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A Longitudinal Study on Mathematics Teaching Efficacy: Which Factors (Un)Support the Development?

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The aim of this longitudinal study was to examine prospective teachers' mathematics teaching efficacy belief during their enrollment in teacher education program and at the end of their first year of teaching. In addition, the factors that enhance or inhibit participants' efficacy belief and how these factors affect their mathematics teaching efficacy when they become inservice teacher were investigated. Mixed research design was used in which data were collected through longitudinal survey and electronic interviews. Findings revealed that prospective teachers' mathematics teaching efficacy beliefs increase during their enrollment in teacher education program but decrease during their first year of teaching. In addition classroom management, communicating with student, communicating with parents, mathematical knowledge for teaching, material usage, and textbook usage are the factors that enhance or inhibit teachers' efficacy beliefs during their first year of teaching.

Keywords: longitudinal study, mathematics teaching efficacy beliefs, mathematics teaching outcome expectancy, middle school mathematics teachers, prospective middle school mathematics teachers

INTRODUCTION

To accomplish a particular work people should possess knowledge, skills and efficacy belief (Bandura, 1986). Bandura defined self-efficacy as "beliefs in one's capabilities to organize and execute the course of action required to produce given attainments" (1997, p. 3). Thus, efficacy belief is a mediator between knowledge and action (Bandura, 1986). Although it is important to see the trend changes in efficacy belief, review of the literature reveals only a few longitudinal studies that track the development of mathematics teaching efficacy across the years. As mentioned by Holzberger, Doris, and Kunter (2013), longitudinal studies with various time

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intervals should be conducted as future research and possible mediator variables effecting efficacy should be explored. In this longitudinal study the development of
prospective mathematics teachers' teaching efficacy beliefs during their enrollment in teacher education program and at the end of their first year of employment as teacher were investigated. In addition, the factors that enhance or inhibit beginning teachers' efficacy and how these factors affect their mathematics teaching efficacy beliefs were examined. The findings of this study would give valuable information to teacher educators about the trends and development of efficacy beliefs over years and needs in teacher education programs in preparing beginning teachers to the profession.

State of the literature

- Teachers' self-efficacy about their ability to successfully accomplish a given task is important to investigate since it affects student learning.
- Teachers' self-efficacy may be most vulnerable during their enrolment in teacher education program and in their first year of teaching.
- There are many studies conducted to quantitatively evaluate preservice teachers' efficacy beliefs during their enrolment in teacher education program or during their early years of teaching. How efficacy belief develops across time and what factors enhance or inhibit its development remains unanswered.

Contribution of this paper to the literature

- In this longitudinal study, prospective teachers' efficacy beliefs during their enrolment in teacher education program and at the end of their first year of teaching were examined.
- In addition, the factor that enhance or inhibit their efficacy belief and how these factors affect their mathematics teaching efficacy when they become in-service teacher were investigated.
- The findings of this study provide valuable information to teacher educators about the trends and development of efficacy beliefs over years

Self-efficacy

Bandura noted the importance of self-efficacy as "among the different aspects of self-knowledge, perhaps none is more influential in people's everyday lives than conceptions of their personal efficacy" (1986, p. 390). People who view themselves as efficacious set objectives for themselves to achieve and resist when they face obstacles. However, people who view themselves as inefficacious are more likely to give up a task when they have difficulties.

Mastery experiences, vicarious experiences, social persuasion, and physiological states are four main sources identified for self-efficacy (Bandura, 1977; 1997). Mastery experiences are defined as the most powerful source for efficacy. If an individual performs a task successfully this will support his/her efficacy. On the other hand, failures in completion of a task will lower self-efficacy of an individual. Vicarious experiences means that people compare their performances with others and judge their competencies regarding those models' successes or failures (Bandura, 1997). When people observe their peers successfully performing a task then their efficacy belief raise. Conversely, when an individual observes others' failure his efficacy declines (Bandura, 1997). In other words, when the role model performs well this will affect the observer's efficacy positively. However, in case of a failure of the model, efficacy belief of the observer is affected negatively. Verbal persuasion or social persuasion is another way to increase individual's efficacy (Bandura, 1977; 1986). When persuaded by the teacher or peers, that individual rated as knowledgeable about the task on their capability to achieve, people efficacy is increased. As Bandura (1982) mentioned, social persuasion leads an individual to start a given task or to develop alternative strategies for accomplishment of a given task. Lastly, physiological states are emotional situations that individual experiences when engaging events corresponding to the other sources of information. Stress, anxiety, or emotions while performing a task could be the source of efficacy. While positive feelings enhance self-efficacy, negative emotions undermine it (Bandura, 1997).

Teacher efficacy is the adaptation of self-efficacy into the teaching context (Fives & Alexander, 2004). In other words, teacher efficacy is teachers' judgment of their capabilities to cause desired outcomes of student engagement and learning even for students who are unmotivated (Armor et al., 1976; Bandura, 1977). Teacher efficacy is perceived as domain specific (Tschannen-Moran & Woolfolk Hoy, 2001). In the domain of mathematics, mathematics teaching efficacy consists of two dimensions: personal mathematics teaching efficacy and mathematics teaching outcome expectancy (Enochs, Smith, & Huinker, 2000). Personal mathematics efficacy is related to teachers' confidence in their ability to teach mathematics. Outcome expectancy is related to teachers' perception that student learning can be influenced by effective teaching.

Research studies showed that pre-service teachers with low self-efficacy more rely on classroom regulations. However, pre-service teachers with high self-efficacy have more classroom control (Woolfolk Hoy, 2000). According to Czerniak (1990) teachers who view themselves highly efficacious are more likely to use student-centered approaches and inquiry, while teachers who view themselves as inefficacious tend to use teacher-centered approaches and mostly depend on textbook. Similarly, teacher efficacy beliefs are related to the teachers' persistence (Tschannen-Moran & Woolfolk Hoy, 2001), classroom management, time allocation for teaching subject, and use of alternative strategies during teaching (Woolfolk Hoy, 2000). Teachers with higher self-efficacy beliefs present higher degree of cognitive challenge to students during instruction, show effective classroom management and provide more individual learning support (Holzberger, Philipp, & Kunter, 2013). In a research study, Koç (2013) found out that there is a significant positive relationship between teachers' self-efficacy and their ability to create constructivist learning environment where they create conceptual conflicts, meet students' needs and create discussions to enhance meaningful learning. In another study, Gür, Çakıroğlu, and Çapa-Aydın (2012) investigated predictors of science, mathematics, and classroom teachers' sense of efficacy beliefs. They found out that satisfaction with performance have a significant contribution to efficacy for instructional strategies, efficacy for classroom management, and efficacy for student engagement. Parental support and teaching resources are found out as significant predictors of only student engagement. In addition, mathematical beliefs and mathematics self-efficacy were stated as statistically significant positive predictors of mathematics teaching efficacy (Briley, 2012).

Since preservice teachers are tomorrow's inservice teachers, teacher education programs have crucial role in shaping pre-service teachers' teaching efficacy beliefs. Teaching method courses, student teaching and field experiences are among the courses that mostly influence preservice teachers' efficacy beliefs. Palmer (2006) stated that preservice teachers' personal science teaching efficacy and outcome expectancy beliefs are increased by well-designed method courses where hands-on activities involving inquiry and group work are extensively used. In another study, Albayrak and Aydin-Unal (2011) investigated the effect of methods of teaching mathematics course on pre-service teachers' mathematics teaching efficacy belief. The analysis of pre-test and post-test results showed that pre-service teachers' outcome expectancy beliefs and self-efficacy beliefs were significantly increased after the method course. In a qualitative study, Yürekli (2015) investigated prospective elementary mathematics teachers' self-efficacy regarding the preparation and implementation of mathematical task throughout a mathematics teaching methods course. Nine prospective teachers were interviewed three times during the method course. Analysis revealed that at the end of the course most of the participants felt highly efficacious to prepare mathematical tasks effectively. However, only half of the participants stated high efficacious for implementing the

given tasks. Lectures, group work, feedback, peer presentation, assigned readings and examinations were found as important factors affecting prospective teachers' efficacy beliefs.

In addition to the method courses, student teaching and field experiences are critical factors affecting pre-service teachers' beliefs about teaching (Hoy & Woolfolk, 1990; Li & Zhang, 2000). While some research studies reported that pre-service teachers' personal teaching efficacy scores increased after student teaching or field experiences (Hoy & Woolfolk, 1990; Li & Zhang, 2000) others stated that those experiences did not affect (Gencer & Çakıroğlu, 2007; Isiksal & Cakiroglu, 2005; Yılmaz & Huyugüzel-Çavaş, 2008) or negatively affected pre-service teachers' efficacy beliefs (Utley, Moseley & Bryant, 2005). Among the studies that favor teaching practices in developing efficacy beliefs, Flores (2015) noted that pre-service science teachers' general efficacy and personal science teaching efficacy significantly increased when they enrolled in field-based science method course with embedded teaching practice. Although science teaching outcome expectancy increased it was not significant.

In another study, Plourde (2002) examined the impact of student teaching on pre-service elementary teachers' personal efficacy and outcome expectancy regarding science teaching. Results revealed that although self-efficacy improved slightly, student teaching did not influence pre-service teachers' sense of personal science teaching efficacy significantly. However, significant negative correlation between pre-test and post –test scores was obtained for outcome expectancy. Utley, Moseley and Bryant (2005) stressed that both mathematics and science preservice teachers' efficacy beliefs increased after their participation in the elementary method course however declined after enrolling in the field experience. Similarly, preservice teachers' self-efficacy increased during teacher education program; but, declined when they started their teaching experience (Barnes, 2000; Hoy & Woolfolk, 1990; Woolkfoy Hoy & Burke-Spero, 2005). Specifically, student teaching supports personal efficacy but does not support pre-service teachers' general efficacy (Hoy & Woolfolk, 1990). In a cross sectional study, Woodcock (2011) investigated the change in teacher efficacy during their teacher training years. It was reported that training teacher education courses have no influence on primary school pre-service teachers' level of teacher efficacy. However, such courses courses increased secondary pre-service teachers' general efficacy belief and decreased their personal teacher efficacy beliefs. In addition, preservice teachers' sense of efficacy beliefs regarding classroom management decrease as they practice field based experiences (Lamote & Engels, 2010). Alternatively, research suggests that students' self-efficacy increases during their enrollment in teacher education programs. However, when preservice teachers face with real classroom environment during their practice teaching they lose their optimism (Barnes, 2000; Erdem & Demirel 2007; Woolfolk 2001). Lamote and Engels (2010) stressed that preservice teachers tend to underestimate the complexity of teaching during their enrollment in teacher education programs and have high sense of efficacy belief. However, when they engage in field based experiences, their sense of efficacy changes.

Rationale

Development of prospective teachers' efficacy belief is important to investigate since once it is established it is hard to change (Woolfolk Hoy, 2000). Thus, teacher education programs play important role during the development of efficacy beliefs. Although its importance, research studies regarding prospective teachers' mathematics teaching efficacy beliefs has been limited (Briley, 2012). Ashton (1984) stated that teacher education programs should help preservice teachers to be motivated and confident for effective classroom performance. However, as stated

above preservice teachers' efficacy beliefs waved during their enrollment in teacher education programs due to both successful and unsuccessful experiences (Ashton & Webb, 1986; Woodcock, 2011). In addition, teachers' self-efficacy about their ability to successfully accomplish a given task may be most vulnerable during student teaching or very first year of their classroom experiences (Bandura, 1997; Flores, 2015). In other words, the first years of teaching could be critical for the long-term development of teacher efficacy.

In a longitudinal study, Woolfolk Hoy (2000) investigated prospective and novice teachers' efficacy belief at the beginning of preparation program, at the end of student teaching, and at the end of their first year of teaching. Changes from beginning of the program to the end of student teaching is significantly higher; however, from the end of student teaching to the end of first year there was a significant decrease. In another longitudinal study, Bümen and Ercan-Özaydın (2013) noted that preservice teachers' efficacy beliefs increase during their enrollment in teacher education program and even after their graduation. Although it is important to see the changes in efficacy belief, review of the literature reveals that few longitudinal studies exist that track the development of self-efficacy across the years (Bümen & Ercan-Özaydın, 2013; Woolfolk-Hoy, 2000). Research studies emphasized the importance of and the need for longitudinal studies to reveal the differences in prospective teachers' efficacy beliefs across time (Gür, Çakıroğlu, & Çapa-Aydın, 2012; Woodcock, 2011). Thus, it is worth to explore to what extent middle school mathematics teachers' mathematics teaching efficacy beliefs change during their enrollment in teacher education program and in the first year of their teaching. Moreover, although such longitudinal studies give valuable information about the trends in teachers' efficacy beliefs over years, they are quantitative in nature. In other words, the factors that enhance or diminished teachers' efficacy beliefs remain unanswered. In the present study, in addition to investigating the trends in teacher efficacy beliefs quantitatively, follow-up interviews were conducted to identify the factors garnering a view of how the changes in efficacy belief occur. As Woodcock (2011) pointed out qualitative data is important to reveal the underlying reasons that affect teachers' beliefs about teaching efficacy. Thus, this study seeks to answer the following questions:

1. How does prospective mathematics teachers' mathematics teaching efficacy belief change after their enrollment in school experience course, practice teaching course and at the end of their first year of employment as a teacher?
2. In which areas do they feel (in)efficacious and how would these issues contribute to or weaken their mathematics teaching efficacy when they become inservice teachers?

METHOD

A mixed methods research design was used to answer research questions. More specifically, the panel study, a longitudinal survey design was used to examine changes in efficacy beliefs of prospective mathematics teachers over time. Data were collected from prospective teachers enrolled in teacher education program at the very beginning of the school experience course, at the end of school experience course, at the end of practice teaching, and after their first year of employment as a teacher. Then, electronic interviews were conducted to get an in-depth exploration on issues that enhance or inhibit prospective teachers' mathematics teaching efficacy belief when they become inservice teachers.

Participants and context

Data was collected from 30 pre-service middle school teachers enrolled in Elementary Mathematics Teacher Education (EME) program at a large public university, Ankara, Turkey. The data was collected at four different times. At first, the data were collected from the senior pre-service teachers just before they enroll in the school experience course (Time 1). The second data set were collected just after they completed the school experience course (Time 2). Then, the third data set were collected when they completed their practice teaching (Time 3). In other words, it took 1 year to collect the first three data sets. After their graduation, those prospective teachers were recruited to work as a mathematics teacher in middle schools. After their one year of teaching, the last data set were collected from the same participants (Time 4).

There were 22 (73.3%) female and 8 (26.7%) male prospective teachers enrolled in the study. Twenty eight (93,3%) of participants graduated from teacher high schools, one from Anatolian high school and one from private high school. When they graduated from the university 5 (16.7%) of the participants have obtained a cumulative GPA of 2.5 and below, 9 (30%) have cumulative GPA between 2.5 and 3.0, and 16 (53.3%) of them had cumulative GPA of 3 and above.

School experience and teaching practice courses are two important courses in the EME program. Prospective teachers are expected to be actively involved in teaching and learning of mathematics in these courses. School experience course was offered in the seventh semester and teaching practice course was offered in the eighth semester. Pre-service teachers are required to spend 4 hours of internship in cooperating schools per week. Similarly, they should spend 6 hours weekly for their teaching practice course. Each practicum prolongs 10 weeks. School experience course was based on observation of the classroom routines without pre-service teachers' active involvement in teaching. In other words, student teachers try to understand their mentor teachers' way of teaching, methods and activities and how learning takes place in the classroom. However, during practice teaching, student teachers are expected to participate in all educational activities in the school. In other words, they should teach the specific topics in the middle school curriculum during their practice teaching.

Turkey has a centralized education system at elementary, middle, and secondary levels (Grades 1-12) governed by the Ministry of National Education (MoNE). The Ministry of National Education is responsible for the implementation of the national curriculum throughout the country. After graduation from the teacher education program, student teachers are required to take a standardized national test in order to be recruited as public school teachers. Based on their scores, they are assigned to public schools in different geographical regions of Turkey. They are expected to teach mathematics in middle schools (5 thr 8 grades). Among the participants of the present study, 28 (93,3%) of them are working in public middle schools located in different geographical regions of Turkey. Two of the participants work in private institutions.

Measuring tools

In order to collect quantitative data, the Mathematics Teaching Efficacy Belief Instrument (MTEBI, Enochs et al., 2000) was used to determine teaching efficacy beliefs of pre-service teachers. The MTEBI consist of two dimensions namely personal mathematics teaching efficacy (PMTE) and mathematics teaching outcome expectancy (MTOE). The PMTE is defined as teachers' perceptions of their ability to teach mathematics. "I understand mathematics concepts well enough to be effective in teaching elementary mathematics", and "I will typically be able to answer students' questions" are two example items for personal mathematics teaching

efficacy. On the other hand, outcome expectancy is related to teachers' perception that teacher action will translate into students learning. "When a student does better than usual in mathematics, it is often because the teacher exerted a little extra efforts", and "If students are underachieving in mathematics, it is most likely due to ineffective mathematics teaching" are two items of outcome expectancy. The MTEBI consists of 21 items, 13 items on the PMTE subscale and 8 items on MTOE subscale. It is a 5-point Likert type scale ranging from strongly agree to strongly disagree. The MTEBI was translated and adapted to Turkish pre-service mathematics teachers by Cakiroglu (2003). When the instrument is given to participants when they become inservice teachers, the wording of some items were changed. For instance, the item "I will typically be able to answer students' questions" was changed into "I am typically able to answer students' questions" since they are no more preservice teachers. In order to measure the internal consistency of the MTEBI, Cronbach's alpha was calculated for the MTEBI and its sub-dimensions for each case. In other words, Cronbach's alpha was calculated for Time 1, Time 2, Time 3, and for Time 4 for sub-dimensions and for the MTEBI as a whole. The values range between .7 and .97 which is considered as high in social science studies. For qualitative data electronic e-mail interview was used to collect data easily from participants who are geographically dispersed around the country. The researcher e-mailed interview questions to 30 participants and obtained rich text database for qualitative analysis at the end of their first year teaching experience. Some of the sample interview items were "Tell me about your school that you are working in?", "Are you happy with your school? Colleagues? Students?", Do you feel efficacious in teaching profession? Why?, Which issues do you feel efficacious? Why? How these issues contribute to your teaching efficacy?, Which issues do you feel inefficacious? Why? How these issues inhibit your efficacy?.

Data collection and analysis

The data of this study were collected through the MTEBI and electronic e-mail interviews. The MTEBI was applied to participants at the very beginning of school experience course, at the end of school experience course, at the end of practice teaching, and after their first year of employment as a teacher. Data were collected during school experience and practice teaching course. The last data were collected through e-mail. The researcher sent the MTEBI electronically to the participants and all of them returned their responses online. After collection of the last survey data, electronic e-mail interviews were sent to participants. Again, all participants turned in their written responses via e-mail. Anonymity was assured among the participants and they were told that their statements would not be reported to the schools they working in.

For quantitative analysis, descriptive statistics regarding mean difference across time intervals were calculated. In order to test the statistical significance, separate one-way repeated measures of ANOVAs were conducted for overall efficacy, personal mathematics teaching efficacy, and mathematics teaching outcome expectancy respectively. Before the inferential analysis, normality, independence, and sphericity assumptions were checked.

The researcher and another coder began the analysis of qualitative data by reading the transcripts of the e-mail interviews. Coders agreed on a list of codes and used these codes to analyze the data independently. They developed list of concepts (units of data) under different categories. The concepts that share familiar characteristics were moved under the same category. This process continued until categories were saturated At the end, issues that affect teachers' efficacy were categorized under 6 headings namely: *Classroom management, communicating with*

students, communicating with parents, mathematical knowledge for teaching, material usage, and textbook usage.

FINDINGS

The aim of this study is to explore middle school mathematics teachers' overall mathematics teaching efficacy belief, personal mathematics teaching efficacy, and mathematics teaching outcome expectancy scores during their enrollment in teacher education program and at the end of first year of their teaching. Descriptive statistics regarding mean difference across time intervals are given in Table 1.

Table1. Participants' mean and standard deviation scores across time intervals

Self-efficacy	Overall score	Personal efficacy Mean (SD)	Outcome expectancy
Time1	83.00 (8.9)	54.13 (6.21)	28.86 (4.46)
Time 2	85.13 (7.4)	54.66 (5.33)	30.46 (3.37)
Time 3	86.53 (7.5)	56.50 (5.29)	30.03 (4.28)
Time 4	82.06 (6.15)	53.93 (4.23)	28.13 (3.75)

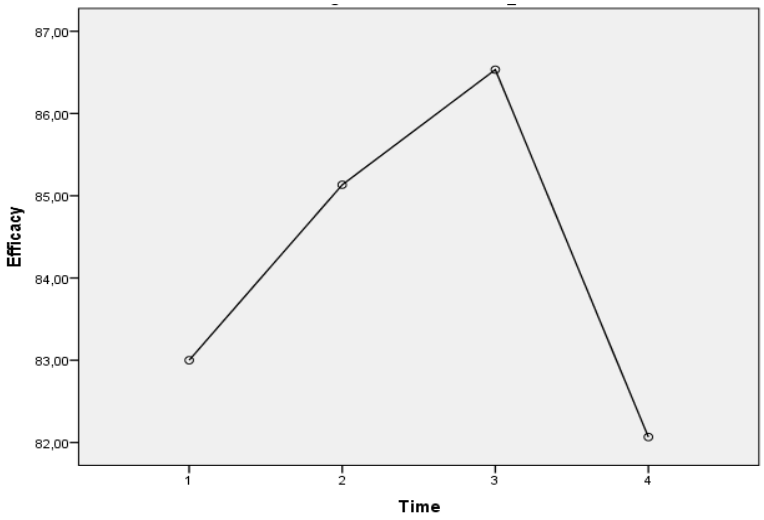

Figure 1. Teaching efficacy scores across time intervals

As understood from the Table 1 and Figure 1, pre-service teachers' overall teaching efficacy score increase during their enrollment in the teacher education program. However, there is a sharp decrease at the end of their first year of teaching experience.

A one-way repeated measures of ANOVA showed that mean mathematics teaching efficacy belief scores differed significantly between time points (F (3, 27) = 4.6, p =.01). Post hoc test using Bonferroni correction showed that overall efficacy score elicited an increase in efficacy score from Time 1 (M = 83.00, SD = 8.9) to Time 2 (M = 85.13, SD = 7.4), which was not statistically significant (p = .46). Pre-service teachers' efficacy scores continue to increase slightly till the end of Time 3 (M = 85.13, SD = 7.4) which creates significant difference from Time 1 to Time 3 (p = .05). Then, participants' efficacy scores decrease at the end of their first year of teaching (M = 82.06, SD = 6.15) which creates significant difference between Time 3 and Time 4. Multivariate eta square was calculated as .34 which suggests a very large effect size (Cohen, 1988). Therefore, we can conclude that teacher education program elicits increase in self-efficacy score, but efficacy decreases when preservice teachers work as teachers in real classroom settings. In addition to overall teaching

efficacy scores, pre-service teachers' self-efficacy scores and outcome efficacy scores were analyzed separately across time intervals. A one-way repeated measures of ANOVA was conducted to compare self-efficacy scores of participants at Time 1, Time 2, Time 3 and Time 4 (See Figure 2).

Analysis showed that mean self-efficacy scores differed significantly between time periods (F (3,27) = 5.19, p = .01). Follow-up post-hoc tests using Bonferroni showed that self-efficacy scores of pre-service teachers slightly increased from Time 1 (M = 54.13, SD = 6.21) to Time 2 (M = 54.66, SD = 5.33) which was not statistically significant (p = 1.0). However, pre-service teachers' self-efficacy scores continue to increase until Time 3 (M = 56.5, SD = 5.29) which yields significant results. However, analysis revealed that participants' scores decrease at the end of their first year of teaching (M = 53.9, SD = 4.2) but not significantly. Therefore, we can conclude that participants' self-efficacy scores increase during their enrollment in the teacher education program, but decrease at the end of their first year of teaching. Multivariate eta square was calculated as .36 which suggests a very large effect size (Cohen, 1988).

Similarly, one-way repeated measures of ANOVA was conducted to analyze participants' mathematics teaching outcome expectancy scores at different time intervals. As in the personal mathematics teaching efficacy case, analysis showed that there was a significant effect of Time (F (3,27) = .68, p = .015). Follow-up post-hoc tests using Bonferroni showed that outcome expectancy scores of pre-service teachers increased from Time 1 (M = 28.86, SD=4.46) to Time 2 (M = 30.46, SD = 3.37) then slightly decreased at Time 3 (M = 30.03, SD = 4.28). Preservice teachers' outcome expectancy scores was the lowest at the end of their first year of experience (M = 28.13, SD = 3.75) (See Figure 3). However, those pairwise

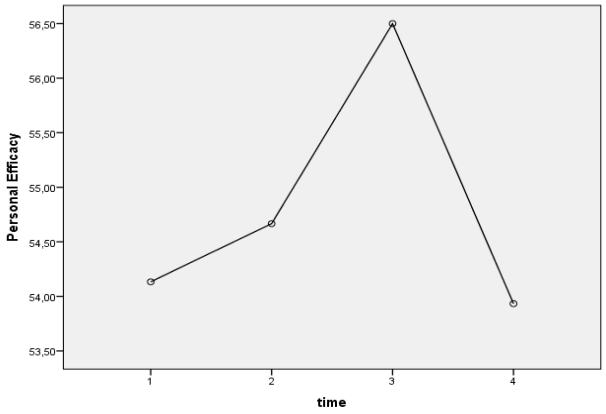

Figure 2. Personal mathematics teaching efficacy scores across time intervals

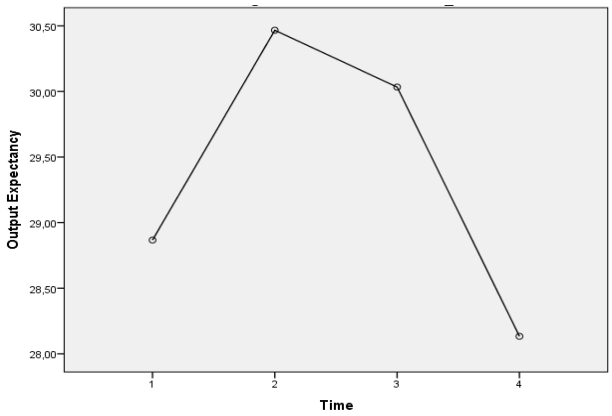

Figure 3. Mathematics teaching outcome expectancy scores across time intervals

differences were not significant. Therefore, we can conclude that outcome scores increase during school experience; but, the scores decrease after that period continuously. Multivariate eta square was calculated as .32 which suggests a very large effect size (Cohen, 1988).

Issues that affect efficacy

Quantitative data analysis showed that participants' personal mathematics teaching efficacy and mathematics teaching outcome expectancy decreased when they became inservice teachers. In addition to the quantitative analysis, qualitative data analysis was conducted to identify the issues that the participants feel (in)efficacious and which factors enhance and inhibit their mathematics teaching efficacy when they became inservice teachers. Data analysis showed that *classroom management, communicating with students, communicating with parents, mathematical knowledge for teaching, material usage, textbook usage* are the main themes that inservice teachers stated while evaluating their efficacy. Details of each category are explained below.

Classroom Management

When participants were asked the factors that they feel (in)efficacious when they become teacher, classroom management is among the popular answers. Nineteen participants emphasized the issue and only two of them stated that they feel efficacious in handling classroom problems. The class sizes of the two teachers are smaller than other teachers' classrooms. As an example,

> The school where I'm working is not crowded. There is only small number of students in my classes. This really helps me while making revisions during the lesson and controlling the classroom. Thus, I really feel competent. However, I guess I would have problems in classroom management if I had crowded classes. (P25)

As oppose to these two teachers, 17 teachers emphasized their inadequacy in classroom management. Those participants emphasized that even they use specific techniques that they learned during their higher education, those techniques do not work in really classrooms and they lose their efficacy which also negatively affect their teaching:

> I could not stop misbehaving children who interrupts my teaching. In order to handle this problem, I signed a contract with them that if they behave in class, I would distribute candy to them. I talked to them one-by-one and I reward them; but, I never succeeded. My techniques worked only for a short time. I think classroom management is the area that I feel least efficacious. I should read more and evaluate different experiences. Otherwise I will not teach anything to my students. (P16)

Similarly,

> When I become teacher, I realized that classroom management is more important than the subject matter knowledge for teachers. If you could not control the class you could never create an effective learning environment. Classroom management is the area that I felt most unsuccessful and inefficacious. I know everything in theory but when I applied theory into practice everything goes wrong. Verbal warning, eye contact, moving in the classroom, ignorance, touch, using body language, contracts, communicating with parents, and collaboration with the school administrator are the techniques that I used. My affection towards students helps me in some cases. However, I have three students in my fifth grade class and none of these techniques works. They always interrupt my lesson and I can never move forward. I could not do anything and I really feel helpless. (P11)

Communicating with student

The other popular topic that novice teachers evaluated their efficacy is *communicating with student*s. Thirteen participants among 15 teachers stated that they feel competent in communicating with students. Those participants stated that to show love and affection is the key point in communication with students:

> I can easily communicate with students. Not only during the lesson but I also show my interest outside the classroom. I play volleyball with them during the breaks, I talked to them, and I warn them not to go outside without their coat during the winter. I love them too much and really feel adequate in communicating with them. This is very helpful during my teaching. (P13)
>
> Even I have problems in classroom management; I love my students in heart whether they behave well or not. I never shout or offend any of the students. Instead I show my love and affection to them, which improves the communication between us. Sometimes I give them reward when we do activities which makes me from other teachers. They are always around me and show their interest to my lesson. This is because of the good communication between us. I feel really competent in communication. This communication affects my teaching positively. They put much attention in my lesson and listen to me carefully. (P21)

In addition, novice teachers stated that having small number of students in their class enhances communication between them and students:

> Number of students in my classroom is very small. So I can show my interest to each student. Thus, I will never have problem in communication with my students. This always enhances my efficacy toward my profession since I think communicating with students is so important. (P25)

However, three participants stated that they feel inefficacious in communicating with students. They believe that to show love is not the key point in communicating with students. The teacher should be rigid and there should be space between teacher and students:

> I'm a novice teacher. Students know and use this. If I show my affection and love, they may indulge and interrupt my lesson. Thus, I decided to be serious and rigid during the lesson. This negatively affects the relation between us but otherwise I cannot finish the topics that I'm supposed to teach. (P28)

Communicating with parents

In addition to the communicating with students, *communicating with parents* is the other hot topic mentioned by most of the novice teachers. Fifteen inservice teachers stated that they put emphasis on the relationship with parents but only two of them could manage it:

> My students' parents are very helpful. It is not hard to communicate with them. We respect to each other, thus it is easy to communicate with them related to their children. If I need any help from them regarding their children they are always ready to help. (P11)

On the other hand, most of the novice teachers stated their inadequacy in communicating with their parents:

> I'm a teacher in a village school. All my parents are busy with their farms. Thus, they could not find any time to come to school and asked for their children. I have no face-to-face communication with them. Then, I try to reach them by phone to let them know about their children. But I realized that most of them had no idea and did not care

> what their children were doing at school. I feel very sad because of this. Parents are so important but I could not get any help from them. They are as important as me in their children success but they left me alone in this process. (P19)

Similarly,

> My students are from very crowded families. They have no environment to study. They share their bedrooms with their siblings and they should care their smaller siblings during the night. Thus, most of the time they could not find the time to finish their homework or to study for exams. They should help their parents. Some of them could not attend school even on exam dates. When I thought the conditions I feel very inefficacious in relationship with parents. We never communicate and I never get support from them. I really feel inadequate on this issue. I do not know how to join them into their children academic life. (P22)

In addition to classroom management and communicating with students and parents, inservice teachers mentioned about instructional issues while evaluating their efficacy. Those topics were handled under three themes, including *mathematical knowledge for teaching, material usage,* and *textbook usage* respectively.

Mathematical knowledge for teaching

Twenty eight novice teachers stated that with the help of the courses they took during their higher education they feel highly efficacious in their knowledge to teach mathematics to their students. For instance,

> With the help of the courses that I took in the university I feel highly confident to teach topics in my class. I can make the topics concrete and make them more understandable and meaningful to students. In addition, because of my high level knowledge I can respond to students' questions including proof of statements. (P3)

Fifteen teachers among the 28 teachers stated that since they teach middle school students they feel high confident in teaching the topics in that grade levels:

> I'm good at mathematics during the high school. In addition I trust the education that I took in the university since I graduated from one of the best universities in Turkey. Thus, I really feel efficacious to teach my subject area. (P4)
>
> I know the middle school topics that I'm teaching. I know how to explain the topic to the students. I know what to do in order to make it meaningful. I also know what to ask in order to evaluate students' learning. I can figure out students' misconceptions that they have and know how to overcome it. (P19)

Teachers also stated that they really benefit from the courses they took in the university in terms of enhancing their knowledge of students' difficulties and to reach students with different ability levels. For instance,

> With the help of the methods of teaching mathematics course that I took in the university, I really feel efficacious in teaching. I know how to introduce a topic and how to integrate students into the lesson. I can figure out the misconceptions or difficulties that they encounter and modify my lesson plan according to their needs. (P27)
>
> When I graduated from university I know all the objectives in the curriculum. I know how to prepare activities, lesson plans according to the levels of students. I can use a variety of teaching methods. I have students in my class with different levels. It is easy to teach students with high ability. But, I can create an environment where those students

> can help low ability level students. So, all the students can reach the expected outcomes. (P16)

In addition to those participants, only three students stated that they feel inefficacious in teaching mathematics to students at various ability levels:

> I do not feel efficacious in teaching. In general, I know how to teach topics, students' misconceptions and how to overcome them. However, this is not enough. I could not reach all the students in my class because they are different in ability. Some of them are very successful and eager to learn. Others are not motivated to learn and very unsuccessful. Those students are in the same class so I do not know how to respond to their needs. (P6)
>
> I'm not competent in teaching. I'm teaching mathematics to whole class for the first time thus I cannot decide how to teach each topic to each student effectively. I cannot figure out students' responses to my questions thus have trouble in replying them. In addition since students are at different ability levels I explain the topic again and again. I try to use alternative methodologies but students who get the idea is very low in number. (P21)

Seventeen inservice teachers rated their efficacy on teaching methodologies. All of them said that they were good at using alternative methodologies but only half of them stated that they can really use them during teaching:

> I think I'm good at teaching. I can create classroom environment where students can construct relationship among concepts, easily express themselves, use multiple representations involving visual, verbal and concrete models. (P24)
>
> I'm good at instructional methodologies and techniques to teach mathematics effectively. I also have sufficient knowledge on teaching specific topic by using specific instructional methodologies. However, when I started to teach in real classroom I realized that I cannot apply each technique that I know because my students are not open to new instructional techniques and their prerequisite knowledge is not good enough. Hence, I understand that teaching efficacy is reshaping what we have learnt in the university according to the conditions we met in daily life. (P14)
>
> My students' academic success is very low. I always try to find alternative methodologies to teach the subject. I did not impose the formula directly. I do not impose memorization. I try to explain where the formula came from and perform activities that we can derive the formula together. However, perceive this period as time consuming and they asked if there is mathematical formula for the topic I taught. (P21)

Material Usage

While evaluating their efficacy, eight teachers mentioned about their competency in using materials in the classroom:

> I definitely love using manipulatives in my teaching. I'm good at using them and my students enjoy much. I believe that students learn better in this way. (P13)

However, although they feel efficacious in their knowledge of using materials most of these teachers complain about the lack of materials in the schools they worked in.

> I definitely agree that use of manipulative is so important in making the topic concrete. I feel that I am qualified in using materials in my lessons. However, I worked in a village school and we do not have enough materials in our school. (P27)

Textbook Usage

Analysis of data revealed that six students stated that they feel efficacious in using textbook during their teaching but nine stated that they feel inadequate.

> I do not feel effective in using textbook. To be honest in general I'm not using textbook. I just use it to give homework on some topics. The order that I follow and the topic given in the textbook are not parallel and examples are not enough. Thus, I prepare my own instructional materials. Since, I do not prefer to use textbooks I do not feel efficacious in using them. (P11)

DISCUSSION AND CONCLUSION

Data analysis revealed that prospective teachers' efficacy beliefs increase during their enrollment in teacher education program but decrease when they become teacher. More specifically, through school experience and teaching practice courses, prospective teachers have high levels of self-efficacy (Hoy & Woolfolk, 1990; Li & Zhang, 2000) but this belief declines at the end of the first year of teaching (Woolfolk Hoy, 2000). In other words, personal mathematics teaching efficacy persisted until the final year of teacher education but declined after participants began actual teaching in real classrooms.

When the first set of data was collected prospective teachers had just completed the mathematics teaching methods course in which they had many opportunities to prepare activities for middle school students to enhance students' learning of mathematics. Thus, students' engagement in the methods course might have positively affected their efficacy belief as mentioned in the literature (Albayrak & Aydin-Unal, 2011; Palmer, 2006). State differently, prospective teachers have some self-assurance about their readiness to teach specific content. They also learn to teach specific topics in curriculum by using alternative techniques, became familiar with students' difficulties and have idea on how to overcome those difficulties. Thus, enactive mastery experiences gained through group work, collaborating with peers, designing and implementing mathematical tasks during the method course might enhance self-efficacy of participants (Yürekli, 2015). As echoed by the participants most of the teachers feel efficacious with the help of the method course they took in the university. They feel confident in using alternative teaching methods, preparing activities according to the objectives in the middle school curriculum and levels of students based on mastery experiences that they gained through methods of teaching mathematics course. Thus, an explanation of increase in personal efficacy during field experience could be attributed to the enactive mastery experience source of efficacy which serves as the direct indicator of capabilities. In addition, during their enrollment in the school experience course that is mostly based on observation, their belief in capability to teach might increase through vicarious experiences. In other words, they had chance to compare their performances and judge their capabilities by observing their mentor teachers and have confidence to teach mathematics effectively. Indeed, this increase is significant during practice teaching course where they had opportunity to teach specific topics. As Holzberger et al. (2013) emphasized teachers' efficacy could be a consequence of educational processes. Thus, vicarious experiences where prospective teachers' observation of their mentor teachers successfully performing a task during school experience and their successful mastery teaching experiences of using alternative methodologies and implementing tasks might support prospective teachers' personal efficacies at the end of school experience and practice teaching.

In contrast to the increase during the enrollment in teacher education program, participants' personal mathematics teaching efficacy declined at the end of their first

year of teaching experience. In other words, when they confronted with the realities and complexities of teaching their personal efficacy decreased (Li & Zhang, 2000). As literature supports, participants of the study might underestimate the complexity of teaching and overestimate their own skills during their enrollment of teacher education program. However, when they are confronted with a real view of learning and teaching, their efficacy belief decreases. Indeed, it should be taken into account that during practicum course when pre-service teachers teach specific topics to students in their cooperating schools, their mentor teacher observes them. In other words, there were two teachers in the classroom which might eliminate many other factors that affect teaching efficacy. As echoed in participants' verbatim, classroom management is one of the most important issues that diminished their efficacy when they become teacher. Thus, classroom management might not be an issue during school experience and teaching practice course but have influence on teachers' efficacy when they become inservice teachers. As voiced by participants although they have higher confidence in teaching mathematics by using various teaching methodologies, their teaching obstructed by misbehave student when they became teacher. In a longitudinal study, Holzberger et al. (2013) stated that self-efficacy beliefs can be both a cause and an effect of educational processes. They mentioned that the long term effect of instructional quality could influence teachers' self-efficacy beliefs. For instance, teachers who reported better classroom management experiences showed increase in self-efficacy beliefs one year later. Thus, in this study inservice teachers' personal mathematics teaching efficacy beliefs might poorly affected through these negative experiences in classroom management.

On the other hand, mathematics teaching outcome expectancy increases till the end of school experience course but starts to decline after involvement in teaching practice course. In other words, teaching outcome expectancy did not increase in spite of field experience (Barnes, 2000; Erdem & Demirel, 2007; Leonard, Barnes-Johnson, Dantley, & Kimber, 2011; Plourde, 2002; Utley, Moseley, & Bryant, 2005; Wingfield, Nath, Freeman, & Cohen, 2000; Woodcock, 2011; Woolfolk, 2001). During enrollment in teacher education programs, as Wingfield et al., (2000) stressed prospective teachers might have high feeling of being able to teach mathematics effectively but not have feeling of being able to contribute students' development as a consequence. As Plourde (2002) voiced time constrains, insufficient materials, inadequate support from faculty, and classroom management issues could be the reasons that decrease outcome expectancy of pre-service teachers that they tend to believe that students' learning could not be established through effective teaching during their practice teaching. Similar to the personal efficacy, there are specific factors that might negatively affect participants' outcome expectancy. As stated above, inservice teachers mentioned about the classroom management problem during their first year of teaching experience. Thus, having problem in controlling misbehave children during teaching might decrease participants' belief that teacher is effective factor in students' learning. To give another example, participants mentioned that they believed in their capability of teaching specific topic by using alternative instructional methodologies but their students are not open to these new methodologies. Similarly, some of the participants stressed that they have problem in communicating with parents. Although participants expect collaboration with parents but they fail to manage it. Thus, participants' beliefs about students' abilities to learn mathematics may be negatively influenced by the problems they have with students and parents. As Gür, Çakıroğlu, and Çapa-Aydın (2012) stated parental support is important predictor of teacher efficacy for student engagement. Thus, to enhance parental support and their enrollment in school culture teacher-parent cooperation should be supported by the administrators. In addition, as Koç (2013) stressed there is relationship between teachers' efficacy and their ability to supply

constructivist learning environments in which they could meet the cognitive and affective needs of their students. Thus, in-service trainings might be offered to the novice teachers in order to help them to overcome basic problems that they have during their early years of teaching and support their development of efficacy beliefs toward mathematics teaching.

Despite the rich literature on self-efficacy, there is still room for more work. Self-efficacy is situation and context specific construct (Tschannen-Moran et al., 1998). In the present context, findings revealed that prospective teachers' teaching efficacy beliefs increase during their enrollment in teacher education program but decrease at the end of their first year of teaching. This longitudinal study allows window of opportunity to see the trends of changes in teacher efficacy over years and factors that enhance or inhibit novice teachers' teaching efficacy. However, very few studies investigate the development of preservice teachers' efficacy beliefs during their enrollment in teacher education program (Briley, 2012). More specifically, how specific courses offered in the program affect prospective teachers' teaching efficacy still needs further exploration. In addition, findings of the present study reveal the fact that there are many factors that affect novice teachers' teaching efficacy belief during their early years of employment as teacher. Thus, further research could be conducted to investigate novice teachers' difficulties during their early years of teaching. With these in-depth explorations teacher educators could have idea on factors that affect teachers' ability to teach mathematics and enrich the content of their courses to raise prospective teachers' awareness of areas in which they need to get further training.

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