

## **Middle School Pre-Service Teachers' Sense of Self-Efficacy in Relation to Authentic Learning Experiences**

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### **Abstract**

The focus of this research was to test the impact of an authentic science experience on pre-service teachers' self-efficacy and their beliefs about their perceived outcomes with middle level students. Data show that there was a statistically significant decrease in the levels of self-efficacy towards teaching science and no significant change in their beliefs about having positive outcomes. Three institutions (a university, a local park district and a school district) formed a partnership with the mission of enhancing science learning for middle school students. The pre-service teachers examined artifacts discovered during an archeological dig of a chair factory and created inter-disciplinary units based on the artifacts during science methods courses. Pre-service teachers then taught these units to 4th graders, when they visited the park.

Key word: self-efficacy, teacher preparation, authentic experiences

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### **Introduction**

Teachers are under the microscope to produce better outcomes. Society is looking at them to teach students to perform higher level thinking skills, increase critical thinking, incorporate real world applications, and ultimately score higher on standardized exams. This is especially true of science education as students are being compared internationally to other nations who excel in STEM based fields (Gonzalez & Kuenzi, 2012). Many factors can be examined to help teachers achieve these standards. One of these is teachers' self-efficacy toward teaching. A link between this belief and classroom outcomes exists (Britner & Pajares, 2006; Dana, Campbell, & Lunetta, 1997; Keys, 2006). The question then remains as to how teacher education programs can increase this level of efficacy in their students and ultimately affect future outcomes in the classroom of these teachers.

### **Review of Literature**

Several factors are taken into consideration when examining the learning process of pre-service teachers. The first of these is the difference in learning between adults and children. Adults' needs vary in terms of how they relate new knowledge with prior experiences. These needs can then form one's self-efficacy towards working with the newly acquired knowledge, such as how to teach science.

A teacher's sense of self-efficacy can then impact their performance in the classroom and potentially influence student performance.

### **Adult Learning**

A sense of self-efficacy is essential in the role of a teacher in having successful outcomes in the classroom. According to Bandura (1997), self-efficacy is defined as, "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives" (p.71). One's level of self-efficacy can influence the amount of effort one will put into overcoming an experience that is perceived to be challenging and how long a person will sustain that effort (Bandura, 1977). There are several methods of changing one's sense of self-efficacy to a higher level. Two of these methods include personal mastery experiences in which a person successfully masters expectations. The more times individuals are successful, the higher their efficacy will become. Another method includes participation in vicarious experiences in which they observe others successfully participating in an activity. Seeing someone else master an intimidating task will help increase one's efficacy belief that they too will be successful (Bandura, 1977).

Increasing one's efficacy may be accomplished by successfully learning a new task. The path to an adult learning something new is different than that of a middle school student. Several stages of adult learning have been established. Some argue that adult learning evolves through stages of development in a cognitive approach to learning while others believe that adult learning shifts when an adult reaches a certain age (Trotter, 2006). Despite the differences in approaches to adult learning, it is generally agreed upon that adults need certain conditions for optimal learning experiences. These include being able to immediately implement new knowledge into their current situation (i.e. their own classroom), having the opportunity to discuss their new knowledge with others and reflect on its potential impact in their lives, and center learning around experiences rather than being "taught" new information (Trotter, 2006). How adult learning differs in comparison with middle school students needs to be considered when developing learning experiences during teacher education courses in an attempt to increase self-efficacy toward teaching.

### **Role of Self-Efficacy**

There are many components that make a teacher successful. These range from content knowledge, knowledge of theoretical frameworks, dispositions that lend to collegiality, and a sense of self-efficacy. Teachers need to feel confident that they are able to successfully guide and facilitate students' learning (Carrier, 2009). Research has concluded that a teacher's belief system is instrumental in his/her decisions regarding classroom management, instruction and overall decisions about their classroom (Fletcher & Luft, 2011; Goodard, Hoy, & Hoy, 2004; Woolfolk & Hoy, 1990). Teachers who report high self-efficacy use a higher number of inquiry-based approaches in their classrooms and generally have a more student-centered approach to teaching (Bursal, 2012). For these reasons, there is a relationship between teacher self-efficacy and student achievement (Bandura, 1993; Caprara, Barbaranelli, Stecca & Malone, 2006; Goddard, Hoy & Hoy, 2000).

Teachers can develop a high sense of self-efficacy through many means. Some of these are included in teacher education programs, especially those events that take place during field experiences (Fletcher & Luft, 2011). At the conclusion of one's teacher education program, a pre-service teacher should have a high sense of self-efficacy and have the confidence to deliver high-quality instruction without any anxiety toward teaching science (Bursal, 2012). However, many students enrolled in

teacher education programs report having a negative experience with science methods courses. Science teaching is presented as a presentation of facts, reading and reflecting on prescribed activities and an occasional activity (Kelly, 2000). Once these students graduate and enter into their own classrooms, they rely mostly on teacher-led instructions rather than engaging their students in authentic learning opportunities and investigations. Many teachers report a lack of confidence in taking their students outside of the classroom and engaging in outdoor learning activities (Ferry, 1995). Even more extreme, due to these negative attitudes towards teaching science, teachers ultimately avoid teaching it. Overall, teachers report low levels of self-efficacy towards teaching science, high levels of anxiety, and hesitancy to teach it (Gunning & Mensah, 2011; Ramey-Gassert & Schroyer, 1992). These negative attitudes ultimately lead to ineffective science instruction (Bursal, 2012). In order to overcome these attitudes, teachers need to examine these affective obstacles (Cho, Kim, & Choi, 2003; Mellado, 1998) and teacher educators need to understand and address the complex relationship between teachers' belief systems, prior science experience and their future science teaching (Kazempour, 2014).

### **Influence of Authentic Learning Experiences**

Involvement in positive, inquiry-based, authentic learning experiences can positively influence self-efficacy of teachers (Avery & Meyer, 2012; Bursal, 2012; Gunning & Mensah, 2011; Nugent, Kunz, Levy, Harwood, & Carlson, 2008; Tosun, 2000). Pre-service teachers need to be involved in the process of learning science and developing their own positive framework for teaching science rather than just being told how to do so (Gunning & Mensah, 2011). One example of this is that exposing pre-service teachers with positive outdoor/environmental learning experiences can positively impact their beliefs about teaching students outside of the classroom (Carrier, 2009). Pre-service teachers engaged in a field-based course rather than traditional teacher led one show a significant increase in their use of cooperative learning, deep understandings of science, use of high level questions and overall confidence in their ability to teach science (Nugent, Kunz, Levy, Harwood & Carlson, 2008).

Despite all the research that shows that positive, authentic learning experiences can increase self-efficacy it is not a guarantee. Some decrease/no change in efficacy has also been found (Avery & Meyer, 2012; Morrell & Carroll, 2003; Wagler, 2011). Similar results found by Moseley, Reinke & Bookout (2002) after an examination of pre-service teachers' efficacy before and after an authentic, environmental education experience. Other studies related to authentic learning experiences have shown no effect on pre-service teachers. Housel (1982) found that pre-service teachers who partook in an outdoor education training program had no significant difference in their attitudes towards teaching science. While this study examined attitude and not self-efficacy it is demonstrative of the lack of change in pre-service teachers after involvement in an authentic learning experience.

One explanation of this is that students generally enter into an experience feeling insecure about teaching science and their potential for teaching students (Carrier, 2009). Some students do not move past these initial feelings. Secondly, pre-service teachers initially report a high sense of their ability to teach environmental education due to a simplified view of its content (Moseley, Reinke, & Bookout, 2002). Another explanation of this decrease includes a refusal to fully partake in a learning opportunity that may be different than their own traditional learning background resulting in an unfamiliar and uncomfortable experience. These learning methods may be different than how particular students have been taught themselves and they are "stuck" in their belief systems. Science teachers use methodologies that are compatible with their belief and value systems (Mellado, 1998) and these systems tend to be

the way that they were taught themselves. Therefore, changing the way a teacher teaches along with his/her beliefs toward teaching can be difficult to change, if possible at all.

### **Middle Level Philosophy**

The concept of developmentally responsive and challenging curriculum and instruction is an essential attribute of the middle level philosophy as laid out by the Association for Middle Level Education (AMLE, formerly National Middle School Association). In order for middle school education to be successful, it must include active engagement of the students (NMSA, 2010). This engagement of middle school students should include students having the opportunity to perform certain tasks such as, “hypothesize, organize information into useful and meaningful constructs, and grasp long-term cause and effect relationships” (NMSA, 2010, p.16). In order to achieve this, curriculum should be delivered in units that are centered on a theme and meet various content specific goals rather than through separate subjects. This philosophy serves as a contextual model for teacher preparation programs. Modeling of this philosophy includes incorporating interdisciplinary, active, and relevant content into content methods courses. This allows future middle level teachers to have an authentic understanding of these principles in action.

NMSA (2010), also notes that successful middle schools should, “seek appropriate partnerships with...organizations with purposes consistent with the school’s mission” (p.41). These partnerships support an all-inclusive commitment from those with an interest in middle level education. Partnerships, such as that between a local school district, university, and park district bring together resources to best meet the needs of all students.

The factors presented above range from how adults learn to the underlying philosophy of a middle level education. Each of these play a role in influencing a science teacher and their ability to effectively teach. Teacher education programs have the responsibility to take them all into consideration when preparing future science teachers. This study is an examination of how pre-service science teachers learn (in an authentic learning experience) influences their perception of their self-efficacy and expected outcomes in their future classrooms.

### **Methodology**

In order to collect sufficient data to not only answer the research questions but also attempt to examine the results at a deeper level, a mixed methods approach to data analysis were taken in which both quantitative and qualitative data were obtained.

### **Research Questions**

The research questions that guided this study are:

1. Will involvement in an authentic learning experience during a science methods course change pre-service teachers’ sense of efficacy towards teaching science?
2. Will involvement in an authentic learning experience outside of a traditional classroom field experience change pre-service teachers’ beliefs regarding their outcomes of teaching science?

## Context

This study was included as part of a larger grant project funded by The Cleveland Foundation. It was a partnership built between three institutions that shared a common mission: to enhance the learning experiences of students while exposing them to authentic learning experiences. Three partners collaborated on this initiative:

- A large state institution's regional campus located in Northeast Ohio. This university campus houses a middle childhood (grades 4-9) education major.
- A local park district that provides learning opportunities and field trips for school-aged children. The park district operates an Environmental Learning Center (ELC) for these learning experiences.
- A large suburban school district that is located within the park district's territory.

These three institutions joined to create a project that met five over-arching goals with three specifically addressing the pre-service teachers:

1. Pre-service teachers will gain real life experience in lesson planning, creating inter-disciplinary lessons, executing lessons plans, and reflecting on ways to use this experience in their future profession as a middle school teacher.
2. Pre-service teachers will be exposed to working with students from diverse populations including diverse socio-economic backgrounds, racial/ethnic backgrounds, and various levels of learners. They will then reflect on these experiences and relate them to their future roles as teachers.
3. Pre-service teachers will help build learning communities with school districts from surrounding counties. By establishing these relationships, the school district and pre-service teachers can use each other in a symbiotic relationship where they can learn from each other and collaborate on the resources available to them.

These goals were met in various ways. The first of these involved pre-service teachers' methodology courses being held at the ELC. During this time, pre-service teachers were immersed within the park setting and learning first-hand how to create authentic learning experiences based on the resources available to them. These activities included working with the park staff on the process of researching artifacts found on the site of an abandoned chair factory located within the park. Pre-service teachers work through an inquiry process of examining and drawing conclusions based on these artifacts. They then researched the history of the archeological site, the community during its existence, its effects on society, and overall significance of the artifacts. The pre-service teachers then observed and eventually co-taught various, existing lesson plans created by the park staff to various visiting school groups.

Secondly, the pre-service teachers worked together with the education staff of the ELC to create an inter-disciplinary unit based on the artifacts. This unit was centered on science learning but also incorporated language arts, mathematics, social studies, and art. Activities in the unit included creation of water wheels to examine potential and kinetic energy, recreating a watershed using a bed sheet and pom-poms to demonstrate the effects of water on surrounding areas, reading authentic journal entries from a school-aged girl living by the chair factory during its existence, simulating various forms of transportation along the creek to analyze effectiveness of each method, and using the authentic artifacts excavated from the chair factory site for the purpose of learning about archeology and the effects of the environment on objects. These plans also included pre and post activities that were delivered to

participating teachers to complete in their classrooms before and after they brought students to the ELC. All materials to complete these lessons were provided to the teachers and funded by the grant.

All fourth graders, approximately 300, from a local school district were brought to the ELC to participate in the unit that was created by the pre-service teachers. At the projects' completion, the lesson plans created by the pre-service teachers remained at the ELC and are continually offered as field trip options to other school districts.

### **Participants**

Participants for this study included seven pre-service teachers enrolled in a large state institution in the Midwest as a middle childhood education major. They are all seeking a teaching license in grades 4-9. Initially, each participant chose two concentration areas of licensure (language arts, mathematics, science, or social studies). They can also choose to pursue extra content courses and pass an additional state exam to add the other two areas to their licensure. This would qualify them to teach grades 4-6 for all subjects in addition to grades 7-9 in their two initial areas.

Each participant is enrolled in the second semester of their junior year and will move onto student teaching the following semester. The current experience involves specific methods courses in their chosen areas along with additional courses in incorporating literacy, general middle school curriculum and instructional/assessment practices.

These participants include six females and one male. They reside in a rural area approximately 45 minutes outside of a large metropolitan area. Five of the seven participants are classified as non-traditional students. This is defined as being enrolled in college four or more years past their graduation from high school.

### **Instrument**

For the purpose of collecting data regarding the participants' self-efficacy towards teaching science The Science Teaching Efficacy Belief Instrument B (STEBI-B) was used and is considered to be both valid and reliable (Enoch & Riggs, 1990). This instrument includes 23 Likert-Scale items in which two areas of beliefs are assessed. The first subscale measures the participants' belief that they can teach science (Personal Science Teaching Efficacy, PTSE). Scores on this measure can range from 13-65 with a high score indicating a high belief in one's ability to teach science. The second subtest assesses the participants' belief that their science teaching will have a positive effect on their students' learning (Science Teaching Outcome Expectancy, STOE). This score can range from 10-50.

### **Data Collection**

The STEBI-B was administered to the participants at the beginning of their project experience with the ELC. It was then re-administered at the end of the project. The time between administrations was approximately seven months.

Once these differences were determined, qualitative data were collected in order to determine what events influenced these differences and the reasons behind them (Tuckman & Harper, 2012). More specifically, a survey was given to the participants to gather this data. Surveys are used, "with the intention of describing the nature of existing conditions" (Cohen, Manion, & Morrison, 2007, p. 205).

Additionally, an anonymous, on-line survey was administered to the participants after the project was completed and all STEBI-B surveys were completed. This survey asked six follow-up questions (Appendix A) to allow the participants to further explain the circumstances surrounding their experience with the project and their perceived sense of self-efficacy.

### Data Analysis

Once all data were collected, the Research and Evaluation Bureau statisticians at the participating university using a paired T-test for each subtest and completed a statistical analysis. The first state of data analysis included performing a t-test to compare group means to determine whether or not the groups differed significantly in relation to the dependent variable (Tuckman & Harper, 2012).

In order to analyze the qualitative data collected, responses from the participants were coded and examined both vertically and horizontally. First, participants' responses were coded vertically for negative/positive indicators. Additionally, there were coded for examples from their experience that influenced their perceived self-efficacy. These codes related to working with students, being in an authentic environment, and staff/faculty influences. Horizontally, each question was coded to examine if patterns existed within each individual question.

### Findings

#### STEBI-B

Research question 1: Will involvement in an authentic learning experience change pre-service teachers' science teacher sense of efficacy? In an attempt to answer this question, results from data collected from PSTE questions of the STEBI-B were analyzed. There was a significant difference in the scores for the pre-test (M=46.7, SD=9.72) and post-test (M=43.14, SD=14.78);  $t(6)=1.40$ ,  $p=.210$ . Table 1 shows these results. The scores show that there was a significant negative change in the participants' self-efficacy from the beginning of the experience to the end.

Table 1

Changes in self-efficacy (PSTE) and outcomes of teaching science (STOE)

Subtest	Pre Test		Post Test		n	t	df
	M	SD	M	SD			
PSTE	46.71	9.72	43.14	14.78	7	1.40*	6
STOE	37.71	4.82	36.42	4.11	7	.629**	6

\* $p < .05$  \*\* $p > .05$

Research question 2: Will involvement in an authentic learning experience outside of a traditional classroom change pre-service teachers' beliefs regarding their outcomes of teaching science? Data to answer this question were gathered from the STOE questions of the STEBI-B. There

was not a significant difference in the scores from the pre-test ( $M=37.71$ ,  $SD= 4.82$ ) and post test ( $M=36.42$ ,  $SD=4.11$ );  $t(6)=.629$ ,  $p= .552$ . Table 1 shows these results. Even though there was a change in scores (a decrease) from the beginning of the experience to the end, these results were not statistically significant.

### Survey

In addition to the quantitative data analyzed, participants' responses from the follow-up survey were examined to further answer the research questions. The pre-service teachers generally reported a high sense of self-efficacy. Positive responses to question 1, "Overall, describe your confidence level in teaching science", included, "I am fairly confident at this point in being able to teach science" and "I feel relatively confident in all science areas." Negative responses to this question were received from other participants including the response, "I am not confident at all in teaching science, although that is not one of my content areas."

Next, the participants were asked to describe how their experience at the ELC helped shape their confidence in teaching science. Like the responses received in question 1, responses to questions 2-4 were generally positive and cited several aspects of the project as being beneficial to their growth as a science teacher. One participant responded:

Working with park researchers has influenced my confidence level because it allowed me to think outside of the box in a way that I may not have had prior to the experience.

Being able to explore ideas and learn the reasons why they may or may not have worked in the field was a great learning experience and one that I may never have had a chance to understand if were not for this.

Negative responses regarding experiences in working with the ELC that affected their self-efficacy were generally associated with a lack of science content knowledge presumably coming from a participant who has a non-science concentration. Responses included, "Science was always my weakest subject even as a student," and "I always had a hard time grasping concepts and the vocabulary that is necessary..." However, these comments were few in comparison to those who described a positive experience with the project and its effect on their self-efficacy.

After examining the original quantitative data, two statements from the STEBI-B showed an overall decrease in score from the pre to post tests. These statements were:

I will typically be able to answer students' science questions.

I wonder if I will have the necessary skills to teach science.

In order to further investigate these two specific questions, questions 5 and 6 were added to the follow up survey. In response to question 5, participants shared concerns with answering student questions. One participant stated, "Some of my concerns about being able to answer students' questions about science are that I will answer them incorrectly or incompletely." Another participant stated, "My concern with this generally comes when there is math involved such as with Chemistry."

In response to question 6, when participants were asked about which skills they don't have currently have to teach science, most participants responded with concerns related to not having higher levels of science content knowledge. One participant stated, "I think the most important is content knowledge, which I don't have. Also a basic understanding of content specific vocabulary is also necessary." Others stated that they need more experience in order to gain these skills.



The responses received through the follow up survey gave context to the quantitative data collected through the STEBI-B. While a decrease in perceived self-efficacy was shown, through the survey responses the possible reasons as to why the decrease occurred were able to be examined as well.

## **Discussion**

Conventional wisdom leads one to assume that exposing pre-service teachers into an environment outside of the traditional classroom environment would lead to all around positive results with little to no disadvantage. In congruence with this belief, one would also assume that an increase in self-efficacy was likely. Many studies support this result (Avery & Meyer, 2012; Bursal, 2012; Gunning & Mensah, 2011; Tosun, 2000). Yet, the data in this study reveal that the participants' self-efficacy towards science actually decreased. These results align with other research that had similar outcomes after various learning experiences (Avery & Meyer, 2012; Housel, 1982; Morrel & Carroll, 2003; Moseley, Reinke & Bookout, 2002 Wagler, 2011).

Examining why this occurred is essential to teacher educators. Before entering into this experience, these participants only had limited experience in a classroom working with students. Their previous experiences included one semester of observation and another semester of assisting a teacher with students and working in small groups. Their experience with actually planning and executing lessons was very limited. This was their first opportunity to think of the whole picture of teaching including planning an interdisciplinary unit while considering activating prior knowledge, connecting to state standards, classroom management, and assessment along with all conceivable facets of teaching an entire unit. Going into this experience with limited opportunities to execute lessons may have given the pre-service teachers an elevated sense of teaching. Overall, the more experience a teacher has the lower their efficacy (Jones & Levin, 1994). They had not yet been exposed to the realities of a classroom including all components that are involved.

Since opportunities for the participant to serve as teachers was limited their framework for teaching still relied on being an "apprentice through observation" in which adults fall back on their experience watching their K-12 teachers for 13 years and assuming that they have a clear understanding of what it takes to be a teacher. However, this viewpoint is limited in scope as students only observe part of the teaching experience—that which is performed in front of the students. They do not see all the background work that teachers partake in before and after they are working with students. This leads people to believe that they are "experts" in being a teacher when in reality, they have limited scope of the profession (Lortie, 1975). This understanding may have led the participants to enter the experience with an inflated self-efficacy towards teaching science. However, once emerged in the experience and reality of the work of a teacher became apparent, the participants may have deflated their self-efficacy to match the increased challenges of being a teacher.

The prior knowledge these pre-service teachers had about teaching science to middle school students may have stemmed from how they were taught during their middle school years. General perceptions of prior experience with learning science are overwhelmingly negative (Tosun, 2000). This may have included a heavy dependence on textbook and teacher directed instruction. Due to this negative prior experience with science, their comfort level lies with this style of teaching and despite a

teacher educator program's progressive mission, teachers tend to revert to beliefs about teaching aligned with the traditional methods they, themselves, were taught with (Fletcher & Luft, 2011). Breaking away from this way of learning may have stirred levels of discomfort for the teachers and a realization may have occurred that authentic learning involves much more work than just teaching from a textbook.

Another explanation for these results might stem from the participants' chosen content areas for licensure. Not all participants chose science to be their main areas of concentration. As a result, that some participants would have taken 24-28 additional semester hours in science content courses while others did not. While this research did not separate out which participants were science concentrations, responses collected during the post-experience survey indicated that some participants self-indicated that they have a non-science concentration and this played a role in their lack of self-efficacy towards teaching science. Jones and Levin (1994) have found that non-science major pre-service teachers had lower levels of self-efficacy towards teaching science than their peers who were science major pre-service teachers. Knowledge of science content is directly linked to science efficacy (Joseph, 2010). Some participants did not even choose to pursue the grades 4-6 generalist option which allows them to add a science concentration area to their licensure and teach the two areas outside of their main subject areas. This means that not all participants plan on teaching science upon graduation and may not be genuinely passionate about science as those who chose a science concentration. Even though this remains true, they were all required to participate in this project as part of an interdisciplinary course that is required for all pre-service teachers.

In addition to content concentrations, another factor to be considered is the gender of the participants. In this study, 6 of the 7 participants were female. Jones and Levin (1994) report that males demonstrate a more positive attitude towards teaching science than females. Additionally, it was found that females felt less confident in teaching science. This finding does not conclude that males have a higher level of content knowledge than females, but rather their confidence in teaching science content. Due to the majority of participants in this study being female, this more negative attitude of teaching science may have led to a lower level of perceived self-efficacy. This population of future female science teachers then lacks the social modeling of confident female science teachers and continue the cycle of demonstrating lower confidence than their male counterparts (Joseph, 2010).

## **Implications**

This study has several implications for those involved in teacher education. The main of these would be having an increasing awareness that just by placing students in an authentic learning experience does not automatically result in a higher sense of efficacy. There are many factors that lead to this happening. Science methods courses need to move outside of the traditional classroom experience. However, the groundwork for these experiences must be laid before they begin. It cannot be assumed that pre-service teachers are ready for the complexities involved with teaching in an authentic setting. It also cannot be assumed that pre-service teachers are ready to break away from the traditional classroom that they have been accustomed to since their own K-12 education experiences.

Secondly, teacher education needs to understand the complexities of experiences that pre-service teachers bring to teacher education programs. This could range from a high sense of confidence due to being an apprentice through observation leading in a ceiling effect in which teachers are overly

confident about their ability to be a successful teacher. Some may also be equating their personal confidence in learning science with their confidence to teach it (Kazempour & Sadler, 2015). On the other end of the spectrum, it can be students who are unwilling to break away from what they know about teaching and have high levels of anxiety about trying new techniques and having new experiences.

Lastly, middle school teachers are expected to embrace a multi-disciplinary approach to teaching (NMSA, 2010). Typically, this is done in a team setting where each teacher teaches within his or her concentration areas. However, when teachers are forced outside of their areas for the sake of multi-disciplinary teaching, this may create feelings of anxiety and stress that can affect their efficacy. Although this is not typically the norm in a traditional middle school setting, teachers should not be given the sense that they teach in silos and that their content area does not/will not overlap with other areas. This might include incorporating aspects from other content areas into their own in order to make content richer.

### **Future Research**

This study shows that there was a decrease in self-efficacy in pre-service teachers before and after an authentic learning experience. However, the reasons behind this decrease were not researched. Assumptions can be made to why this occurred but without the qualitative analysis to back it up, they cannot be confirmed. Additionally, comparative analysis that is broken down by concentration area would need to be examined. This would allow the researcher to examine if the fact that some participants did not have a science concentration was a factor in the results.

The issue of how to increase self-efficacy amongst middle school science teachers remains multi-faceted. This study examines how one aspect affects this piece of the puzzle. While the findings were significant, they were no less intriguing. They strayed away from conventional wisdom and further exposed just how complex this issue is. It is not suggested that teacher educators do not immerse their students in authentic, field-based learning experiences but rather that they pre-service teachers need to be prepared for all areas of this type of learning. Additionally, teacher educators need to be aware of how multi-faceted their students are and plan accordingly.

### **Limitations**

Several limitations for this study exist. First, the size of the population was low (N=7) and limited in scope of size and overall demographics. Secondly, participants were chosen based on convenience and not randomly selected. Due to this, the study is not generalizable outside of the context it was conducted. Participants were also students in the researcher's university course. Although students were informed that their participation was voluntary, confidential, and would not affect their grade in the course, results may be influenced.

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Appendix A  
Follow Up Survey Questions

1. Overall, describe your confidence level in teaching science.
2. What experiences have you had that contributed to this confidence level?
3. Describe specifically how your experience working with park researchers have influenced this confidence level.
4. In which ways do you feel that working with students at the ELC affected this confidence level?
5. What concerns do you have about being able to answer students' questions about science?
6. What are the necessary skills to teach science that you don't currently have?