Preservice Teacher Self-Efficacy for Teaching Mathematics

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PRESERVICE TEACHER SELF-EFFICACY FOR TEACHING MATHEMATICS

by

Jade McGuire

A Thesis Submitted in Partial Fulfillment
of the Requirements for a Degree with Honors
(Elementary Education)

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Abstract

Self-efficacy for teaching mathematics has an effect on students’ math achievement (Bandura, 1997; Stipek, Givvin, Salmon, & MacGyvers, 2001). It is therefore important that teachers have high self-efficacy for teaching mathematics. The purpose of this study was to discover if the University of Maine’s College of Education and Human Development’s teacher education program is doing enough to help elementary education majors feel confident in their ability to teach mathematics at the kindergarten through eighth grade levels. A modified version of the “Self-Efficacy for Teaching Mathematics Instrument”, or SETMI (McGee & Wang) was administered to one hundred and eleven elementary education majors at the University of Maine. The results show that participants’ self-efficacy beliefs for teaching mathematics were not influenced by required math courses or required field placements. However, participants’ self-efficacy beliefs for teaching mathematics were influenced by enjoyment for math and the belief in the importance of math in every-day life. This study suggests that there is more that the University’s teacher education program could be doing in order to help elementary education majors feel confident in their ability to teach mathematics.
Dedication

I dedicate this thesis to my AP Calculus teacher, Mr. Poulin.

Whenever I second guess my career choice, I am reminded of his kind words: “I would rather have someone who graduated third in their class teach my kids than someone who graduated last.”

You will never know how much those words mean to me.

Thank you.
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Introduction

Self-efficacy in teachers’ ability to teach has been shown to have a direct effect on student achievement (Bandura, 1997). In other words, if teachers feel confident in their ability to teach, their students’ achievement will be higher. If teachers lack confidence in their ability to teach, then their students’ achievement will be lower. One of the subjects in which teacher self-efficacy becomes particularly important is in math. Research shows that most adults do not enjoy mathematics, and many report having negative feelings towards math as early as elementary school (Ramirez, Gunderson, Levine, & Beilock, 2013). This may be the result of a low level of math achievement or a strong belief in their inability to do math. It is therefore important that teacher self-efficacy for teaching mathematics is high. Higher teacher self-efficacy will result in higher student achievement in math, which may increase the overall enjoyment of math.

The purpose of this study was to determine whether or not the University of Maine’s College of Education and Human Development’s teacher education program is doing enough to help elementary education majors feel confident in their ability to teach mathematics at the kindergarten through eighth grade levels. A degree in elementary education certifies a teacher candidate to teach all of the core subjects from kindergarten through eighth grade. When these students graduate from the University of Maine, they will likely be required to teach mathematics during their careers. It is therefore important that they feel confident in their ability to do so for the sake of their future students’ achievement.

Participants in this study were pre-service teachers in the elementary education program at the University of Maine. Participants were asked to take a short survey that
measured their self-efficacy for teaching mathematics. The first twenty-one questions of the survey were taken from the Self-Efficacy for Teaching Mathematics Instrument (SETMI), a valid and reliable survey that measures teachers’ self-efficacy for teaching mathematics (McGee & Wang, 2014). The remaining questions were developed by the principal investigator as a reflection of results from other studies and as a means of asking questions that reflect expectations of the University of Maine’s College of Education and Human Development’s teacher education program.
Review of Literature

The world that surrounds us is full of different challenges and potential hazards. Albert Bandura declares that because of this, humans need to be able to make good judgments about their capabilities (Bandura, 2001). Of course, this makes sense. If somebody knows that they are not a strong swimmer, then they should not choose to swim to an island that is four hundred yards away with their peers. Bandura reasons that humans’ ability to make good judgments about their capabilities helps them reach desired outcomes and avoid unwanted results (Bandura, 2001). The inability of the swimmer in the previous example to make good judgments about their swimming capabilities could cost them their life. Likewise, their ability to recognize that they would likely not make it to the island keeps them safe on land.

On the other hand, a person’s belief in their ability to achieve a desired outcome, rather than the knowledge of their capability, has an effect on their actual ability to do so (Bandura, 2001). This belief in the ability to achieve a desired outcome is called self-efficacy. The ability to make judgments about personal capabilities has an effect on self-efficacy. For example, say that you know that you can write a strong persuasive essay because you have done it before; this knowledge about your personal capabilities will make you more likely to believe that you can write a persuasive essay that your critical professor will be pleased with. On the opposite side of the spectrum, if you have only ever written creative stories, your belief in your ability to write a persuasive essay that your critical professor will be pleased with will likely be much less confident.

However, a person’s self-efficacy does not always take their knowledge of their capabilities into account. Bandura explains that optimistic beliefs in personal ability can
bring about self-enhancing results while pessimistic beliefs can bring about self-hindering results (Bandura, 2001). This means that even though you might have written a strong persuasive essay in the past, if you believe that you will not be able to write one that your professor will be pleased with, then you are hindering your actual ability to do so.

Similar to standard self-efficacy, teacher self-efficacy is defined as: “the extent to which a teacher believes that she or he can influence students’ behavior and their academic achievement” (Friedman & Kass, 2002). This means that if a teacher does not have high belief in their ability to foster academic achievement in their students, then they are hindering their actual ability to do so. Teachers with a high sense of teaching efficacy tend to believe that they can reach the most difficult students, regardless of extenuating circumstances. However, teachers with a low sense of teaching efficacy tend to believe that there is not much they can do to help a difficult student when other factors, like home life, are involved in the student’s academic achievement (Bandura, 1997).

Self-efficacy is also an important factor in teacher burnout. Efficacy has an effect on how long people continue with something when they are faced with obstacles (Bandura, 2001). When faced with stressors that the teaching career brings, teachers with high self-efficacy focus on resolving the problems, while teachers with low self-efficacy internalize the problems, which adds to their personal emotional stress (Bandura, 1997). If teachers who are struggling with problems internalize those problems due to low self-efficacy, then they are more likely to quit when teaching becomes hard, adding to the high teacher burnout rate. In fact, teacher self-efficacy is the best indicator of whether or not a teacher will stay in the teaching profession. Therefore it is important for teacher
self-efficacy to be high so that new, well-educated teachers do not abandon their school systems.

Self-efficacy also affects the effort people put forth. Efficacy has an effect on how much effort a person puts into a task (Bandura, 2001). This becomes important when looking at teacher effort. If a teacher does not have high self-efficacy for teaching mathematics, Bandura concludes that this teacher might put less effort into teaching math since their efficacy is low. This means that the teacher who needs the additional practice and education for teaching mathematics, will likely not seek it out.

Studies have shown that children with a high sense of self-efficacy do better than students of equal ability and a lower sense of self-efficacy; additionally, children with higher self-efficacy for doing mathematics had higher interest in and positive attitudes toward mathematics. (Bouffard-Bouchard, Parent & Larivee cited in Bandura, 1997). On the other hand, these same students’ actual mathematical ability did not predict their interest or attitudes. In another study in which students raised their efficacy through the use of creating subgoals for themselves, the higher their efficacy the greater their mathematical accomplishments became (Bandura 1997). This again shows that self-efficacy is an important determinant in how well somebody does on a given task.

Teacher self-efficacy for teaching is important in regards to their students. Research has shown that teacher self-efficacy has an effect on how students judge their intellectual capabilities (Bandura, 1997). Teachers with a high sense of efficacy create classrooms in which all students can master the subject matter, but teachers with low efficacy create classrooms that undermine students’ beliefs about their own academic abilities (Bandura, 1997). Research shows that younger students take cues from their
teachers because these students do not yet know much about their own abilities. This means that if a teacher has low self-efficacy for teaching, they might be creating a classroom full of students who have low self-efficacy for their academic abilities. As mentioned earlier, students with low self-efficacy on different academic subjects tend to do poorly on those subjects. Therefore, lower teacher self-efficacy for teaching may harm student performance. Adding further concern, students that already have doubts about their academic abilities are affected even more by low teacher self-efficacy than students who are confident in their abilities (Bandura, 1997). This is a problem because these are the students that need the most help, but if they have a teacher with low self-efficacy for teaching, their education is likely being compromised.

Since students are not born with innate interests in certain activities, these interests must be formed (Bandura, 1997). That is why, when it comes to teaching, teachers must not only emphasize the technical skills that students need to know, but they must also foster interest in the subject. According to Bandura (1997) people remain interested in activities in which they have high efficacy and they become interested in subjects in which they are highly efficacious. Therefore, teachers also need to foster efficacious beliefs in students so that their interest in different subjects continues.

One subject where interest seems to being lacking is mathematics. “The majority of individuals in the United States, regardless of cultural and economic background, dislike and fear mathematics (Burns, 1998; Zaslavsky, 1994) and report having negative experiences with math as early as elementary school (Jackson & Leffingwell, 1999),” (cited in Ramirez et al., 2013, p. 188). It is therefore particularly important for teachers to
foster an interest in mathematics, and for them to have high self-efficacy for teaching mathematics in order to help their students gain confidence in mathematics.

Since self-efficacy for teaching is likely not the same across multiple subjects, a teacher who has high efficacy beliefs for teaching language arts, might not have the same efficacy beliefs for teaching mathematics (Bandura, 1997). In one study of beginning teachers in Iceland, researchers found that students who had high self-efficacy for Icelandic chose it for their major, while those who had low self-efficacy in their Icelandic abilities chose a different major, regardless of the fact they might have to teach Icelandic anyways (Aðalsteinsson et al., 2014). This study looked even further and found that many teachers who are teaching Icelandic in the upper grades did not have Icelandic for their major and do not feel confident in their ability to teach the subject. Many public schools in Maine require teachers in the K-5 levels to teach more than one of the core subjects (language arts, mathematics, science and social studies). Thus, similar to Iceland, even though a teacher might not be confident in her ability to teach mathematics, and even though it might not be the subject she concentrated in, she could be required to teach it.

Preservice teachers usually do not have strong mathematical knowledge (Brown, Cooney, & Jones, 1990; Cramer & Lesh, 1988; Post, Harel, Behr, & Lesh, 1991 cited in Brown, 2006). However, several studies showed that preservice teachers who had completed math content courses and math methods courses had a statistically significant increase in self-efficacy for teaching mathematics (Charalambous, Philippou, & Kyriakides, 2008; Huinker & Madison, 1997; Rethlefsen & Park, 2011; Swars et al., 2007; Utley, Moseley, & Bryant, 2005; Alsup, 2004 cited in Briley, 2012). So, it is therefore important that universities provide preservice teachers with mathematics classes
that employ methods that have been shown to help increase their self-efficacy for teaching mathematics. In one study where a mathematics methods course began using the BAR model ((a) Build knowledge; (b) Act on the knowledge through discussion and/or assignments and feedback; and (c) Reflect on the action and in its course) preservice teachers’ self-efficacy scores showed positive changes on all measured components (Rethlefsen & Park, 2011). This is one tool that universities could employ in their methods courses in order to help raise self-efficacy for teaching mathematics. Other successful mathematics methods courses that have raised self-efficacy for teaching mathematics have focused on a constructivist model of teaching where students are the ones who construct meaning based on previous knowledge and explicitly taught knowledge (Swars et al., 2007; Alsup, 2004).

Research has shown that enjoyment of mathematics can lead to higher perceived ability to do math (Pinxten, Marsh, De Fraine, Van Den Noortgate, & Van Damme, 2014). This higher perceived ability to do math could also lead to higher self-efficacy for teaching math. One study on preservice teachers also showed that their beliefs and feelings toward mathematics had a significant effect on their self-efficacy for teaching mathematics (Briley, 2012). If a higher enjoyment of mathematics could lead to higher self-efficacy for teaching mathematics, then it becomes important for math methods courses to not only teach the theoretical practices for teaching math, but to also help foster positive feelings towards math and enjoyment towards math for their preservice teachers.

Another study showed that preservice teachers that had high self-efficacy for teaching mathematics had lower mathematics anxiety (Gresham, 2008). This same study
found the following results: “The preservice teachers with high mathematics anxiety
focused upon mathematics in school such as timed tests and pop quizzes which imply a
memorization of mathematics procedural knowledge. In contrast, the preservice teachers
with low mathematics anxiety mentioned a parent who was a positive role model in
mathematics and focused upon experiences with mathematics that implied processes such
as problem-solving, reasoning, and communication,” (Gresham, 2008, p. 312). This
means that by increasing self-efficacy for teaching mathematics, preservice teachers will
have a lower level of mathematics anxiety, which in turn, helps them create a
mathematics classroom that is more conducive to learning.

In another study that was based on 21 fourth and sixth grade teachers at the
beginning and end of the school year, researchers found that teacher self-efficacy for
teaching math had a significant correlation with students’ own beliefs about their ability
to do math after having that teacher for a full school year (Stipek et al., 2001). The report
states: “Teachers may have influenced students' beliefs directly by simply modeling self-
confidence themselves. Or, the effect could be indirect. Perhaps teachers who judged
their competencies as mathematics teachers to be high were, in fact, better teachers who
produced greater learning, and consequently more self-confidence in students,” (Stipek et
al., 2001, p. 224). Whatever the reasoning for the results, they are nonetheless
concerning. This study shows a direct correlation to teacher self-efficacy for teaching
mathematics and student self-efficacy for doing mathematics, and as has already been
discussed, student belief in their ability to do well in a subject has a large effect on their
actual ability to do well in that subject.
It is very clear that helping students have high self-efficacy for doing mathematics is important. When conducting a study on students in the early elementary school grades, researchers found that there was a correlation between reported math anxiety and math achievement in students in as early as first and second grade (Ramirez et al., 2013). Teachers must have the ability to foster confidence in their students’ ability to do math; that ability begins with those very teachers having developed their own degree of confidence prior to entering the classroom.
Methods

Participants

The participants in this study were students in the *University of Maine’s College of Education and Human Development* who were elementary education majors, or a double major that included elementary education, in the fall of 2015. Participants from varying stages of degree progress were surveyed for this study. Some of the students surveyed did not have a major in elementary education–these participants’ responses were omitted from the results. There were one hundred and eleven participants that had a major in elementary education. Of those surveyed, twenty-nine had no field experience, nineteen had completed their week-long observation for teacher candidacy, twenty-one had done this as well as the field experience placement required for ERL 319, twenty-seven had already completed these two experiences as well as their 100 hour placement (EHD 400), and eleven had completed all of these requirements and were currently student teaching. The remaining four participants did not give sufficient data to determine their field experience. It should be noted that with the exception of those who were student teaching, it was not noted whether or not the participants had completed their most recent field experience. This means that someone who circled the 100 hour placement on the survey could likely have been in the middle of that placement when the survey was administered. With that being said, the survey was administered after Education Week, which means that any participant who circled the 100 hour placement had taught at least one lesson by the time this survey was administered.
Survey

After examining many different surveys that were created to measure teacher self-efficacy, a researcher named Jennifer McGee discovered that there were no surveys that measured teacher self-efficacy for teaching mathematics that followed all of the tenants for creating a self-efficacy measure (McGee & Wang, 2014). McGee then decided to create her own survey, which she called the Self-Efficacy for Teaching Mathematics Instrument (SETMI). McGee closely followed Bandura and Pajares’ instructions for creating a self-efficacy device (Pajares, 2006). McGee, with a partner, went on to show that the SETMI is a valid and reliable measure of teacher self-efficacy for teaching mathematics (McGee & Wang, 2014). It is for these reasons that this survey was chosen for this study.

The first seven questions of the survey used for this study were taken from Part One of the SETMI and aim to focus on self-efficacy for pedagogy in teaching mathematics. Questions eight through twenty-one were taken from part two of the SETMI and are related to the specific content that teachers are expected to teach in the K-8 levels. All of these questions were compared to the Common Core State Standards (CCSS), because these are the standards that preservice teachers at the University of Maine are expected to use in their teaching. After examining all of the questions in part two of the SETMI, one was found not to align with the CCSS, so this question was omitted from the survey.

Question twenty-two was created because it gets at the overall heart of this thesis: is the University of Maine’s College of Education and Human Development’s teacher education program doing enough to help elementary education majors feel confident in
their ability to teach mathematics after they graduate? If the participants filled out the survey honestly, then the results should show a relationship between this question and overall self-efficacy.

Question twenty-three and twenty-four were created based on the findings of a 2014 study. This study found that positive emotions lead to higher perceived competency (Pinxten et al., 2014). This means that if a student enjoys math and believes that it is useful (positive emotions) then they are more likely to be confident in their mathematics ability. These questions then became important to include because high or low self-efficacy scores might be affected by enjoyment of mathematics and belief in its importance, and not just the quality of education that the University of Maine’s teacher education program is providing.

Jennifer Tyne, a lecturer in the mathematics department at the University of Maine, created questions twenty-five through twenty-nine. Tyne has taught MAT 107, which is a required course for all elementary education majors to take. Tyne has also taught other courses that some elementary education majors take, like MAT 126, MAT 232, MAT 103, and the newly created MAT 116. Due to her experience working with preservice teachers in the field of mathematics, Tyne has an acute understanding of what the College of Education and Human Development wants student teachers to be able to do upon graduation. Tyne’s questions focus in on specific math problems that might arise in the classroom. Her questions also align with the Common Core State Standards.

Each of the questions on the survey can be answered on a five point Likert scale with one being the lowest and five being the highest. The descriptors are different among the different groups of questions due to their specific content. Questions one through
seven have the descriptors “not very able” to “highly able”. Questions eight through twenty-two have the descriptors “very poorly” to “very well”. Question twenty-three has the descriptors “do not enjoy” to “really enjoy”. Question twenty-four has the descriptors “very unimportant” to “very important”. Questions twenty-five through twenty-nine have the descriptors “very unconfident” to “very confident”. While this last set of questions would have worked as open ended questions, they would have been difficult to score consistently. One study that looked at different forms of assessment used to determine teacher self-efficacy in teaching mathematics found that reported self-efficacy was the same when presented with multiple choice math problems as well as open ended math problems (Pajares & Miller, 1997). Based on the results of this study that showed that there is no difference in self-efficacy scores when using multiple choice questions rather than open ended questions, the decision was made to keep questions twenty-five through twenty-nine on the Likert scale in order to keep the scoring fair among all participants.

The demographics section of the survey asks participants to identify their year in school, gender, age, GPA, field experiences required as part of the College of Education and Human Development program, major, concentration, minor (if applicable), favorite subject, best subject, math courses taken in college, grade level experiences, grade level interests, as well as Praxis One and Praxis Two scores. While all of these demographics are important, particular attention should be paid to field experiences and math courses. These two categories are the ones that the University of Maine’s College of Education and Human Development’s teacher education program have the largest impact on when it comes to self-efficacy for teaching mathematics. The field experiences provide students practical classroom experience as well as the opportunity to teach lessons. The math
courses provide students with the content knowledge that will be necessary in order to
teach math at the K-8 levels. The survey in its entirety can be found in Appendix A.

Procedures

In order to reach elementary education majors from varying stages of degree
progress, professors who were teaching the following courses during the Fall semester of
2015 were contacted: MAT 107 (Elementary Descriptive Geometry), MAT 108
(Elementary Numerical Mathematics From a Modern Perspective), EHD 203
(Educational Psychology), EMA 314 (Teaching Mathematics in Elementary School),
ERL 317 (Children’s Literature), and EHD 498 (Seminar for Interns). Each of these
courses is a requirement for elementary education majors and they all are taken at varying
points in the teacher education program. The professors of these courses were informed
about the research being conducted and agreed to give fifteen minutes of their class time
in order for their students to take the survey.

I went to each of the courses mentioned above to administer the survey. Upon
entering the room, I introduced my research project and myself. The script that was used
to introduce the survey in each class can be found in Appendix B. As participants
completed the survey, I stood near the front of the room and was available to answer any
questions and clear up confusions. Once participants finished their survey, they placed it
in a random order in a manila envelope that was in the front of the room. After all of the
surveys were completed, I placed them in a bag and brought them back to my apartment
where they were kept in a locked room until they were ready to be analyzed.

After all of the results were complied, a one-way ANOVA was used to analyze
the survey data. This test was used because it allowed a quick insight into whether or not
there were any significant differences between the means (self-efficacy scores) of two or more unrelated groups (i.e. those in MAT 107 versus those in EMA 314). If the results showed that there significant differences, then post hoc analyses were run to determine where the differences laid.
Data Results

In this section, I report the results of the study. The reported results address the central question of the study: Is the University of Maine’s College of Education and Human Development’s teacher education program doing enough to help elementary education majors feel confident in their ability to teach mathematics in the kindergarten through eighth grade levels? Further results are included to expand on the main results.

The self-efficacy questions on this survey were grouped into three subgroups: self-efficacy broad, self-efficacy standard, and self-efficacy specific. See Appendix A to view the survey. Questions one through seven are grouped under the title “self-efficacy broad” because their aim is to focus on self-efficacy pedagogy for teaching mathematics—or the broad aspects that you must be confident about in order to teach mathematics. Questions eight through twenty-one are grouped under the title “self-efficacy standard” because these questions are related to the mathematics standards that elementary school teachers will need to follow in their math curricula. Questions twenty-five through twenty-nine are grouped under the title “self-efficacy specific” because they are specific mathematics questions that teachers might encounter in the classroom. All of these self-efficacy questions are also summed under one category titled “self-efficacy global”. See Appendix C, table 3.1 to review this information.

One method that the University’s teacher education program uses to prepare elementary education majors to teach mathematics is by requiring them to take certain mathematics courses. Research has shown that there is usually a statistically significant increase in mathematics teaching efficacy upon completion of math content courses and math methods courses, which is why the following results, regarding required
mathematics courses, were included (Briley, 2012). The University requires that elementary education majors take two math courses (MAT 107 and MAT 108) during the second year of their degree program. These two courses aim to give elementary education majors a background on the content that they will need to teach in the kindergarten through eighth grade levels. Elementary education majors are then required to take EMA 314 in the semester prior to their student teaching. The aim of this course is to give elementary education majors practice with planning mathematics lessons as well as teaching elementary education majors how to present mathematics content to students in a meaningful and interesting manner.

In regards to the self-efficacy standard questions, the results show that participants’ self-efficacy beliefs were influenced by these math courses, F (4, 105) = 3.429, p< .01. There was a significant difference on how participants rated themselves on the self-efficacy standard questions based on the number of required math courses they took (either one, two or three math courses). The mean average rating on self-efficacy standard questions was 3.43. Participants that had only taken MAT 107 (M=2.91) or MAT 108 (M=3.19) rated themselves lower than participants who had taken both of the courses (M=3.54). However, participants who had taken both MAT 107 and MAT 108 (M=3.54) rated themselves higher than participants who had taken all three required courses (M=3.44). Additionally, there were four participants who had not yet taken any of the required courses; these participants rated themselves higher than any other group of participants (M=3.60). These results can be seen in tables 3.2 and 3.3 in Appendix C.

The results also indicated that participants’ self-efficacy broad, specific, and global beliefs were not influenced by these math courses. In regards to the self-efficacy
broad questions, the results show that participants’ beliefs were not influenced by these mathematic courses, $F(4, 105)= .374, p = .83$. There was no significant difference on how participants rated themselves on the self-efficacy broad questions based on the math courses they took. The mean average rating on self-efficacy broad questions was 3.65. In regards to the self-efficacy specific questions, the results show that participants’ beliefs were not influenced by these mathematic courses, $F(4, 105)= 2.102, p = .09$. There was no significant difference on how participants rated themselves on the self-efficacy specific questions based on the math courses they took. The mean average rating on self-efficacy specific questions was 3.30. In regards to the self-efficacy global questions (i.e. all of the self-efficacy questions summed together), the results show that participants’ beliefs were not influenced by these mathematic courses, $F(4, 105)= 1.905, p = .12$. There was no significant difference on how participants rated themselves on the self-efficacy global questions based on the math courses they took. The mean average rating on self-efficacy global questions was 3.46. While there was no statistically significant difference of participant self-efficacy in regards to math courses on any of these three subscales, the four participants that had not taken any math courses actually rated themselves higher than participants who had taken all three math courses ($M= 3.60$ and $M= 3.43$ respectively). These results can be seen in table 3.2 and 3.3 in Appendix C.

While the math courses that participants have taken did have a significant effect on how participants rated themselves on self-efficacy standard questions, it did not have an effect on how they rated themselves on self-efficacy global, which took into account the self-efficacy standard questions. As a whole, for participants in this study, the
required math courses taken did not influence whether or not they felt confident in their ability to teach mathematics.

Another method that the University’s teacher education program uses in an attempt to prepare elementary education majors for teaching mathematics in the kindergarten through eighth grade levels is by putting them in different field placements. By the end of their second year, elementary education majors are required to have completed a 30-hour observation placement in order to apply for teacher candidacy (which allows elementary education majors to take upper level courses). This 30-hour placement is meant to be a weeklong observation in one classroom. This means that the teacher candidate will spend six hours a day for five days, mainly observing the teacher and the classroom at work. While the University is willing to schedule this placement for teacher candidates, the candidates can also schedule it on their own. This means that there is no requirement for the grade or the school that the candidate does their observation at, as long as the grade level and subject matter align with the candidate’s program of study. By the end of their third year, elementary education majors are required to have completed a 30-hour placement as part of the course ERL 319 (Teaching Reading and Language Arts in Preschool to Grade 3). Elementary education majors are placed in a classroom ranging from kindergarten to grade three. In this placement, University elementary education majors are paired with an elementary school student and work with them intently to learn more about literature development. In this placement, elementary education majors are required to administer different literacy assessments as well as do a read aloud lesson. Before elementary education majors begin their student teaching (generally in the fall of their senior year) they are required to take EHD 400, a 100-hour
long field observation. In this placement, elementary education majors attend a classroom for the whole day once a week for the entire semester. Additionally, elementary education majors spend one entire week (education week) in this placement as well. If elementary education majors are in this placement during the time that they are taking EMA 314, then they are required to write and teach at least one mathematics lesson. Elementary education majors are required to teach at least two additional lesson plans in any subject of their choosing. During elementary education majors’ final semester, they complete their student teaching (EHD 490). Generally, elementary education majors are placed in two separate classrooms—one for eight weeks and one for seven weeks. Elementary education majors are required to attend the same classroom every day of the week for the entire semester. As the semester progresses, elementary education majors are asked to start taking over classroom duties until they have taken over every subject. This means that if there is mathematics being taught in either of those two placements, the student teacher will be expected to teach it.

The results indicated that participants’ self-efficacy standard, broad, specific, and global beliefs were not influenced by field placements. In regards to the self-efficacy standard questions, the results show that participants’ self-efficacy beliefs were not influenced by these field placements, $F (4, 102)= 2.167, p=.078$. There was no significant difference on how participants rated themselves on the self-efficacy standard questions based on field placements. The mean average rating on self-efficacy standard questions was 3.42. In regards to the self-efficacy broad questions, the results show that participants’ beliefs were not influenced by these field placements, $F (4, 102)= .370, p =.83$. There was no significant difference on how participants rated themselves on the
self-efficacy broad questions based on field placements. The mean average rating on self-efficacy broad questions was 3.65. In regards to the self-efficacy specific questions, the results show that participants’ beliefs were not influenced by these field placements, F (4, 102)= 2.388, p=.056. There was no significant difference on how participants rated themselves on the self-efficacy specific questions based on field placements. The mean average rating on self-efficacy specific questions was 3.30. In regards to the self-efficacy global questions (i.e. all of the self-efficacy questions summed together), the results show that participants’ beliefs were not influenced by these field placements, F (4, 102)= 1.664, p=.164. There was no significant difference on how participants rated themselves on the self-efficacy global questions based on field placements. The mean average rating on self-efficacy global was 3.46. While there was no statistically significant difference of participant self-efficacy in regards to math courses on any of these four subscales, participants who were in their EHD 400 field experience rated their self-efficacy beliefs lower than any other group of participants on all but one self-efficacy subscale (self-efficacy standard questions). However, participants who were in their student teaching placement did rate their self-efficacy beliefs higher than any other group of participants on each self-efficacy subscale. These results can be seen in table 3.4 and 3.5 in Appendix C.

Question 23 on this survey asks participants, “Do you enjoy mathematics?” Participants were asked to rate their answer to this question on a five point Likert scale with 1 being “do not enjoy” and 5 being “really enjoy”. The reason for analyzing this question is that the participants in this study also came in with personal beliefs about mathematics. A 2014 study found that positive emotions lead to higher perceived
competency (Pinxten et al., 2014). This means that if someone enjoys math and believes that it is useful (positive emotions) then they are more likely to be confident in their mathematics ability. The results indicated that participants’ self-efficacy standard, broad, specific, and global beliefs were in fact influenced by their enjoyment of math. In regards to the self-efficacy standard questions, the results show that participants’ self-efficacy beliefs were influenced by their enjoyment of math, $F (5, 105)= 5.153$, $p< .001$. There was a significant difference on how participants rated themselves on the self-efficacy standard questions based on their enjoyment of math. The mean average rating on self-efficacy standard questions was 3.42. In regards to the self-efficacy broad questions, the results show that participants’ self-efficacy beliefs were influenced by their enjoyment of math, $F (5, 105)= 5.729$, $p< .001$. There was a significant difference on how participants rated themselves on the self-efficacy broad questions based on their enjoyment of math. The mean average rating on self-efficacy broad questions was 3.65. In regards to the self-efficacy specific questions, the results show that participants’ self-efficacy beliefs were influenced by their enjoyment of math, $F (5, 105)= 8.574$, $p< .001$. There was a significant difference on how participants rated themselves on the self-efficacy specific questions based on their enjoyment of math. The mean average rating on self-efficacy specific questions was 3.30. In regards to the self-efficacy global questions (i.e. all of the self-efficacy questions summed together), the results show that participants’ beliefs were influenced by their enjoyment of math, $F (5, 105)= 9.115$, $p< .001$. There was a significant difference on how participants rated themselves on the self-efficacy global questions based on their enjoyment of math. The mean average rating on self-efficacy global questions was 3.46. On the self-efficacy global questions (i.e. all of the self-
efficacy questions combined) participants who said that they do not enjoy mathematics had a mean average self-efficacy score of 2.86, while those who said that they really enjoy mathematics had a mean average self-efficacy score of 3.87. A follow-up Tukey LSD post hoc test revealed that the differences were between those rating low on their enjoyment of math (e.g., 1 or 2) versus those rating high (e.g., 4 or 5). All of these results can be found in tables 3.6 and 3.7 in Appendix C.

Question number twenty-four was created based on the same findings of that 2014 study. This question asks participants, “How important do you think math is in everyday life?” Participants were asked to rate mathematics importance on a scale of 1-5, with 1 being “very unimportant” and 5 being “very important”. On the subscale of self-efficacy broad questions, the results showed that participants’ self-efficacy beliefs were not influenced by their belief in the importance of math in everyday life, F (3, 107)= 2.575, p=.058. There was no significant difference on how participants rated themselves on the self-efficacy broad questions based on their belief in the importance of math in everyday life. The mean average rating on self-efficacy broad questions was 3.65. However, the results indicated that participants’ self-efficacy standard, specific, and global beliefs were in fact influenced by their belief in the importance of math in everyday life. In regards to the self-efficacy standard questions, the results show that participants’ self-efficacy beliefs were influenced by their belief in the importance of math in everyday life, F (3, 107)= 4.617, p< .004. There was a significant difference on how participants rated themselves on the self-efficacy standard questions based on their belief in the importance of math in everyday life. The mean average rating on self-efficacy standard questions was 3.42. In regards to the self-efficacy specific questions, the results show that participants’
self-efficacy beliefs were influenced by their belief in the importance of math in everyday life, F (3, 107) = 6.062, p < .001. There was a significant difference on how participants rated themselves on the self-efficacy specific questions based on their belief in the importance of math in everyday life. The mean average rating on self-efficacy specific questions was 3.30. In regards to the self-efficacy global questions (i.e. all of the self-efficacy questions summed together), the results show that participants’ beliefs were influenced by their belief in the importance of math in everyday life, F (3, 107) = 5.692, p < .001. There was a significant difference on how participants rated themselves on the self-efficacy global questions based on their belief in the importance of math in everyday life. The mean average rating on self-efficacy global questions was 3.46. On the self-efficacy global questions (i.e. all of the self-efficacy questions combined) participants who said that they thought mathematics was somewhat important to everyday life had a mean average self-efficacy score of 3.10, while those who said that they thought mathematics was really important to everyday life had a mean average self-efficacy score of 3.69. A follow-up Tukey LSD post hoc test revealed that the differences were between those rating low on their belief in the importance of math in everyday life (e.g., 3) versus those rating high (e.g., 4 or 5). It should also be noted that no participants said that they thought mathematics was either very unimportant or unimportant. All of these results can be found in tables 3.8 and 3.9 in Appendix C.

Question number twenty-two on this survey is this the essential question of this thesis reworded in a way that participants could answer on a 1-5 scale: “How well do you think the University of Maine’s College of Education and Human Development has prepared you to teach mathematics after you graduate?” Participants rated the
University’s teacher education program’s attempt of preparation with 1 being “very poorly” and 5 being “very well”. The results indicated that participants’ self-efficacy standard, broad, specific, and global beliefs were in fact influenced by how well they believed the University’s teacher education program had prepared them to teach mathematics. In regards to the self-efficacy standard questions, the results show that participants’ self-efficacy beliefs were influenced by how well they believed the University had prepared them to teach mathematics, $F (6, 103)= 7.060, p< .001$. There was a significant difference on how participants rated themselves on the self-efficacy standard questions based on how well they believed the University had prepared them to teach mathematics. The mean average rating on self-efficacy standard questions was 3.42. In regards to the self-efficacy broad questions, the results show that participants’ self-efficacy beliefs were influenced by how well they believed the University had prepared them to teach mathematics, $F (6, 103)= 4.017, p< .001$. There was a significant difference on how participants rated themselves on the self-efficacy broad questions based on how well they believed the University had prepared them to teach mathematics. The mean average rating on self-efficacy broad questions was 3.65. In regards to the self-efficacy specific questions, the results show that participants’ self-efficacy beliefs were influenced by how well they believed the University had prepared them to teach mathematics, $F (6, 103)= 6.945, p< .001$. There was a significant difference on how participants rated themselves on the self-efficacy specific questions based on how well they believed the University had prepared them to teach mathematics. The mean average rating on self-efficacy specific questions was 3.30. In regards to the self-efficacy global questions (i.e. all of the self-efficacy questions summed together), the results show that
participants’ beliefs were influenced by how well they believed the University had prepared them to teach mathematics, \( F (6, 103) = 7.777, p < .001 \). There was a significant difference on how participants rated themselves on the self-efficacy global questions based on how well they believed the University had prepared them to teach mathematics. The mean average rating on self-efficacy global questions was 3.46. On the self-efficacy global questions (i.e. all of the self-efficacy questions combined) participants who said that they thought the University’s teacher education program had prepared them “very poorly” had a mean average self-efficacy score of 3.15, while those who said that they thought the University had prepared them “very well” had a mean average self-efficacy score of 4.21. A follow-up Tukey LSD post hoc test revealed that the differences were between those rating low on their belief on how well the University’s teacher education program had prepared them (e.g., 1 or 2) versus those rating high (e.g., 4 or 5). All of these results can be found in tables 3.10 and 3.11 in Appendix C.
Discussion

The purpose of this study was to discover if the University of Maine’s College of Education and Human Development’s teacher education program is doing enough to help elementary education majors feel confident in their ability to teach mathematics at the kindergarten through eighth grade levels. The results showed that the two factors that participants’ self-efficacy beliefs were influenced by were belief in the importance of math and an enjoyment of math. It is imperative that teachers have high self-efficacy beliefs so that their students have a better chance of high achievement. Since first year teachers are relatively inexperienced, it is particularly important that they begin their teaching career with high self-efficacy for teaching. It is therefore crucial that universities work to help pre-service teachers feel confident in their ability to teach.

The first result of this study shows that there is in fact a significant difference on how participants rated themselves on the self-efficacy standard questions based on the number of required math courses they took. Participants who had either taken MAT 107 or MAT 108 rated themselves lower on these self-efficacy questions than those who had taken both of these math courses. This shows that having both of these courses helps participants feel more confident in their ability to teach math in regards to the Common Core State standards. However, once participants took EMA 314 their self-efficacy beliefs in regards to these same self-efficacy standard questions were less confident than those who had not yet taken EMA 314. A reason that this could be true is because EMA 314 is the first time in which elementary education majors are required to write and teach a math lesson. In this math lesson, elementary education majors must include Common Core State standards to which their lesson is aligned. Working directly with the standards
would give these participants a more realistic sense about their confidence in using these standards. Additionally, there were four participants in this study who have not yet taken any of the required math courses; these four participants rated their self-efficacy in relation to these self-efficacy standard questions higher than any of the groups that had taken any of the required math courses. One possible reason for this result is that these participants do not yet have any mastery experience, which means that they do not have realistic views of what teaching mathematics is like (Bandura, 2001).

While there was a significant difference in self-efficacy beliefs in regard to required mathematic courses on self-efficacy standard questions, there was not a significant difference on self-efficacy specific, broad or global questions. This means that regardless of which required mathematics courses the participants took, they all scored relatively the same on these self-efficacy subscales. One of these subscales takes into account all of the self-efficacy questions that were on this survey. That means that the self-efficacy standard questions, which had significant results, summed with the rest of the self-efficacy questions produced non-significant results. This indicates that these required math courses are not having a positive or a negative effect on pre-service teachers’ self-efficacy for teaching mathematics. It should also be noted that even though there is not a significant difference between the groups, there are trends that are present. On each of the self-efficacy subscales, participants who had not taken any required math courses rated themselves the highest. Again, this is likely due to unrealistic beliefs based on lack of mastery experiences (Bandura, 2001). Additionally, on each of the self-efficacy subscales, participants who had taken all of the required math courses rated themselves lower than those who had only taken MAT 107 and MAT 108. The likely
reason for this is that these pre-service teachers have a more realistic view of their ability due to their mastery experiences (Bandura, 2001). It should also be noted that the participants that had taken all three required math courses rated themselves higher than those who had only taken either MAT 107 or MAT 108, however this is just a trend, not a significant difference.

The second aspect examined in this study is the field placements that elementary education majors are required to participate in. The results showed that on all four of the self-efficacy subscales, self-efficacy standard, specific, broad, and global, there was no significant difference in self-efficacy depending on the amount of field experience. This indicates that these required field placements are not having a positive or a negative effect on pre-service teachers’ self-efficacy for teaching mathematics. It should also be noted that, like with the math courses, even though there is not a significant difference between the groups, there are trends that are still present. For simplicity’s sake we will discuss the trend on the self-efficacy global subscale, since it encompasses all of the self-efficacy questions. Participants that had only been in the weeklong placement rated themselves the exact same as participants that had been in the weeklong placement as well as the ERL 319 placement. A likely reason for this occurrence is that the ERL 319 placement is a placement that revolves strictly around Language Arts, so it makes sense that there would be no growth in self-efficacy for teaching mathematics since there is no mathematics present in the placement. Surprisingly, participants who were in their EHD 400 field experience (meaning they had already had the previous two field experiences) rated themselves the lowest out of any group –even lower than participants that had had no experience. This survey was administered shortly after education week. During this
week, these participants would have been required to teach at least one mathematics lesson (unless they were in a placement where mathematics was not taught). Due to this, the participants would have a more realistic idea about their ability to teach mathematics, which might be the reason their self-efficacy scores are so low. Yet, when we look at participants who were in their student teaching placements, their self-efficacy scores rose sharply, making them the group with the highest scores. So, if experience teaching math lessons for participants in EHD 400 gives them a more realistic, and lower, score than the other groups, then why is the opposite true for student teachers? Since participants in their EHD 400 placement typically only had the opportunity to observe math once a week in their host classrooms, and only had the opportunity to teach one or two mathematics lessons, they would have less experience with teaching math than their student teaching counterparts. Additionally, if the participants in EHD 400 taught a math lesson that did not go well, then their self-efficacy for teaching math would likely drop since they only had one experience. On the other hand, student teachers would have multiple experiences teaching math lessons that they could take into account when reporting their self-efficacy.

While these trends are insightful, it is important to remember that the results showed that they were not significant. This means that even though participants in their student teaching rated themselves the highest, their self-efficacy scores were not significantly different from the other groups.

So if required math courses and field placements are having no significant effect on pre-service teachers’ self-efficacy, what is? One study showed that enjoyment of mathematics could lead to higher perceived ability to do math (Pinxten et al., 2014). This higher perceived ability to do math could also lead to higher self-efficacy for teaching
math. Therefore, a higher enjoyment of mathematics could lead to higher self-efficacy for teaching mathematics. The results of this research project show, that yes, participants’ self-efficacy standard, broad, specific, and global beliefs were in fact influenced by their enjoyment of math. There was a significant difference in self-efficacy depending on participants’ enjoyment of math when comparing those who rated their enjoyment low versus those who rated it high. Generally, the more the participants enjoyed math, the higher their self-efficacy scores. However, on every subscale, with the exception of the self-efficacy standard questions, participants who rated their enjoyment of math as a three (on a scale of 1-5) had lower self-efficacy scores than those who rated themselves a two. It should be noted, however, that the difference between these two groups was very small (self-efficacy global shows M=3.32 for the rating of a 2 and M=3.28 for the rating of a 3). When comparing those who said that they “do not enjoy” math to those who said they “really enjoy” math, there was an entire point difference in their mean average scores of the self-efficacy global subscale (M=2.86 and M=3.87). The post hoc tests then showed that those who scored high on enjoyment for math also scored high on self-efficacy for teaching math, much like previous studies suggested. Since many adults report having negative experiences with math as early as elementary school, it is likely that these participants’ enjoyment (or dislike) of math was present long before they even entered college (Jackson & Leffingwell, 1999). This is not to say that the University’s teacher education program can’t take steps in order to help foster positive feelings towards math, rather that elementary education majors likely come in with preconceived feelings towards math that may effect their self-efficacy for teaching math.
Yet this study shows that positive feelings towards mathematics is not the only factor that has an effect on pre-service teachers’ self-efficacy. The results indicated that participants’ self-efficacy standard, specific, and global beliefs were influenced by their belief in the importance of math in everyday life. As with enjoyment for math, the results show that the more important that participants thought math was in everyday life, the higher their self-efficacy scores. Even on the self-efficacy broad questions, which showed no significant difference between groups in regards to participant belief of the importance of math in everyday life, there was a trend in which the higher the belief of the importance of math, the higher the self-efficacy beliefs. When comparing those who said that they thought math was “somewhat important” with those who said they thought math was “really important”, there was a half a point difference in their mean average scores of the self-efficacy global subscale (M=3.10 and M=3.69). The post hoc tests then showed those who scored high on their belief in the importance of math also scored high on self-efficacy for teaching math. It is also important to note that the vast majority of participants either said they thought math was “important” or “very important” in everyday life (ninety-nine out of one-hundred and ten participants). Additionally, no participants said that they thought math was “very unimportant” or “unimportant” in everyday life. This result is promising to see because these participants are the very people who will be educating our youth and teaching them mathematics. If these participants believed that math was unimportant to everyday life, they would likely pass that on to their students. Additionally, the results indicate that if there were any participants who said they thought mathematics was unimportant or very unimportant, then they would have even lower self-efficacy scores. Of course, the goal is for pre-
service teachers to have high self-efficacy scores, so it would be disconcerting if their self-efficacy scores were severely low.

Perhaps the most interesting results were those related to question number twenty-two. As a reminder, this question asked participants to rate how well they felt the University of Maine’s College of Education and Human Development had prepared them to teach mathematics after their graduation. The results indicated that participants’ self-efficacy standard, broad, specific, and global beliefs were in fact influenced by how well they believed the University’s teacher education program had prepared them to teach mathematics. There was a significant difference in self-efficacy depending on how well the participants believed the University’s teacher education program had prepared them to teach mathematics when comparing those who rated the program low versus those who rated it high. Like with questions twenty-three and twenty-four, generally the better they thought the University’s teacher education program had prepared them, the higher their self-efficacy beliefs. However, on every subscale, with the exception of the self-efficacy specific questions, participants who rated how well the University’s teacher education program had prepared them as a two (on a scale of 1-5) had lower self-efficacy scores than those who rated the University’s teacher education program as a one. It should be noted, however, that the difference between these two groups was rather small (self-efficacy global shows M=3.15 for the rating of a 1 and M=3.00 for the rating of a 2). When comparing those who said that the University’s teacher education program had done “very poorly” to those who said the program had done “very well”, there was an entire point difference in their mean average scores of the self-efficacy global subscale (M=3.15 and M=4.21). The post hoc tests then showed that those who scored high on
how well they believe the University is preparing them also scored high on self-efficacy beliefs for teaching mathematics.

Question twenty-two should also be examined outside of the realm of its relation to participants’ self-efficacy beliefs. Of the 105 participants that gave useable responses, only five said that the University’s teacher education program had done “very poorly”, but on the opposite hand, only eight said the program had done “very well”. While it is promising to see that only five participants feel the University’s teacher education program has done a very poor job at preparing them to teach math after graduation, it is a bit alarming to see that only eight of the 105 participants feel that the University’s teacher education program had done a very good job at preparing them to teach math. In a very similar vein, only nineteen participants said they felt that the University’s teacher education program had done “poorly”, but again, on the opposite hand only twenty-two said that they felt the University’s teacher education program had done “well”. While it is satisfying to see that the number of participants that said the University’s teacher education program had done well was higher than the number that said they had done poorly, three participants higher is really not much to boast about. Fifty-one of the participants said that they thought the University’s teacher education program had done an “adequate” job at preparing them. The mean average of what every participant rated the University’s teacher education program at was a 3.08, which again equates to the descriptor “adequate”. Of course, adequate is not bad. Adequate means that the participants feel as though the University’s teacher education program is doing well enough that they do not feel like the University’s teacher education program is failing them when it comes to preparing them to teach math. But then again, adequate is not
spectacular either. The hope would be that the majority of the participants would believe that the University had done, at least, a good job at preparing them to teach mathematics, but the results show that this is not how the majority of the participants feel.

When looking at the overall self-efficacy scores in each of the subscales, the participants scored a mean average of a 3.5. This means that they feel somewhere between “uncertain” and “able” or “adequate” and “good” or “mildly confident” and “confident” in their self-efficacy for teaching mathematics. Given these descriptors, the self-efficacy scores are quite pleasing. Previous studies had indicated that preservice teachers usually do not have strong mathematical knowledge (Cramer & Lesh, 1988; Brown, Cooney, & Jones, 1990; Post, Harel, Behr, & Lesh, 1991 cited in Brown, 2006). Having less mathematical knowledge, of course, would result in lower self-efficacy for teaching mathematics. The fact that, on average, these participants are somewhere between mildly confident and confident in their ability to teach mathematics in the kindergarten through eighth grade levels is promising.

Let’s revisit the essential question of this research: Is the University of Maine’s College of Education and Human Development’s teacher education program doing enough to help elementary education majors feel confident in their ability to teach mathematics at the kindergarten through eighth grade levels? The answer, in short, is no. The University’s teacher education program is not doing enough; while it is true that elementary education majors are, on average, somewhere between mildly confident and confident in their abilities to teach mathematics, the results show that the University’s teacher education program is not the main reason for this. One would expect that required mathematics courses and field placements provided by the University of Maine would
have an effect on preservice teacher self-efficacy belief, but the results showed no significant difference between groups’ self-efficacy beliefs with either of these two variables. Additionally, on average, participants said that they thought the University’s teacher education program did an adequate job preparing them to teach mathematics. The factors that did have an effect on participants’ self-efficacy beliefs were their enjoyment of mathematics and their belief in its importance – both factors that participants likely entered the University having notions about based on their past experiences.

**Recommendations**

Since the University of Maine’s College of Education and Human Development’s required math courses and field experiences are not having a significant effect on elementary education major’s self-efficacy beliefs, some changes clearly need to be made in regards to those courses and field experiences. First off, elementary education majors should be required to create and implement mathematics lessons earlier in their degree program. In a mathematics course examined in a previous study, pre-service teachers were given the opportunity to create lessons, present them to their peers as well as classrooms of students, receive feedback, and then present the same content in an entirely different manner; this course increased pre-service teachers’ self-efficacy scores (Rethlefsen & Park, 2011). If the required math courses taken early in the degree program could be adapted to do something like this, then perhaps a relationship between required math courses and preservice teacher self-efficacy for teaching math would arise. This means that the teaching of some mathematics teaching pedagogy would need to be introduced in the MAT 107 and MAT 108 courses instead of having those courses continue to be strictly content based. This would mean that elementary education majors
would be required to practice writing mathematics lessons for the first time by the end of their second year, rather than the beginning of their fourth. However, giving elementary education majors the opportunity to begin implementing these math lessons earlier as well would prove to be a bit more difficult. Perhaps a required field placement that is similar to the one associated with ERL 319 should be added with the focus of mathematics.

The second recommendation is that the University’s teacher education program should encourage elementary education majors to pick concentrations in which they are less confident. In one study of beginning teachers in Iceland, researchers found that students who had high self-efficacy for Icelandic chose it for their major, while those who had low self-efficacy in their Icelandic abilities chose a different major, even though they might have to teach Icelandic regardless (Aðalsteinsson et al., 2014). This study looked even further and found that many teachers who are teaching Icelandic in the upper grades did not have Icelandic for their major and do not feel confident in their ability to teach the subject. This is similar to the fact elementary education majors at the University of Maine are expected to choose a subject to concentrate in. They are then required to take 24 credits in that area. The problem here, like in Iceland, is that elementary education majors usually choose a subject that they have particular interest in and are already confident in. This means that they are receiving more education and more confidence in something that they are likely already rather adept in. Instead, these elementary education majors should ideally pick a concentration where they need more support. Of course, many elementary education majors might not like this idea due to the fact that they do not want to get poor grades in these courses and have it affect their GPA.
Additionally, they probably do not want to spend a lot of time around a subject they do not enjoy. Regardless of this possible resistance, the University’s teacher education program should still encourage elementary education majors to concentrate in areas that they feel weaker in because many elementary education majors will be required to teach all core subjects, so they should ideally obtain the high confidence in their ability for each subject.

Previous research has shown that in math methods courses, preservice teachers should be given the opportunity to reflect on their negative experiences with mathematics (Gresham, 2008). This could help elementary education majors reduce their math anxiety and heighten their self-efficacy for teaching mathematics (Gresham, 2008). Additionally, the results in this thesis, as well as previous research, show that higher enjoyment of mathematics as well as a strong belief in the importance of math in every day life leads to higher perceived ability to teach mathematics. It then becomes important for math methods courses to not only teach the theoretical practices for teaching math, but to also help foster positive feelings towards math and enjoyment towards math for their preservice teachers. This is not to say that the math methods course is not already doing this, only that this should be one of the main focuses of the math methods course. This recommendation also extends to the two other required math courses – throughout the degree program, elementary education majors should have the opportunity to reflect on past negative experiences and to participate in math courses that aim to foster positive feelings towards mathematics.
Limitations and Future Research

The first limitation of this study is the number of participants that were in each group. When looking at the math courses, there were relatively few participants that had taken no math courses or had taken just MAT 108 (four and five respectively). This limits the ability to compare the mean average self-efficacy scores of these groups with the other three groups. If further research were to be conducted, the suggestion would be to have a more even spread of participants in each of the math courses. This issue of the number of participants in each group is also present when looking at field experience. While the number of participants was relatively close across all groups, those who were student teaching were part of the smallest group. Since those who are student teaching are arguably part of the most important group of this study due to their high levels of experience, the number of student teachers surveyed should ideally be higher. If this study were to be implemented again, the suggestion would be to administer the survey during a spring semester when more student teachers are placed in schools.

The second limitation of this study is that it was a cross sectional study rather than a longitudinal study. This has a few different implications. First off, each participant is a very different individual and will likely respond to the University’s teacher education program’s efforts of preparing them to teach mathematics in a very different way. Secondly, not all of these participants have had the same professors or expectations for the required math courses and field experience courses. It is possible that a different professor and different expectations might have a large effect on preservice teacher self-efficacy for teaching mathematics. Additionally, changes in the requirements for the Teaching Process course (a course where students first learn how to write lesson plans)
leads to changes in when and how elementary education majors are taught to write and implement lesson plans. If this study were to be redone, it would be ideal that a group of elementary education majors were followed from their very first semester to the semester they complete their student teaching. This would reduce the chance that they would have different professors and expectations for math courses and field placement courses. It would also help show the University how their efforts were impacting the students because by staying with the same students the University would be able to see how their self-efficacy beliefs personally change as they continue through the program. This is more beneficial than the current study because say, for example, participants in the EMA 314 course rated their self-efficacy scores really low in comparison to those that had taken no math courses. However, these same participants in that EMA 314 course might be rating themselves higher than they would have back when they had taken no math courses. In other words, by doing a longitudinal study, the participants stay consistent as the factors implemented by the University’s teacher education program change.
References


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Informed Consent for Pre-Service Teacher Self-Efficacy for Teaching Mathematics Survey

You are invited to participate in a research project being conducted by Jade McGuire, an undergraduate student in the Honors College and the College of Education and Human Development at the University of Maine. This research is being supervised by professor Sid Mitchell of the College of Education and Human Development. The purpose of the research is to determine if University of Maine Elementary Education students feel confident in their ability to teach mathematics at the Kindergarten through Eighth grade levels. You must be at least 18 years of age to participate.

What Will You Be Asked to Do?
If you decide to participate, you will be asked to take a short survey. It may take approximately 15 minutes to participate.

Risks
- There is the possibility that you may become uncomfortable answering the questions. You may skip any questions that make you uncomfortable.
- Some questions might make you feel inept in your current ability to teach mathematics. Remember that you still have opportunities to grow your skills in the future.

Benefits
- This survey may help you reflect on your current confidence in your ability to teach mathematics.
- While the benefits of participating in this study are minimal for you, the results will help us determine where or not the University of Maine is doing enough to help pre-service teachers gain confidence in their ability to teach mathematics in the kindergarten through eighth grade levels.

Confidentiality
This study is anonymous. Please do not write your name on the questionnaire. There will be no records linking you to the data. You may remove and keep this form if you wish. When you are done with your survey, please place it in the manila envelope in the front of the room. Please put your survey in the envelope in a random order.

The survey data will be stored in a password-protected folder on the principal investigator’s computer. The data will be kept indefinitely in case of the likely event that the principal investigator will do additional research in this field. The paper surveys, however, will be destroyed by May 31, 2016.

Voluntary
Participation is voluntary. If you choose to take part in this study, you may stop at any time, with no loss of benefit to you. You may skip any questions you do not wish to answer.

Contact Information
If you have any questions about this study, please contact me at jade.mcguire@maine.edu. You may also reach the faculty advisor on this study at 207-581-3435 (or e-mail sid.mitchell@maine.edu). If you have any questions about your rights as a research participant, please contact Gayle Jones, Assistant to the University of Maine’s Protection of Human Subjects Review Board, at 581-1498 (or e-mail gayle.jones@umit.maine.edu).

Submission of the survey indicates you have read the above information and give consent for the information provided by your survey to be used for Jade McGuire's research.
Appendix A

Pre-Service Teacher Self Efficacy for Teaching Mathematics

*Please circle your answers to the following questions or write in an answer when prompted.*

**What is your year in school?**

First Year  Sophomore  Junior  Senior  Fifth Year

**What is your gender?**

___________________________

**What is your age?**

___________________________

**What is your current GPA?**

___________________________

**Which field experiences have you had? (include experiences you are currently in)**

- Week-long observation for teacher candidacy
- Field experience for ERL 319
- 100 Hour Placement (EHD 400/EDG 400)
- Student Teaching
- Other: _______________________

**What is your major? (if you have a double major, please write the other major under “other”)**

Elementary Education  Early Childhood Education  Other: ____________

46
Appendix A

What is your concentration?

<table>
<thead>
<tr>
<th>English</th>
<th>Mathematics</th>
<th>Life Science</th>
<th>Physical Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>French</td>
<td>Spanish</td>
<td>Human Development</td>
<td>Social Studies</td>
</tr>
</tbody>
</table>

| English as a Second Language | Other: ________________ |

What is your minor (if applicable)?

___________________________________________________

What is your favorite subject?

_______________________________________________________

What is your best subject?

_______________________________________________________

Please circle the math classes you have taken at the University of Maine and indicate the grade you received in those classes (if you are in the class currently, please write TBD for your grade; if you received credit for a class you did not take at the University (AP credit, CLEP credit, etc.) please circle the class and indicate that you gained the credit elsewhere)

MAT 107 - Elementary Descriptive Geometry ________

MAT 108 - Elementary Numerical Mathematics From A Modern Perspective ________

MAT 111 - Algebra for College Mathematics ________

MAT 122 - Pre-Calculus ________

EMA 314 - Teaching of Arithmetic ________

Other:__________________________ Other:__________________________

Other:__________________________ Other:__________________________

Other:__________________________ Other:__________________________
Appendix A

Please circle any elementary grade levels you have had experience in (volunteering, observing, substitute teaching, student teaching, etc.)

<table>
<thead>
<tr>
<th>Pre-K</th>
<th>Kindergarten</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>4th</td>
<td>5th</td>
<td>6th</td>
</tr>
</tbody>
</table>

Please circle all of the elementary grade levels you would be interested in teaching.

<table>
<thead>
<tr>
<th>Pre-K</th>
<th>Kindergarten</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
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<tr>
<td></td>
<td></td>
<td>4th</td>
<td>5th</td>
<td>6th</td>
</tr>
</tbody>
</table>

Have you taken the Praxis One?

Yes  No

How many attempts did it take you to pass the math section?

1  2  3  4  5
Other:__________

Have not taken  Have not received scores

Have you taken the Praxis Two?

Yes  No

How many attempts did it take you to pass the math section?

1  2  3  4  5
Other:__________

Have not taken  Have not received scores
Appendix A

Please rate your ability to do the following tasks by circling the number that most closely represents your abilities at this time (Do NOT rate what you expect your future ability will be). Feel free to write any comments relating to the questions in the blank spaces provided.

1. To what extent can you motivate students who show low interest in mathematics?

   Not very able  Somewhat able  Uncertain  Able  Highly able
   1  2  3  4  5

2. To what extent can you help your students value learning mathematics?

   Not very able  Somewhat able  Uncertain  Able  Highly able
   1  2  3  4  5

3. To what extent can you craft relevant questions for your students related to mathematics?

   Not very able  Somewhat able  Uncertain  Able  Highly able
   1  2  3  4  5

4. To what extent can you get your students to believe they can do well in mathematics?

   Not very able  Somewhat able  Uncertain  Able  Highly able
   1  2  3  4  5
Appendix A

5. To what extent can you use a variety of assessment strategies in mathematics?

<table>
<thead>
<tr>
<th>Not very able</th>
<th>Somewhat able</th>
<th>Uncertain</th>
<th>Able</th>
<th>Highly able</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>5</td>
</tr>
</tbody>
</table>

6. To what extent can you provide an alternative explanation or an example in mathematics when students are confused?

<table>
<thead>
<tr>
<th>Not very able</th>
<th>Somewhat able</th>
<th>Uncertain</th>
<th>Able</th>
<th>Highly able</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

7. How well can you implement alternative teaching strategies for mathematics in your classroom?

<table>
<thead>
<tr>
<th>Not very able</th>
<th>Somewhat able</th>
<th>Uncertain</th>
<th>Able</th>
<th>Highly able</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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</tbody>
</table>

8. How well can you teach students to describe characteristics of numbers (i.e., whole numbers, rational/irrational numbers)?

<table>
<thead>
<tr>
<th>Very poorly</th>
<th>Poorly</th>
<th>Adequately</th>
<th>Well</th>
<th>Very well</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
9. How well can you teach students to perform strategies for composing and decomposing numbers by manipulating place value in addition and subtraction?

<table>
<thead>
<tr>
<th>Very poorly</th>
<th>Poorly</th>
<th>Adequately</th>
<th>Well</th>
<th>Very well</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

10. How well can you teach students to perform strategies for composing and decomposing numbers by manipulating place value in multiplication and division?

<table>
<thead>
<tr>
<th>Very poorly</th>
<th>Poorly</th>
<th>Adequately</th>
<th>Well</th>
<th>Very well</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

11. How well can you teach students to convert a fraction to a decimal and vice versa?

<table>
<thead>
<tr>
<th>Very poorly</th>
<th>Poorly</th>
<th>Adequately</th>
<th>Well</th>
<th>Very well</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

12. How well can you teach students to compare equivalence of fractions and decimals?

<table>
<thead>
<tr>
<th>Very poorly</th>
<th>Poorly</th>
<th>Adequately</th>
<th>Well</th>
<th>Very well</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
13. How well can you teach students to interpret inverse relationships between operations (i.e., +, − and *, ÷)?

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very poorly</td>
<td>1</td>
</tr>
<tr>
<td>Poorly</td>
<td>2</td>
</tr>
<tr>
<td>Adequately</td>
<td>3</td>
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<tr>
<td>Well</td>
<td>4</td>
</tr>
<tr>
<td>Very well</td>
<td>5</td>
</tr>
</tbody>
</table>

14. How well can you teach students to manipulate coordinate planes?

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very poorly</td>
<td>1</td>
</tr>
<tr>
<td>Poorly</td>
<td>2</td>
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<tr>
<td>Adequately</td>
<td>3</td>
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<tr>
<td>Well</td>
<td>4</td>
</tr>
<tr>
<td>Very well</td>
<td>5</td>
</tr>
</tbody>
</table>

15. How well can you teach students to collect, plot, and interpret data (on any type of graph)?

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very poorly</td>
<td>1</td>
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<tr>
<td>Poorly</td>
<td>2</td>
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<tr>
<td>Adequately</td>
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<tr>
<td>Well</td>
<td>4</td>
</tr>
<tr>
<td>Very well</td>
<td>5</td>
</tr>
</tbody>
</table>

16. How well can you teach students to measure area and perimeter?

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very poorly</td>
<td>1</td>
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<tr>
<td>Poorly</td>
<td>2</td>
</tr>
<tr>
<td>Adequately</td>
<td>3</td>
</tr>
<tr>
<td>Well</td>
<td>4</td>
</tr>
<tr>
<td>Very well</td>
<td>5</td>
</tr>
</tbody>
</table>
Appendix A

17. How well can you teach students to convert between units in the same system (i.e., grams → kilograms, inches → yards)?

<table>
<thead>
<tr>
<th>Very poorly</th>
<th>Poorly</th>
<th>Adequately</th>
<th>Well</th>
<th>Very well</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

18. How well can you teach students to measure the length of objects?

<table>
<thead>
<tr>
<th>Very poorly</th>
<th>Poorly</th>
<th>Adequately</th>
<th>Well</th>
<th>Very well</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

19. How well can you teach students to discover and create mathematical patterns?

<table>
<thead>
<tr>
<th>Very poorly</th>
<th>Poorly</th>
<th>Adequately</th>
<th>Well</th>
<th>Very well</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

20. How well can you teach students to interpret variables in an algebraic equation?

<table>
<thead>
<tr>
<th>Very poorly</th>
<th>Poorly</th>
<th>Adequately</th>
<th>Well</th>
<th>Very well</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
21. How well can you teach students to interpret probability of outcomes?

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very poorly</td>
<td>Poorly</td>
<td>Adequately</td>
<td>Well</td>
<td>Very well</td>
<td></td>
</tr>
</tbody>
</table>

22. How well do you think the University of Maine’s College of Education and Human Development has prepared you to teach mathematics after you graduate?

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very poorly</td>
<td>Poorly</td>
<td>Adequately</td>
<td>Well</td>
<td>Very well</td>
<td></td>
</tr>
</tbody>
</table>

23. Do you enjoy mathematics?

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not enjoy</td>
<td>Somewhat enjoy</td>
<td>Really enjoy</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

24. How important do you think math is in every day life?

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very unimportant</td>
<td>Unimportant</td>
<td>Somewhat important</td>
<td>Important</td>
<td>Very important</td>
<td></td>
</tr>
</tbody>
</table>
25. A 7th grade students asks why “invert and multiply” works for division of fractions. In other words, why is \( \frac{7}{8} \div \frac{2}{3} = \frac{7}{8} \times \frac{3}{2} \) ? How confident do you feel in your ability to explain why “invert and multiply” works?

<table>
<thead>
<tr>
<th>Very Unconfident</th>
<th>Unconfident</th>
<th>Mildly Confident</th>
<th>Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>5</td>
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</tbody>
</table>

26. To help make meaning for your students, you want to come up with a real-life situation or story-problem to show your students why they would need to calculate \( \frac{3}{4} + \frac{1}{2} \). How confident are you in your ability to create a story model for this problem?

<table>
<thead>
<tr>
<th>Very Unconfident</th>
<th>Unconfident</th>
<th>Mildly Confident</th>
<th>Confident</th>
<th>Very Confident</th>
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</table>

27. You are teaching your students about the volume of a cylinder. You need to explain why the volume of a cylinder is equal to \( \pi r^2 h \). How confident are you in your ability to explain why this is true?

<table>
<thead>
<tr>
<th>Very Unconfident</th>
<th>Unconfident</th>
<th>Mildly Confident</th>
<th>Confident</th>
<th>Very Confident</th>
</tr>
</thead>
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<tr>
<td>1</td>
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<td>3</td>
<td>4</td>
<td>5</td>
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</tbody>
</table>
28. You give the following problem to your fourth grade class. A student finds an answer, but asks you to explain why it is that he needs to move the decimal place three places to the left at the end, yielding the final answer 9.504. How confident are you in your ability to explain why he has to put the decimal point where it is?

\[ 3.52 \times 2.7 \]

<table>
<thead>
<tr>
<th>Very Unconfident</th>
<th>Unconfident</th>
<th>Mildly Confident</th>
<th>Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

29. You give the following problem to your third grade class. A student finds an answer, but asks you to explain why the process regrouping works. How confident are you in your ability to explain why regrouping (carrying) works?

\[ 5.73 + 4.58 \]

<table>
<thead>
<tr>
<th>Very Unconfident</th>
<th>Unconfident</th>
<th>Mildly Confident</th>
<th>Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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</tbody>
</table>
Appendix B

**Script for Introduction of Survey**

My name is Jade McGuire and I am an Elementary Education major and an Honors College student. I am here today because I am writing a thesis for the Honors College about pre-service teachers' beliefs in their ability to teach mathematics at the Kindergarten through Eighth grade levels. In order to gain data for my research, I am asking University of Maine Elementary Education majors at varying levels of degree progress to take a short survey. If you agree to participate, the survey will take you about 15 minutes. Before you begin, please read the informed consent form. Once you have completed the survey you can tear off the informed consent form to keep. Please then place the survey in one of these envelopes in the front of the room. Once you begin your survey, please take note that you should answer the questions based on your current beliefs, not on what you think your beliefs will be in the future. Thank you all for your time and your help.