their intelligence. These ideas were not things that these teachers had been exposed to previously. Perhaps not coincidentally, this is the only week in which teachers’ confidence to implement mindset-related strategy increased pre- to post.
With the exception of the mindset week, the fact that teachers’ efficacy for implementing instructional strategies remained relatively stable from before the professional development to after is consistent with findings from teachers’ weekly confidence ratings. Teachers’ confidence ratings gathered before and after each strategy was implemented did not change significantly, except in the week that mindset was discussed. Because this topic may have been new to teachers, they may have felt that they gained the most knowledge about specific strategies in comparison to the other weeks. The results indicated that when teachers’ implemented strategies related to promoting a growth mindset they were successful. This could have influence the increase in level of confidence after implementation.

The findings of weekly confidence support previous research about changes in efficacy. According to Ross (1994) teacher self-efficacy beliefs are difficult to change, particularly with experienced teachers. Ross (1994) argued that teachers have difficulty seeing the value of integrating new practices into their instruction in particular, when teachers believe that their current practice is working fine. Guskey (1986) found that in order to change practice one needs to understand that change is a process that takes time and effort. Possibly if the professional development sessions were longer than six-weeks we may have seen more change in teachers’ self-efficacy to implement instructional strategies.

The observed pattern that teacher self-efficacy either increases or remains stable contradicts what previous researchers have found about the effect of implementing new strategies on teachers’ self-efficacy. Specifically, Woolfolk and Hoy (1990) found that pre-service teachers’ self-efficacy tended to decline after the implementation of a new strategy. Similarly, Ross (1994) found in his analysis that there was a decrease in teacher self-efficacy as teachers implemented a new strategy. This pattern was not observed in the current study. These
contradictory findings might be explained by the fact that many of the strategies that teachers chose to implement might have not been new strategies for them.

The analysis of weekly strategies chosen by teachers’ indicated that with the exception of week five, each week several suggested strategies were not chosen for implementation by any teacher. One may conclude that teachers might not be as familiar with such strategies thereby avoiding implementation. Some example strategies not implemented include: (Week 1) Inquiry and Problem Based Learning (PBL), (Week 2) student ownership of the learning process, (Week 3) Use role models, and (Week 4) tell about scientist who failed before succeeding. As you can see some of these strategies require some level of familiarity with background information and knowledge. For instance, it is fair to argue that if teachers do not know a scientist who has failed before succeeding, this strategy might have been perceived to be too difficult to integrate into teaching, and as a result this strategy was not implemented.

Results indicated that the professional development workshop was successful at changing teachers’ beliefs about their abilities to influence student engagement, which was the goal of this workshop. Friedman and Kass (2002), found that teachers who are highly efficacious are more likely to persist in adverse situations with students who are difficult and have low learning motivation. Perhaps, teachers’ beliefs about their ability to influence student engagement are more malleable than asking teachers to implement instructional strategies. On the other hand, it may simply be more difficult to change teacher beliefs about implementing instructional strategies. According to Ross (1994) many experienced teachers have already possess a sense of teaching self-efficacy even when exposed to new practices. This makes change difficult to articulate into the classroom.
Weekly Confidence as a Predictor of Future Intention to Implement Strategies

Because teacher self-efficacy has been previously linked with willingness to try new strategies (Guskey, 1988), the relationship between level of confidence after the implementation of a strategy and intention of trying the strategy again was tested. Results indicated that there was a relationship between teacher’s level of confidence and intentions to try the strategy again. Confidence level can at least partially predict teacher’s intention of implementing the strategy in the future.

The relationship between level of confidence and intention to implement supports previous research that suggests teachers with higher teaching efficacy are more open to new strategies and are willing to integrate them into their practice to meet the needs of their students (Friedman & Kass, 2001; Pajares 1996; Tschannen-Moran & Woolfolk Hoy, 2001). This finding is important because teacher efficacy is a powerful predictor of teacher outcomes such as willingness to implement new instructional strategies as well as a predictor of student achievement (Ross, 1994). Guskey (1984) found that a professional development that is administered correctly can contribute to higher teacher self-efficacy, which has been related to the likelihood of integrating new instructional strategies in the classroom that can impact student learning.

Guskey (1986) argued that in order for teachers to implement new strategies, the strategies needed to be presented in a clear and explicit way. In addition, guidance on how the new strategies can be implemented without too much disruption or extra work for teachers is key. Observations made during the professional development provided evidence that strategies were presented in a clear way with much guidance and feedback. The professional development
facilitators also ensured that these strategies were easily implemented in the classroom without much disruption. Participants were exposed to videos as examples as to how they could integrate the strategies into their classroom. It may be that due to the support and guidance of the facilitators, teachers were able to implement the strategies with much success and as a result we were able to remain open to implementing the strategy again. Research has also suggested that teachers are more willing to integrate new strategies into their practices when they see positive outcomes (Guskey, 1986). In the current professional development teachers reported mostly positive outcomes during implementation. These positive outcomes may have contributed to their confidence level and in turn influenced intention to implement. Tschannen-Moran, Woolfolk Hoy and Hoy (1998) found that teachers with high efficacy show a better sense of keeping an open mind about new practices and ideas that can benefit student learning and are more persistent and resilient when things don’t go smoothly.

Potential Sources of Teacher Self-Efficacy

In keeping with Bandura’s (1977) assertion that mastery experiences inform self-efficacy, Guskey’s (1984 & 1986) professional development model (process of teacher change) argues that the most powerful professional development format includes a mastery experience in teachers’ regular context. The current professional development integrated a mastery experience each week, by asking teachers to implement a strategy of their choice in their classrooms. In addition, teachers were asked to reflect on their implementation through written responses and oral in-class discussions. The written responses gave teachers an avenue to describe their experiences and also report any affect. The in-class discussions gave teachers a platform to reflect on their mastery experiences and share their successes and challenges, thus providing
vicarious experiences for their peer teachers. Finally, through class discussions, both the teachers and the professional development facilitators provided regular verbal persuasion in the form of feedback and support. Thus, throughout the professional development, all four potential sources of efficacy were observed.

**Mastery**

The most frequent sources of efficacy were mastery experiences which are said to be the most powerful of all (Bandura 1997). The length of time teachers had to implement the strategies (1 week) could have influenced the overwhelming reports of positive mastery experiences. Because teachers had a whole week to implement their strategy, it is possible that they had multiple opportunities to implement and refine their strategies. As a result, by the time they were asked to reflect on their implementation, they had experienced a successful implementation.

**Affect**

There were only rare reports of affect among the teachers’ written responses. However, affect is said to be the least influential of all four sources (Bandura, 1997). It is likely that affect was under-reported in this study because the professional development environment may not have been a place to openly express affect. The professional development facilitators did not ask for this specific source of information. Lastly, the open-ended question in the survey where participants could have express affect may not have been specific enough to generate this type of reflective information. Another possibility is that participants may not have felt comfortable to express their feelings (positive or negative) about their practice as teachers.
During the in-class reflection part of the workshop participants were exposed to approximately three positive vicarious experiences per week. Teachers were asked to share their experiences about the implementation of their chosen strategy with the class. According to Bandura (1997) when one witnesses another person similar to oneself successfully complete a task, vicarious experiences can raise observer’s beliefs that they too can obtain the same outcome. The majority of the experiences shared during the in-class reflection were successful experiences. A reason for this is that the majority of participants experienced a successful implementation and therefore, mainly successful reflections were shared.

**Persuasion**

The in-class reflection portion of the workshop allowed for verbal persuasion in the form of encouragement and feedback. When teachers’ shared their experiences with the class the facilitators would persuade the teachers about their capabilities to continue the implementation of the strategy. Approximately three verbal persuasions were observed each week. According to Bandura (1997), verbal persuasion is likely to be a weaker source of efficacy, yet when positive messages are given to a person (you did great, I knew you could do this), they are more likely to try hard to succeed. During the professional development workshop there were no observations of negative verbal persuasion. The facilitator and participants were very encouraging with verbal persuasion.
Implications for Delivery of Professional Development

The results gleaned from this study indicated the professional development workshop was effective in altering teachers’ self-efficacy beliefs and may have had a corresponding impact on the future teaching behaviors of the participants. Based on my observations one can speculate that the success of this workshop lies with not only the content but also the design. Guskey (1986) proposed that in order for a professional development to be effective it needed to consider the “process of teacher change.” This process suggests that when introducing new classroom practices, the successes of those practices during implementation are important for teachers to observe change in student learning outcomes and as a result change in teachers’ beliefs and attitudes is more likely to occur. More specifically, Guskey (1986) stated that practices that are implemented and show success in terms of desired student learning outcomes are retained. The success of student learning outcomes is key to change in teachers’ beliefs and attitudes. This was evident during the professional development through the integration of the four sources of efficacy. In particular, through mastery experiences, teachers were given the opportunity to implement a strategy with guidance and support to increase the likelihood of a positive experience. Three main components of a successful model were observed (1) the integration of strategies into teachers practice without too much work or disruption, keeping the process of teacher change in mind, (2) Teachers were given one week to implement the strategy, during this length of time teachers were able to receive student feedback through the implementation of the strategy which most of the time was a reflection of a positive experience in their written responses, (3) Participants reflection and feedback was an important component of the
professional development, possibly this may have been responsible for teachers being able to alter their self-efficacy beliefs and behaviors.

The qualitative data reveal that there were three strategies that teachers reported having complete intention of trying again. The three strategies were: storytelling, engage parents through information and the use of visuals and models in the classroom. We can assume that teachers have been exposed to these strategies numerous times and we know that they are for the most part very confident about their abilities to execute these strategies; therefore, it is no surprise that these were the top three. Guskey (1986) and Tschannen-Moran and McMaster (2009) found that although teachers reported high levels of efficacy during professional development and that a relationship between high confidence and intention to implement exist, coaching and follow-up were necessary to successful application of new strategies learned during professional development. Although the teachers who participated in this professional development workshop generally increased their confidence after the implementation of a strategy and a moderate relationship was found between confidence and their intention to implement the strategy again, there was no follow-up related to strategy implementation beyond the 6 week workshop.

A closer examination of the strategies implemented each week highlighted the level of confidence with weekly topics. The findings showed that teachers appeared to be more confident after the implementation of weekly strategies with the following topics: value, autonomy, emotion and mindset. In contrast, teachers’ confidence slightly decreases after the implementation of goal orientation strategy. A possible explanation for this decline could be that these strategies allowed teachers to re-evaluate their teaching methods and force them a little out of their comfort. According to Shumow and Schmidt (2014) teachers’ instructional practices and
their classroom design influence students’ goal orientation (p. 83). As a result, teacher might have realized that this was something was going to take more work than anticipated and force them to realize that this is not an easy change without much disruption to their current teaching method. In addition this can be the case since all teachers who implemented these strategies reported having a positive mastery experiences.

Teachers were allowed to choose the instructional strategy they would try to implement each week. These choices may be indicators of which types of strategies teachers already feel most comfortable with, and which might require more coaching and encouragement. For example, the suggested instructional strategies related to the topic of appropriately challenging students were not implemented by many teachers. One of the reasons one teacher may have implemented a challenged strategy might be because other teachers did not feel confident enough to do so or they might not have seen the value of this topic. Another reason could be because the strategies related to challenging students take more work and structural change for teachers. According to Guskey (1986), although teachers are highly committed to student learning, instructional strategies offered to teachers with the less disruption to current classroom practices are more likely to be implemented. Considering the importance of Goal Orientation and Challenge, as well as, the importance of the strategies that were not implemented such as Problem Based Learning and finding role models, it is essential that teachers feel confident and understand how to integrate these into their practice. These topics and strategies can potentially be the focus of professional development in the future.
Future Research

The current study included a description of potential evidence of the four sources of efficacy; however, we did not attempt to measure the relationship of any of these potential sources with teacher self-efficacy. Thus, the nature and strength of these potential relationships is not known at this time. We recommend an experimental study that examines the difference between two professional development workshops: one that includes the four sources of efficacy and one that does not. Further research is essential to gain an in-depth understanding of the degree to which each source of efficacy impacts teacher self-efficacy during a professional development. This information will be of great value as we attempt to learn how to better train and equip teachers using professional development.

Furthermore, the current findings indicated that professional development can change teacher’s self-efficacy. However, these findings along with teachers’ open responses suggest that additional attention needs to focus on bridging the gap between teacher confidence reported in the professional development and the practices they actually adopt in their classrooms, which can have the potential of increasing student learning outcomes. In addition, we need to further explore which strategies worked best during the strategy implementation process in teachers’ classrooms, and under what circumstances these strategies generated successful results.

Limitations

Several important limitations need to be considered when interpreting the findings. First, the external validity of this study is limited to some degree due to the design. In particular teachers who participated in this study were self-selected volunteers and were paid a stipend. It is
possible that the participants could have been highly motivated to participate in professional
development by the stipend. There is no way to know if this professional development would
work with a different population.

Second, this study used a small sample of teachers. This small sample was not
representative of the teacher population because the sample was gathered from only one school
district. Due to a small sample size we were not able to perform complex analyses or examine
the effect of particular strategy implementation. Although there were significant changes in
efficacy found, further research involving a bigger pool of participants is necessary.

Third, the four sources observed during the professional development were potential
sources of efficacy. However, we don’t know is if there is any causal relationship in that the
presence of these potential sources had any measurable impact on teachers efficacy or practice.
Consequently, the results of this study need to be interpreted carefully.

Concluding Remarks

In conclusion, the results of this study indicated that a professional development that
includes the potential integration of the four sources of efficacy could contribute to changes in
teachers’ self-efficacy beliefs and potential changes in behavior. Analysis of both the teacher
self-efficacy measure and the weekly surveys yield results that indicated the workshop was
effective at increasing teacher self-efficacy to influence student engagement and positively
change teacher self-efficacy beliefs. This workshop met the objective which was to enhance
teachers’ self-efficacy about student engagement and science motivation. Lastly, results from
this professional development suggested that teachers’ self-efficacy to engage students may be
more malleable compared to teachers’ self-efficacy for instructional strategies.
REFERENCES


APPENDIX A

PROFESSIONAL DEVELOPMENT SURVEY (PRE AND POST)
Directions: The questions in this survey are designed to measure confidence about your ability to perform the following tasks in your classroom. Please rank your level of confidence with the following tasks.

1. Employee ID Number ______________________________

2. How much can you do to craft good questions for students?
   1  2  3  4  5  6  7  8  9
   Nothing  Very little  Some Influence  Quite a Bit  A Great Deal

3. How much can you do to implement a variety of assessment strategies?
   1  2  3  4  5  6  7  8  9
   Nothing  Very little  Some Influence  Quite a Bit  A Great Deal

4. How much can you do to provide an alternative explanation when students are confused?
   1  2  3  4  5  6  7  8  9
   Nothing  Very little  Some Influence  Quite a Bit  A Great Deal

5. How much can you do to implement alternative strategies in your classroom?
   1  2  3  4  5  6  7  8  9
   Nothing  Very little  Some Influence  Quite a Bit  A Great Deal

6. How much can you do to motivate students who show low interest in school work?
   1  2  3  4  5  6  7  8  9
   Nothing  Very little  Some Influence  Quite a Bit  A Great Deal

7. How much can you do to get students to believe they can do well in school work?
   1  2  3  4  5  6  7  8  9
   Nothing  Very little  Some Influence  Quite a Bit  A Great Deal

8. How much can you do to help student's value learning?
   1  2  3  4  5  6  7  8  9
   Nothing  Very little  Some Influence  Quite a Bit  A Great Deal

9. How much can you do to assist families in helping their children do well in school?
   1  2  3  4  5  6  7  8  9
   Nothing  Very little  Some Influence  Quite a Bit  A Great Deal
APPENDIX B

PROFESSIONAL DEVELOPMENT WEEKLY GOAL
Please identify a strategy or practice from today’s content that you will try in your classroom in the upcoming week:

________________________________________________________________________________________

Please answer the question below based on the strategy identified above

<table>
<thead>
<tr>
<th>Question</th>
<th>Completely Confident (5)</th>
<th>Very Confident (4)</th>
<th>Moderately Confident (3)</th>
<th>Slightly Confident (2)</th>
<th>Not at all Confident (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How confident do you currently feel about your ability to implement this strategy in your classroom?</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
APPENDIX C

PROFESSIONAL DEVELOPMENT WEEKLY GOAL AND REFLECTION
What Strategy/practice did you implement in your classroom last week?
_____________________________________________________________________________________

How did it go?
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Additional Questions

Did you implement a different or additional strategy last week?  YES or  NO

If yes, what Strategy/practice did you implement in your classroom last week?
_____________________________________________________________________________________

How did it go?
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Please answer the following question based on the strategy identified above.

<table>
<thead>
<tr>
<th>1. How confident do you feel about your ability to implement this strategy in your classroom now?</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completely Confident</td>
<td>Very Confident</td>
<td>Moderately Confident</td>
<td>Slightly Confident</td>
<td>Not at all Confident</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. How likely are you to use this strategy again?</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completely likely</td>
<td>Very likely</td>
<td>Moderately likely</td>
<td>Slightly likely</td>
<td>Not at all likely</td>
<td></td>
</tr>
</tbody>
</table>

Please answer the following question based on the strategy identified above.

APPENDIX D

QUALITATIVE DATA WEEK# 1- VALUE
<table>
<thead>
<tr>
<th>Strategy</th>
<th># of Impl.</th>
<th>Avg. Confidence before</th>
<th>Avg. Confidence after</th>
<th>Avg. Intention</th>
<th>Positive Mastery n (%)</th>
<th>Negative Mastery n (%)</th>
<th>Ambiguous Mastery n (%)</th>
<th>Affect (0= no, 1= yes)</th>
<th>Vicarious (0= no, 1= yes)</th>
<th>Persuasions (0= no, 1= yes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model Enthusiasm</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3 (60%)</td>
<td>0</td>
<td>2 (40%)</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Connect content with student interest, everyday life or other subjects</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>2 (67%)</td>
<td>0%</td>
<td>1 (33%)</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Story telling</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>6 (75%)</td>
<td>2 (25%)</td>
<td>0%</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Engage parent through information</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>1 (50%)</td>
<td>1 (50%)</td>
<td>0%</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Inquiry and PBL</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>3.6</td>
<td>3.8</td>
<td>4.2</td>
<td>12</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
APPENDIX E

QUALITATIVE DATA WEEK# 2- AUTONOMY
<table>
<thead>
<tr>
<th>Strategy</th>
<th># of Impl.</th>
<th>Avg. Confidenc e before</th>
<th>Avg. Confidenc e after</th>
<th>Avg. Intention</th>
<th>Positive Mastery n (%)</th>
<th>Negative Mastery n (%)</th>
<th>Ambiguous Mastery n (%)</th>
<th>Affect (0= no, 1= yes)</th>
<th>Vicarious (0= no, 1= yes)</th>
<th>Persuasion (0= no, 1= yes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opportunities for student to take responsibility</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3 (100%)</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Give students choices in class activities</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4 (100%)</td>
<td>0%</td>
<td>0%</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Provide students with materials to solve problems themselves, not answers to problems</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>1 (100%)</td>
<td>0%</td>
<td>0%</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Use inquiry methodology</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4 (80%)</td>
<td>1 (20%)</td>
<td>0%</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Student ownership of the learning process</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13</strong></td>
<td><strong>3.61</strong></td>
<td><strong>3.84</strong></td>
<td><strong>4.23</strong></td>
<td><strong>12</strong></td>
<td><strong>1</strong></td>
<td><strong>0</strong></td>
<td><strong>1</strong></td>
<td><strong>2</strong></td>
<td><strong>3</strong></td>
</tr>
</tbody>
</table>
APPENDIX F

QUALITATIVE DATA WEEK# 3- CHALLENGE AND EMOTION
<table>
<thead>
<tr>
<th>Strategy</th>
<th># of Impl.</th>
<th>Avg. Confidence before</th>
<th>Avg. Confidence after</th>
<th>Avg. Intention</th>
<th>Positive Mastery n (%)</th>
<th>Negative Mastery n (%)</th>
<th>Ambiguous Mastery n (%)</th>
<th>Affect (0= no, 1= yes)</th>
<th>Vicariou s (0= no, 1= yes)</th>
<th>Persuasions (0= no, 1= yes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor students challenge</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>1 (100%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Attribution</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>1 (100%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Teach study skills</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>1 (100%)</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Praise and verbal persuasion</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Use visuals and models</strong></td>
<td><strong>6</strong></td>
<td><strong>3</strong></td>
<td><strong>3</strong></td>
<td><strong>5</strong></td>
<td><strong>6</strong> (100%)</td>
<td><strong>0</strong></td>
<td><strong>0</strong></td>
<td><strong>0</strong></td>
<td><strong>1</strong></td>
<td><strong>1</strong></td>
</tr>
<tr>
<td>Use role models</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Provide &quot;low cost&quot; challenges.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Treat mistakes as challenges and chance to learn</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
<td><strong>3</strong></td>
<td><strong>3.3</strong></td>
<td><strong>3.6</strong></td>
<td><strong>8</strong></td>
<td><strong>1</strong></td>
<td><strong>1</strong></td>
<td><strong>1</strong></td>
<td><strong>3</strong></td>
<td><strong>3</strong></td>
</tr>
</tbody>
</table>
APPENDIX G

QUALITATIVE DATA WEEK# 4 - GOAL ORIENTATION
<table>
<thead>
<tr>
<th>Strategy</th>
<th># of Impl.</th>
<th>Avg. Confidenc e before</th>
<th>Avg. Confidenc e after</th>
<th>Avg. Intentio n</th>
<th>Positiv e Mastery n (%)</th>
<th>Negative Mastery n (%)</th>
<th>Ambiguou s Mastery n (%)</th>
<th>Affect (0= no, 1= yes)</th>
<th>Vicarious (0= no, 1= yes)</th>
<th>Persuasion s (0= no, 1= yes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make mistakes and ask students to catch them</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>5 (100%)</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Permit revision &amp; Respond to error as a learning experience.</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2 (100%)</td>
<td>0%</td>
<td>0%</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Directly Teach about Goal Orientation.</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>6 (75%)</td>
<td>0%</td>
<td>2 (25%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Provide reassurance, feedback, and instrumental support.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tell about scientists who failed before succeeding.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Be a role model for mastery learning</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15</strong></td>
<td><strong>3.9</strong></td>
<td><strong>3.4</strong></td>
<td><strong>3.4</strong></td>
<td><strong>13</strong></td>
<td><strong>0</strong></td>
<td><strong>2</strong></td>
<td><strong>0</strong></td>
<td><strong>2</strong></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>
APPENDIX H

QUALITATIVE DATA WEEK# 5- MINDSET
<table>
<thead>
<tr>
<th>Strategy</th>
<th># of Impl.</th>
<th>Avg. Confidence before</th>
<th>Avg. Confidence after</th>
<th>Avg. Intention</th>
<th>Positive Mastery n (%)</th>
<th>Negative Mastery n (%)</th>
<th>Ambiguous Mastery n (%)</th>
<th>Affect (0= no, 1= yes)</th>
<th>Vicarious (0= no, 1= yes)</th>
<th>Persuasions (0= no, 1= yes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teach students that intellectual skills can be acquired.</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>1 (%100)</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Recognize EFFORT not Intelligence</td>
<td>9</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>9 (%100)</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Encourage PROCESS rather than simple right answers.</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2 (%67)</td>
<td>0%</td>
<td>1 (%33)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Teach Study Skills, Have them choose: BRAIN</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>5 (100%)</td>
<td>0%</td>
<td>0%</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>18</strong></td>
<td><strong>3.5</strong></td>
<td><strong>4.1</strong></td>
<td><strong>4.2</strong></td>
<td><strong>17</strong></td>
<td><strong>0</strong></td>
<td><strong>1</strong></td>
<td><strong>0</strong></td>
<td><strong>3</strong></td>
<td><strong>4</strong></td>
</tr>
</tbody>
</table>