Mathematics Teaching Self-Efficacy and Outcome Expectancy of Pre-Service and In-Service Primary Education Teachers

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ABSTRACT

Background: Given the importance of studies the mathematics teaching self-efficacy and outcome expectancy of pre-service teachers, novice teachers (up to 10 years of experience) and experienced teachers (more than 10 years of experience), it is important to research the behaviour of the three groups proposed. **Objectives:** Compare the mathematics teaching self-efficacy and outcome expectancy of pre-service and in-service Primary Education teachers. **Design:** The Mathematics Teaching Efficacy Belief Instrument (MTEBI) is used to carry out the study. The MTEBI comprises two subscales: Personal Mathematics Teaching Efficacy (or teaching self-efficacy) (PMTE) and Mathematics Teaching Outcome Expectancy (MTOE). **Setting and Participants:** The first group of participants consists of 419 pre-service teachers enrolled at the bachelor's degree in Primary Education, the second group of participants consists of 69 novice teachers and the last group consists of 176 experienced teachers. **Data collection and analysis:** Students of all the years of the bachelor's degree were invited to answer the MTEBI. Therefore, the participation was optional and completely anonymous. Directors of Primary Education schools in the city were sent the link of the survey during the second trimester of 2018-19 academic year. They shared the link so that novice and experienced teachers were able to answer it confidentially. **Results:** The comparison reveals that experienced teachers have the highest scores in PMTE subscale. The pre-service teachers, on the contrary, give the lowest scores in this subscale. In the MTOE subscale, the lowest values are obtained in the case of novice teachers. Additionally, the statistical analysis shows that there are significant differences between the three groups in both the PMTE and MTOE subscales. **Conclusions:** The findings of the current study provides information that would be useful for teacher educators to design or modify courses in order to enforce the mathematics teaching efficacy beliefs of pre-service and in-service Primary Education teachers.

Keywords: Self-efficacy, mathematics teaching, outcome expectancy, pre-service teachers, in-service teachers.

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Autoeficácia no ensino de matemática e expectativa de resultados de professores do ensino fundamental em formação e em serviço

RESUMO

Contexto: Dada a importância de estudar a autoeficácia no ensino de matemática e a expectativa de resultados de professores em formação, professores novatos (até 10 anos de experiência) e professores experientes (mais de 10 anos de experiência), é importante pesquisar os comportamento dos três grupos propostos. **Objetivos:** Comparar a auto-eficácia do ensino de matemática e a expectativa de resultados de professores do ensino fundamental em formação e em serviço. **Design**: O Instrumento de Crença em Eficácia no Ensino de Matemática (MTEBI) é usado para realizar o estudo. O MTEBI compreende duas subescalas: Eficácia no ensino de matemática pessoal (ou autoeficácia no ensino) (PMTE) e Expectativa de resultado no ensino de matemática (MTOE). **Ambiente e participantes**: O primeiro grupo de participantes é composto por 419 professores em formação matriculados no Bacharelado em Educação Primária, o segundo grupo de participantes é composto por 69 professores iniciantes e o último grupo é composto por 176 professores experientes. **Coleta e análise de dados**: Estudantes de todos os anos do Bacharelado foram convidados a responder ao MTEBI. Portanto, a participação foi opcional e completamente anônima. Os diretores das escolas de ensino fundamental da cidade receberam o link da pesquisa durante o segundo trimestre do ano acadêmico de 2018-19. Eles compartilharam o link para que professores novatos e experientes pudessem respondê-lo confidencialmente. **Resultados:** A comparação revela que professores experientes têm as pontuações mais altas na subescala PMTE. Os professores em formação, pelo contrário, dão as notas mais baixas nesta subescala. Na subescala MTOE, os valores mais baixos são obtidos no caso de professores iniciantes. Além disso, a análise estatística mostra que há diferenças significativas entre os três grupos nas subescalas PMTE e MTOE. **Conclusões:** As conclusões do presente estudo fornecem informações que seriam úteis para os educadores de professores projetarem ou modificarem cursos, a fim de reforçar as crenças de eficácia do ensino de matemática de professores de educação primária em serviço e em serviço.

Palavras-chave: Autoeficácia, ensino de matemática, expectativa de resultados, professores em formação, professores em serviço.

INTRODUCTION

Bandura developed the self-efficacy theory (Bandura, 1977; 1982; 1986), which is based on the principal assumption that psychological procedures serve as means of creating and strengthening expectations of personal efficacy. Within this analysis, efficacy expectations are distinguished from response-outcome expectancies. An outcome expectancy is defined as a person's estimate that a given behavior will lead to certain outcomes. An efficacy expectation is the conviction that one can successfully execute the behavior required to produce the outcomes.

According to Bandura (1977, 1997), people fear and tend to avoid threatening situations they believe exceed their coping skills, whereas they get involved in activities and behave assuredly when they judge themselves capable of handling situations that would otherwise be intimidating. Efficacy expectations determine how much effort people will expend and how long they will persist in facing obstacles and aversive experiences. The stronger the perceived self-efficacy, the more active the efforts.

The current work is focused on studying mathematics teaching efficacy beliefs, which can be defined as teachers' beliefs in their abilities to organize and execute courses of action necessary to bring about desired results (Takunyaci & Takunyaci, 2014). Teachers' efficacy belief is a psychometric factor that influences the teaching and learning experience (Hoy & Woolfolk, 1990). This belief represents teachers' considerations about their competence in managing student learning (Pajares, 1996). Korthagen (2004) considers that teachers' efficacy belief is the most important parameter in teacher education literature.

Based on the self-efficacy theory, some studies of teachers' efficacy beliefs consider two separate dimensions (Hassan & Hassan, 2012). The first dimension, personal teaching efficacy, represents a teacher's belief in their skills and abilities to be an effective teacher. The second dimension, teaching outcome expectancy, is a teacher's belief that effective teaching can bring about student learning regardless of external factors such as home environment, family background, and parental influences (Swars et al., 2007).

There exists a large number of research works about teacher's efficacy belief of pre-service teachers and in-service teachers (e.g., Mulholland et al., 2004; Bursal, 2010; Chang, 2015). Some of these works highlight the importance of teacher's efficacy beliefs towards mathematics to obtain positive results with their students (e.g., Sivri & Balci, 2015; García et al., 2015). According to Mulholland et al. (2004), students learn more from teachers with high self-efficacy than from those whose self-efficacy is low.

However, very few studies addressed the change of efficacy beliefs along time. Furthermore, there is not any work, as far as we are concerned, tackling a comparison between pre-service and in-service teacher mathematics teaching efficacy beliefs. This research aims at comparing the mathematics teaching self-efficacy and the outcome expectancy of pre-service and in-service Primary Education teachers. Concretely, the goal of this work is to study if they have similar mathematics teaching self-efficacy and outcome expectancy feelings, and if teaching experience help to enforce those beliefs.

Related work

Literature research shows that teacher's efficacy belief is an important construct in teaching. Hadley and Dorward (2011) mentioned how low-level self-efficacy beliefs for teaching mathematics can cause mathematics anxiety, which, at the same time, can influence negatively on students' achievement.

Newton et al. (2012) examined the relationship between mathematics content knowledge and teacher efficacy during an elementary mathematics methods course. They found a positive moderate relationship between content knowledge and teaching self- efficacy. However, they did not find any relationship between content knowledge and outcome expectancy.

Other studies investigated teaching efficacy beliefs of Primary Education pre-service teachers. Utley et al. (2005) investigated the relationship between science and mathematics teaching efficacy of pre-service teachers. Additionally, they investigated if the teacher efficacy beliefs about mathematics and science teaching change during participation in methods courses and student teaching. Their results show that both the personal teaching efficacy and the outcome expectancy beliefs increase during the science and mathematics courses. However, they decrease slightly after the student teaching period. Swars et al. (2007) presented a longitudinal study of elementary pre-service teachers' mathematics beliefs and content knowledge in which they concluded that teacher preparation programs could have an impact on the beliefs of pre-service teachers about teachers' efficacy beliefs and learning.

Bursal (2010) investigated teaching self-efficacy beliefs of pre-service elementary teachers' in elementary mathematics and science (PMTE and PSTE). The outcome expectancy was not studied, since according to Bursal, it is usually viewed to be inconsistent among pre-service teachers. The author indicated that participants' self-efficacy beliefs in teaching mathematics and science were associated.

Giles et al. (2016) studied elementary pre-service teachers' self-efficacy beliefs related to teaching mathematics. They announced that pre-service teachers had positive levels of efficacy regarding their mathematics teaching abilities as well as positive levels of outcome expectancy for their students in mathematics.

Other works study the influence of teaching experience on teacher's efficacy belief. Liu et al. (2007) investigated Taiwan elementary teachers' views of teaching efficacy and outcome expectations. They show that the teaching experience of elementary science teachers have a significant impact on personal science teaching efficacy and science teaching outcome expectations.

Holzberger et al. (2013) explored if teachers' self-efficacy beliefs affect their instructional quality or if positive experiences in the classroom positively influence the development of teachers' self-efficacy. Their findings show that teachers with higher self-efficacy did not necessarily provide higher quality instruction, when measured with a 1-year time lag. On the other hand, they show that the self-efficacy of teachers not only changes over the course of a school year but also increases in response to experiences of success in the classroom.

Takunyaci and Takunyaci (2014) determined that preschool teachers 'efficacy beliefs on teaching mathematics depends on their years of experience. Specifically, their results evidenced that the preschool teachers who have 13 and more years of teaching experience presented significant higher values of teachers' efficacy beliefs than the teachers that have less years of teaching experience.

Researchers emphasize the importance of studying teacher's efficacy beliefs of in-service teachers, since they are associated with teachers' professional behavior as well as with their pupils' performance and motivation (Tschannen et al., 1998; Charalambous et al., 2008). Additionally, researchers highlight that efficacy beliefs of pre-service teachers

are the source of positive attitudes and a significant predictor of academic performance (Pajares, 1992; Bandura, 1997; Zimmerman, 2000; Kaya & Bozdag, 2016).

Purpose of the study

This research aims at comparing the mathematics teaching self-efficacy and outcome expectancy of pre-service and in-service Primary Education teachers. Concretely, two different groups of in-service teachers are considered: novice teachers (up to 10 years of experience) and experienced teachers (more than 10 years of experience). We defined these two groups of in-service teachers after exploring the results considering different ranges of time. The number of years that made the difference was 10, as found in previous studies (e.g., Chang, 2015).

It should be remarked that this is not a longitudinal study. Ideally, it would be very interesting to work with the same participants, beginning when they are pre-service teachers, continuing with their first 10 years of teaching experience and finishing when they have more than 10 years of teaching experience. However, several factors make that kind of study very difficult to consider. Firstly, it would take more than 10 years just to collect the data. People, society and school change remarkably in 10-12 years. Secondly, it would be very difficult to track so many subjects. Thirdly, that study would imply to answer the same test 10 or 12 times. For all these reasons, this research is based on cross-sectional data.

Specifically, the current research was designed to answer the following questions:

(1) Do the three studied groups present significant differences in their mathematics teaching self-efficacy beliefs?

(2) Do the three studied groups present significant differences in their mathematics teaching outcome expectancy feelings?

(3) Does the teaching experience help to enforce those beliefs?

METHODOLOGY

In order to find the answers to the questions formulated above, the current work compares obtained scores in the MTEBI items considering the three groups: pre-service, novice and experienced Primary Education teachers. Additionally, this research studies if there are significant differences between the mathematics teaching self-efficacy and outcome expectancy of the three studied groups.

Participants

The participants comprised a purposeful sample (Patton, 2002). Concretely, the sample in this study consisted of three independent groups. The first group of participants consists of pre-service teachers enrolled at the Bachelor Degree in Primary Education at the Rovira i Virgili University in the 2016-17 academic year. Students of all the years of the Bachelor Degree were invited to answer the MTEBI. Therefore, the participation was optional and completely anonymous. At the end, 419 pre-service teachers assisted at the session when the test was applied (76% of the enrolled students that academic year). The Degree in Primary Education consists of a four-year Bachelor Degree program including three mandatory courses of teaching and learning mathematics and two periods of student teaching.

Besides, the MTEBI survey was adapted for in-service teachers, as explained in short, and created in google forms. Directors of Primary Education schools in the city were sent the link of the survey during the second trimester of 2018-19 academic year. They shared the link so that novice and experienced teachers were able to answer it confidentially. As a result, 69 novice teachers and 176 experienced teachers sent their answers. Recall that the number of novice teachers is notably inferior to the number of experienced teachers. This is due to the teaching experience of Primary Education teachers in the current country, which is, in average, 14 years. Therefore, it was expected to obtain a higher percentage of experienced teachers when considering a purposeful sample.

Instrument

The Mathematics Teaching Efficacy Belief Instrument (MTEBI) for pre-service teachers was used in this research (Enochs, Smith and Huinker, 2000). It resulted from the modification of the Science Teaching Efficacy Belief Instrument STEBI-B (Enochs & Riggs, 1990) to reflect future mathematics teaching beliefs. Indeed, the MTEBI for pre-service teachers has been widely used to measure mathematics teaching self-efficacy and teaching outcome expectancy (e.g., Giles et al., 2016; Moody & DuCloux, 2015; Newton et al., 2012; Swars et al., 2007). The original MTEBI consisted of 21 items in a five-point Likert scale measuring one (strongly disagree) to five (strongly agree). As in (Liu et al., 2007), the third Likert scale item, uncertain, was deleted in the current work to encourage all participants to indicate a level of certainty.

It should be highlighted that the MTEBI was adapted for novice and experienced teachers using the present tense instead of the future. In fact, the MTEBI for in-service teachers was also used in (Liu et al., 2007) and (Takunyaci & Takunyaci, 2014).

The questions that conform the MTEBI in the case of pre-service teachers are detailed in Table 1. The MTEBI is comprised of two subscales, the personal mathematics teaching efficacy (PMTE) subscale, which is composed of 13 items (2, 3, 5, 6, 8, 11, 15, 16, 17, 18, 19, 20, and 21) and Mathematics Teaching Outcome Expectancy (MTOE)

subscale, which is composed of 8 items (1, 4, 7, 9, 10, 12, 13, and 14). Eight of the items of PMTE are reverse scored (3, 6, 8, 15, 17, 18, 19 and 21). The responses corresponding to these items must be inverted before being added into the total PMTE score (4=1, 3=2, 2=3, and 1=4).

Table 1
MTEBI (Mathematics Teaching Efficacy Belief Instrument) for pre-service teachers

	Question
Q1	When a student does better than usual in mathematics, it is often because the teacher exerted a little extra effort.
Q2	I will continually find better ways to teach mathematics.
Q3	Even if I try very hard, I will not teach mathematics as well as I will most subjects.
Q4	When the mathematics grades of students improve, it is often due to their teacher having found a more effective teaching approach.
Q5	I know how to teach mathematics concepts effectively.
Q6	I will not be very effective in monitoring mathematics activities.
Q7	If students are underachieving in mathematics, it is most likely due to ineffective mathematics teaching.
Q8	I will generally teach mathematics ineffectively.
Q9	The inadequacy of a student's mathematics background can be overcome by good teaching.
Q10	When a low-achieving child progresses in mathematics, it is usually due to extra attention given by the teacher.
Q11	I understand mathematics concepts well enough to be effective in teaching elementary mathematics.
Q12	The teacher is generally responsible for the achievement of students in mathematics.
Q13	Students' achievement in mathematics is directly related to their teacher's effectiveness in mathematics teaching.
Q14	If parents comment that their child is showing more interest in mathematics at school, it is probably due to the performance of the child's teacher.
Q15	I will find it difficult to use manipulatives to explain to students why mathematics works.
Q16	I will typically be able to answer students' questions.
Q17	I wonder if I will have the necessary skills to teach mathematics.
Q18	Given a choice, I will not invite the principal to evaluate my mathematics teaching.
Q19	When a student has difficulty understanding a mathematics concept, I will usually be at a loss as to how to help the student understand it better.
Q20	When teaching mathematics, I will usually welcome student questions.
Q21	I do not know what to do to turn students on to mathematics.

Reliability

In order to determine the reliability of the instrument for the current context, the Cronbach's alpha was computed for both PMTE and MTOE subscales. Table 2 shows the obtained values considering each studied group. According to George and Mallery (2003), the values of Cronbach's alpha are good (>0.8) or acceptable (>0.7) in all the cases.

Table 2
α-Cronbach (PMTE, MTOE)

	Pre-service	Novice	Experienced
PMTE (α-Cronbach)	0.86	0.86	0.81
MTOE (α-Cronbach)	0.70	0.82	0.78

Validity

To study the validity of the instrument for the current context, the Kaiser-Meyer-Olkin (KMO) and the Bartlett's Test of Sphericity (BTS) are used. Results are summarized in Table 3.

Table 3
Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity (BTS)

	Pre-service	Novice	Experienced
KMO	0.88	0.67	0.81
BTS (p-value)	< 0.001	< 0.001	< 0.001

Results shown in Table 3 allow to conclude that the Exploratory Factor Analysis (Kaiser, 1974; Bartlett, 1950) can be applied in the three studied groups (KMO > 0.60 and p < 0.001). Table 4 shows the individual item-total correlations.

Table 4
Item-Total Correlations values

Items (PMTE)	Pre-service	Novice	Experienced
Q2	0.45	0.37	0.33
Q3	0.71	0.72	0.60
Q5	0.61	0.60	0.68
Q6	0.67	0.78	0.58
Q8	0.52	0.64	0.44
Q11	0.72	0.57	0.58
Q15	0.54	0.57	0.41
Q16	0.72	0.61	0.55
Q17	0.55	0.76	0.53
Q18	0.56	0.40	0.33
Q19	0.67	0.60	0.50
Q20	0.51	0.43	0.44
Q21	0.64	0.61	0.57

Items (PMTE)	Pre-service	Novice	Experienced
Items (MTOE)			
Q1	0.51	0.53	0.38
Q4	0.60	0.65	0.44
Q7	0.64	0.56	0.40
Q9	0.48	0.45	0.47
Q10	0.57	0.67	0.50
Q12	0.60	0.63	0.51
Q13	0.66	0.68	0.66
Q14	0.57	0.69	0.52

Results presented in Table 4 allow to affirm that item-total correlations are adequate, since all items have a factor loading above 0.30 (Büyüköztürk, 2013). Hence, the Exploratory Factor Analysis confirms that two subscales are defined (PMTE and MTOE).

RESULTS AND ANALISES

This section provides an in-depth analysis of the obtained results in order to answer the research questions formulated above. The PMTE and MTOE subscales are studied separately.

PMTE subscale

In this section, the average scores given for the participants to the questions corresponding to the PMTE subscale are studied ($\bar{X}$). Figure 1 shows the average scores obtained in the 13 items of the teaching self-efficacy (PMTE).

Figure 1
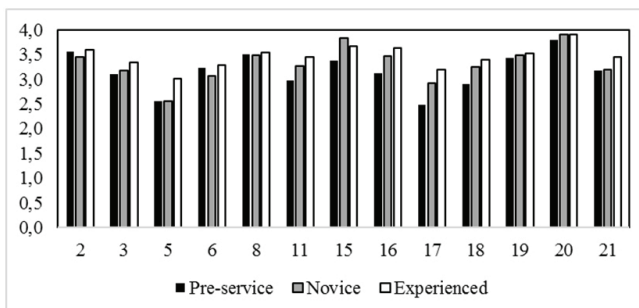*Average score obtained in each PMTE item.*

Figure 1 shows that the three groups express in general a high level of mathematics teaching self-efficacy. Notice that there are only few questions scored with less than 3 points. Table 5 summarizes these results.

Table 5
Comparison of values obtained in the PMTE subscale questions

PMTE mean value	pre-service	novice	experienced
<3	Q5 (I know how to teach mathematics concepts effectively)	Q5	
	Q11 (I understand mathematics concepts well enough to be effective in teaching elementary mathematics)		
	Q17 (I wonder if I will have the necessary skills to teach mathematics)	Q17	
	Q18 (Given a choice, I will not invite the principal to evaluate my mathematics teaching)		
>3	Q2, Q3, Q6, Q8, Q15, Q16, Q19, Q20, Q21		
		Q11, Q18	Q11, Q18
			Q5, Q17
minimum	Q17	Q5	Q5
maximum	Q20 (When teaching mathematics, I will usually welcome student questions)		

Table 5 shows that only 4 items are scored, in average, below 3 in the case of pre-service teachers. This group gives the minimum score to Q17. The novice teachers score only 2 items, in average, below 3. The experienced teachers score all the items above 3. Both groups of in-service teachers give the minimum score to Q5. The three groups of participants give the maximum score value to Q20.

Additionally, a differential analysis of items is performed to see if the three groups answer specific questions differently. According to the conditions of the data, the ANOVA test and the Tukey's HSD (honestly significant difference) are applied. Table 6 summarizes the obtained results when comparing consecutive groups.

Table 6

Significant difference between mean obtained in each of the PMTE questions

| p-value	comparing pre-service and novice teachers	comparing novice and experienced teachers
no significant difference (p>0.05)	Q2, Q3, Q6, Q8, Q19	
significant difference		Q5 (I know how to teach mathematics concepts effectively)
(p<0.01, *p<0.05)	Q11 (I understand mathematics concepts well enough to be effective in teaching elementary mathematics)	
	Q15 (I will find it difficult to use manipulatives to explain to students why mathematics works)	
	Q16 (I will typically be able to answer students' questions)	
	Q17 (I wonder if I will have the necessary skills to teach mathematics)	
	Q18 (Given a choice, I will not invite the principal to evaluate my mathematics teaching)	
	Q20 (When teaching mathematics, I will usually welcome student questions)*	
		Q21 (I do not know what to do to turn students on to mathematics)*

Table 6 shows that there are 6 questions for which there exists a significant difference between pre-service and novice teachers. Comparing the two groups of in-service teachers, there are only 2 questions for which there exists a significant difference between their scores. Although it is not included in the table, the difference between pre-service and experienced teachers was statistically significant in 9 of the 13 questions.

Comparing the three groups

The goal of this section is to study if there are statistically significant differences among the three group of participants in the PMTE subscale. To carry out the study, the total score of the PMTE subscale items obtained by each participant is computed (the total score is averaged by the number of items scored by the participant). In order to study the distribution of the scores, Figure 2 shows the average scores of the teaching self-efficacy corresponding to the pre-service, novice and experienced teachers. Specifically, the boxplot allows to identify the quartiles, the median (represented by horizontal lines in thinner regions) and the mean (denoted with points).

Figure 2
Individual pre-service, novice and experienced teachers average scores given to PMTE subscale
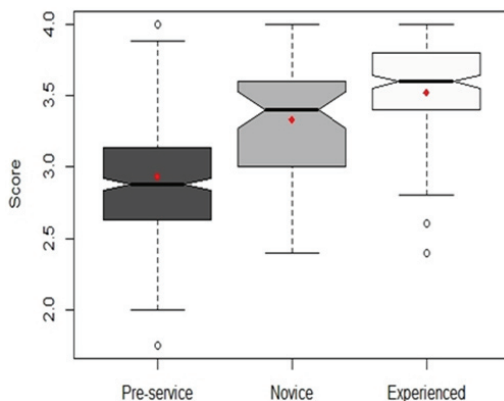
Notice in Figure 2 that the range of values of the pre-service teachers is clearly wider than the ones of the other two groups. Specifically, the minimum value of the pre-teachers is the smallest one (2). In the case of novice teachers, the number of small values (below 2.5) has been reduced (the minimum is 2.31). In the case of experienced teachers, there are not so many small values: there are two outliers (2.46 and 2.69) and the minimum value is 2.77.

The specific values of the mean $(\bar{X})$, median $(\tilde{X})$ and standard deviation (σ) of scores given by pre-service, novice and experienced teachers in the case of the PMTE subscale are shown in Table 7.

Table 7
Mean, median and standard deviation of each studied group in the PMTE subscale questions

	$\bar{X}$	$\tilde{X}$	σ
Pre-service	2.93	2.88	0.40
Novice	3.33	3.40	0.39
Experienced	3.52	3.60	0.34

In order to analyze the significance of the difference in the groups, the hypotheses of normality (Shapiro-Wilk test) and homoscedasticity (Fligner-Killeen test) of the three groups of participants are verified. According to the conditions of the data, the Kruskal-Wallis test is applied. It can be concluded that there are significant differences between medians of the groups in teaching self-efficacy ($p < 0.01$).

Secondly, the Tukey's range test is applied to determine the significant differences observed between consecutive groups. Obtained p-values allow to affirm that the

difference between the obtained medians is statistically significant between pre-service and novice teachers ($p<0.01$) and between novice and experienced teachers ($p<0.01$).

MTOE subscale

As in the PMTE subscale, the average scores ($\bar{X}$) that the participants of each group give to each individual MTOE item are studied. Figure 3 shows the average scores obtained in the eight items of the MTOE.

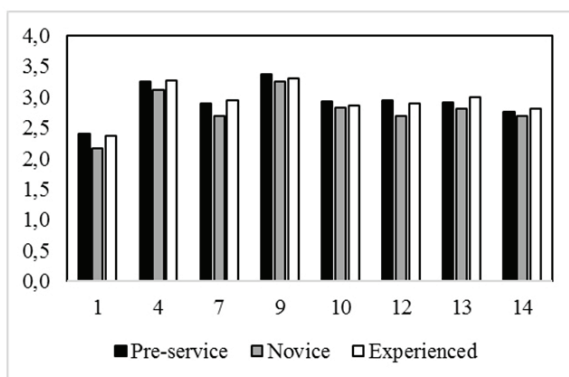**Figure 3**
Average score obtained in each MTOE item

Figure 3 shows that the three studied groups surpass the value 3 in only two items: Q4 and Q9. Notice that the average scores of experienced teachers exceed pre-service teachers in just four questions. Besides, it is noteworthy to remark that in all the items novice teachers give lower scores (in average) than pre-service teachers. Table 8 shows the obtained results.

Table 8
Comparison of values obtained in the MTOE subscale questions

MTOE mean value	pre-service	novice	experienced
<3		Q1, Q7, Q10, Q12, Q13, Q14	
>3	Q4 (When the mathematics grades of students improve, it is often due to their teacher having found a more effective teaching approach)		
	Q9 (The inadequacy of a student's mathematics background can be overcome by good teaching)		
minimum	Q1 (When a student does better than usual in mathematics, it is often because the teacher exerted a little extra effort)		
maximum	Q9	Q9	Q9

As in the PMTE subscale case, the ANOVA test and the Tukey's HSD (honestly significant difference) are applied to see if the three groups answer specific questions differently. Obtained p-values allow to conclude that there is only significant difference between the mean obtained in Q12 (The teacher is generally responsible for the achievement of students in mathematics) by considering consecutive groups. That is, between pre-service and novice teachers and between novice and experienced teachers ($p<0.05$).

Comparing the three groups

The goal of this section is to study if there are statistically significant differences among the three group of participants in the MTOE subscale. Figure 4 shows the distribution of the individual outcome expectancy values of pre-service, novice and experienced teachers.

Figure 4
Individual pre-service, novice and experienced teachers average scores given to MTOE subscale.
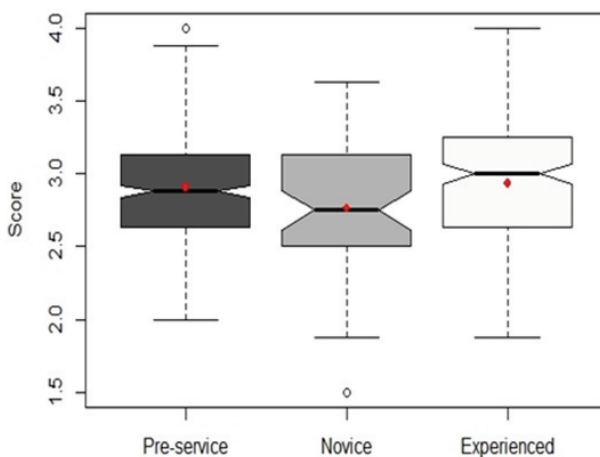

Figure 4 shows that the distribution of individual MTOE values are similar in the three groups of participants. Recall that the range of values is slightly wider in the case of experienced teachers (minimum=1.88, maximum=4). However, a very similar distribution is obtained in the case of pre-service teachers. The novice teachers present clearly the smallest values. Notice that the maximum value in this case is 3.63 and there is an outlier with a value of 1.50.

Table 9 shows the mean, median and standard deviation of scores obtained by participants in the case of the outcome expectancy.

Table 9

Mean, median and standard deviation of each studied group in the MTOE subscale questions

	$\bar{X}$	$\tilde{X}$	SD
Pre-service	2.91	2.89	0.39
Novice	2.76	2.75	0.48
Experienced	2.94	3.01	0.43

Additionally, a statistical analysis is carried out to study if there are significant differences among groups. First, compliance with the conditions of hypothesis of normality (Shapiro-Wilk) and homoscedasticity (Bartlett) are verified. Then, results obtained with the ANOVA test (F=3.53, p = 0.03) confirm that there are significant differences among the groups.

Second, the Tukey's HSD (honestly significant difference) test is applied. According to the results, there is a significant difference between pre-service and novice teachers (p = 0.04) and between novice and experienced teachers (p = 0.02).

DISCUSSION AND IMPLICATIONS

In order to answer the first research question, the mean scores of each question of the PMTE subscale were studied for each of the three groups of participants (pre-service, novice teachers and experienced teachers). Our findings indicate that in the PMTE questions experienced teachers give higher scores than novice teachers and the latter give higher scores than pre-service teachers. Only in question Q15 (I will use manipulatives to explain to students why mathematical solutions work), novice teachers give a higher average than experienced teachers. We believe that this occurs because some experienced teachers did not learn how to use manipulatives during their training. Manipulatives are currently more studied and used in mathematics education.

Besides, a statistically analysis of items was performed to see if the three groups answer specific questions differently. It is noteworthy to remark that there are 6 questions to which pre-service and novice teachers give statistically significant different scores. In the case of novice and experienced teachers that occurs only in 2 questions. There are 5 questions whose scores do not present significant differences between consecutive groups of participants. Therefore, the difference is more significant between pre-service and novice teachers than between the latter and experienced teachers.

Furthermore, a statistical analysis of the PMTE values given by each group was carried out. Results show that there are statistically significant differences among the three groups of participants regarding the PMTE subscale. Specifically, experienced teachers obtain a significantly higher median than novice teachers and the latter have significantly higher median than pre-service teachers.

Analogously, a similar approach was used to compare the mathematics teaching outcome expectancy of the three studied groups (second research question). First of all, the mean scores of each MTOE subscale question and for each group of participants (pre-service, novice and experienced teachers) were studied. Obtained results show that experienced teachers give higher scores than novice teachers. That is, the results show that the teaching experience helps to promote the MTOE. However, it is important to note that novice teachers have lower scores than the pre-service teachers in all items. Thus, MTOE values decline in the first few years of school teaching. These results are consistent with those presented in Utley et al. (2005) and in Swars et al. (2007).

Utley et al. (2005) pointed out that as the pre-service teachers progress in their college coursework, the student's optimism and enthusiasm tend to increase and then become blemished when confronted with the reality of the classroom. Swars et al. (2007) claim that teachers in training have an unrealistic optimism that is modified with the teaching of students. MTOE values decrease during the first years of teaching at school because, although pre-service teachers attended student practice at Primary school, they have not already faced the reality of being a teacher.

A possible idea to foster the MTOE of novice teachers would be to assist at school as apprentice teachers the first year (or even more than one year). The key point is that they would be accompanied by a teacher to gain confidence and to acquire skills that every teacher should have. Our proposal is in accord with the finding presented in Holzberger et al. (2013), where they evidenced that the self-efficacy of teachers increases in response to experiences of success in the classroom.

Moreover, the scores obtained in each item of the MTOE subscale were compared considering pairs of consecutive groups in order to see if their answers are statistically different. Results evidence that there is only significant difference between the mean obtained in one item. The other 7 items of the MTOE subscale do not present significant differences between consecutive groups of participants. This finding reinforces the fact that MTOE does not vary as much as the PMTE along time.

Additionally, a statistical analysis of MTOE values obtained by each group was carried out. Results show that there are statistically significant differences between the groups of teachers considered in this study. Concretely, experienced teachers get significantly higher values than novice teachers. In the case of pre-service and novice teachers, the MTOE is also significantly different, but the MTOE values are lower for novice teachers.

The significant difference that has been shown between the different groups, both in the case of PMTE and MTOE subscales, reinforces the robustness of the initial choice of the groups of in-service teachers: novice teachers (up to 10 years of experience) and experienced teachers (more than 10 years of experience).

Obtained results allow to affirm that the teaching experience enforces the mathematics teaching efficacy beliefs (third research question). Particularly, it has been

shown that the teaching experience strengthens the personal mathematics teaching efficacy (PMTE), coinciding with the results of previous studies (e.g., Takunyaci & Takunyaci, 2014). In the case of mathematics teaching outcome expectancy (MTOE), our findings evidence that the teaching experience also enforces those beliefs, but only in the case of in-service teachers.

CONCLUSIONS

This research compares the mathematics teaching self- efficacy and outcome expectancy of three groups of participants: pre-service, novice and experienced teachers. For this purpose, the Mathematics Teaching Efficacy Belief Instrument (MTEBI), which measures the mathematics teaching self-efficacy (PMTE), and the mathematics teaching outcome expectancy (MTOE), was used.

In the PMTE subscale, obtained values of novice teachers are significantly higher than those of pre-service teachers and experienced teachers have significantly higher PMTE values than novice teachers. Furthermore, this study shows that 6 of the 13 items present significant different mean values when comparing pre-service and novice teachers. In the case of novice and experienced teachers, that occurs with only 2 items of the PMTE subscale. Therefore, the difference is more significant between pre-service and novice teachers than between the two groups of in-service teachers.

In the case of MTOE subscale, results manifest that experienced teachers give values significantly higher than those of novice teachers and pre-service teachers give significantly higher values than novice teachers. The later result is attributed to the optimistic scores that pre-service teachers give to the MTOE subscale items, which in many cases may be due to lack of experience in a real school classroom. Additionally, results evidence that the average scores of only 1 item of the MTOE subscale is significantly different between consecutive groups of participants.

As a conclusion, this research shows that teaching experience strengthens mathematics teaching efficacy beliefs. Specifically, the smallest values of PMTE subscale are given by pre-service teachers while the highest ones are given by experienced teachers. In the case of MTOE, novice teachers present the smallest values, while the other groups present similar MTOE beliefs. It can be concluded that in the case of in-service teachers, the MTOE beliefs are enforced with mathematics teaching experience.

The findings of this study could be useful for pre-service and in-service teacher educators. Concretely, obtained results suggest that specific formation about managing a classroom would help to reduce the negative MTOE beliefs teachers will possibly have during their first in-service teaching years. In addition, longer teaching study periods would help pre-teachers to know better the reality of a classroom. These two ideas could give a more realistic perception of being a teacher in a school. In the case of novice teachers, the figure of apprentice, as mentioned above, could improve their MTOE beliefs.

A future line of research would be to put in practice a pilot project consisting of guiding novice teachers in their first year of school teaching. Their MTOE could be measured at the beginning and at the end of the academic school year. Furthermore, the relation between the PMTE and the mathematics academic achievements could be analyzed.

AUTHORS' CONTRIBUTIONS STATEMENTS

J. S and C.J actively participated in the developed the theory, the methodology, discussion of the results, reviewed and approved the final version of the work.

DATA AVAILABILITY STATEMENT

The data that supports the results of this study will be made available by the corresponding author J.S., upon reasonable request.

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