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Research Article

Turkish adaptation of the Mathematics Teachers' Beliefs Scale

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Mathematics education research often emphasizes beliefs as a key construct. Accordingly, beliefs about mathematics are significantly associated with difficulties encountered during the process of teaching and learning mathematics. The current study aims to assess the validity and reliability of the Turkish version of the Mathematics Teachers' Beliefs Scale [MTBS], which was developed by Xie and Cai (2021). In addition to encompassing five distinct types of beliefs about mathematics, the scale is designed specifically for the beliefs of mathematics teachers in regard to mathematics. Using a 4-point Likert scale, a 26-item belief survey was administered to 259 middle and high school mathematics teachers. This scale was subjected to a confirmatory factor analysis to verify its underlying factor structure. Six items were subsequently removed for lack of validity and reliability based on the collected data. Therefore, a final version of the MTBS with 20 items was developed. Confirmatory factor analysis showed that the structure of the scale was acceptable as measured by the Cronbach alpha internal consistency value and goodness-of-fit indices. As a result of the research findings, the Turkish version of the MTBS can be considered a valid and reliable measurement tool. Adapted scale may be able to measure five types of beliefs by Turkish mathematics teachers. Taking gender and years of teaching experience into consideration, the results indicated that teachers' mathematical beliefs didn't change significantly.

Keywords: Mathematical beliefs, teachers, scale adaptation

1. Introduction

Within the field of mathematics education, there is widely acknowledged understanding that achieving desired outcomes in the affective domain is equally crucial as in the cognitive domain. Beliefs constitute one of the key constructs that foster the affective development of mathematics; they encompass the individual value judgments of teachers regarding their teaching of mathematics, as well as the value judgments of students regarding their own learning of mathematics. Teacher beliefs are one of the prominent topics that researchers in the context of mathematics education frequently emphasize (Ernest, 1989; Kul, 2017; Liljedahl et al., 2021; Nespor, 1987), as they have a significant impact on classroom practices and subsequently, student learning. Merely interpreting teachers' different behaviors in the classroom based solely on their current knowledge may not be sufficient (Liljedahl, 2008). These differences can also be explained by examining teachers' beliefs (Pajares, 1992). Goldin et al. (2009) described beliefs as complex and diverse constructs, yet they criticized the absence of a definitive, distinct, and universally acknowledged definition. The ambiguous nature of beliefs (cognitive, affective, psychological, etc.) and the use of various terms (ideology, conceptions, worldview, etc.) are also reflected in their definitions (Barkatsas & Malone, 2005). While Sigel (1985) defined beliefs as mental structures formed through experiences, Cross (2009) defined them as propositions that individuals assume to be true about themselves and their environment, and structures that indirectly affect behaviors. Additionally, according to Raymond (1997), belief in mathematics refers to an individual's value judgments that result from past experiences with mathematics. Pajares (1992) stated that the challenge of studying beliefs lies in their difficult identification and evaluation, and the lack of a consistent definition. Nevertheless, there is a consensus among researchers that most teachers hold conceptions about their roles, and identifying and comprehending these beliefs would be beneficial for the forthcoming professional development courses.

Various studies have investigated beliefs about mathematics across different sample groups, practices, and types of conceptions, including the nature of mathematics, textbooks, problem posing and solving, its teaching and learning, mathematical skills, technology, and curriculum (Alfaro-Víquez & Joutsenlahti, 2021; Hacıömeroğlu, 2011, 2012; Handal, 2003; Jamieson-Proctor & Byrne, 2008; Kloosterman & Stage, 1992). The present study concentrates on the mathematics beliefs of teachers, as each teacher holds certain beliefs about mathematics that influence their priorities in teaching and learning practices (Pajares, 1992; Speer, 2005). There exists a reciprocal relationship between teacher beliefs and classroom teaching, whereby they mutually influence each other and consequently affect learning goals and outcomes (Beswick, 2012; Philipp, 2007). Hence, to improve teachers' classroom practices, their beliefs about mathematics must be taken into account (Swan, 2006). Numerous researchers have endeavored to gain insight and delve into the beliefs held by teachers, as these beliefs influence their pedagogical choices and classroom practices (Cross, 2009; Kul & Çelik, 2017; Liljedahl, 2010; Zhang, 2022). Research has demonstrated that teachers' mathematical beliefs can exert an influence on the beliefs held by their students as well (Carter & Norwood, 1997). Furthermore, international comparative studies have recognized teacher beliefs as a significant factor contributing to teaching effectiveness and competencies (Tatto et al., 2012). The impact of mathematical beliefs extends to teacher roles, classroom practices, and student achievement (Ernest, 1989; Pajares, 1992; Kunter et al., 2013; Staub & Stem, 2002; Wang et al., 2022; Zhang, 2022). Hence, it is imperative to gain a comprehensive understanding of mathematics teachers' beliefs and to identify them accurately in order to effectively manage their impact on the mathematics education process. By uncovering and examining teachers' beliefs, stakeholders can design targeted professional development programs, curriculum materials, and instructional strategies that align with teachers' existing beliefs while also promoting positive change and growth.

Extensive research has firmly established that teachers' beliefs are shaped by a variety of factors, including gender and years of teaching experience, which can significantly impact teaching quality, student achievement, and attitudes. Despite the importance of understanding how these factors affect teachers' beliefs about mathematics, few studies have specifically examined the differences or similarities in the beliefs of mathematics teachers based on their gender and years of teaching experience (Duatepe-Paksu, 2008; Li, 1999; Philipp, 2007; Uysal & Dede, 2019, 2021). The exploration of such variations in teachers' beliefs is an area that has received relatively limited attention within the research on mathematics education. However, the findings of these above studies suggest that while there may be some differences, gender does not generally have a statistically substantial impact on teachers' mathematical conceptions (Li, 2004). Moreover, Uysal and Dede's (2021) study indicates that teachers with varying levels of teaching have similar belief structures that possess both static and dynamic features regarding mathematics education. Nevertheless, the study revealed that mathematics teachers with over 15 years of experience exhibit a stronger inclination towards student-centered beliefs in their teaching practices. Conversely, those with less than 15 years of experience tend to adhere to more traditional beliefs. Notably, teachers' beliefs are known to influence their instructional practices, as teachers tend to act in accordance with their beliefs, which are often shaped by their past experiences, including both their previous school experiences and their higher education (Philipp, 2007).

Aligned with the studies that underline the vital role of teacher beliefs in teaching practice, extensive research has been conducted to ascertain the mathematical beliefs held by teachers, and scale development studies have been conducted for this purpose (Barlow & Cates, 2006; Tatto et al., 2012). The scholarly literature examines beliefs about mathematics across various sub-dimensions, addressing different contexts and situations within the field of mathematics. Measurements have been developed to determine the mathematical beliefs of teachers and prospective teachers in general (Akyıldız & Dede, 2019; Güven et al., 2013; Kayan et al., 2013). For example, Akyıldız and Dede (2019) developed a 41-item scale with a 5-point Likert-type, demonstrating strong validity and reliability. This scale aimed to assess the beliefs of future elementary mathematics teachers specifically related to the nature of mathematics. The research yielded several categories associated with the nature of mathematics, including function-oriented tool-oriented, progress-oriented, and goal-oriented mathematics. In a different study, Kayan et al. (2013) developed the Beliefs About Mathematics Scale, which aimed to assess the beliefs of prospective mathematics teachers regarding the nature, learning, and teaching of mathematics. During the item development process for this scale, the authors utilized a three-stage combined model that incorporated findings from various studies. Moreover, McLeod (1992) categorized mathematical beliefs into four sub-dimensions, which included beliefs towards the nature of mathematics, the individual's self, teaching, and social issues. This categorization is due to the vague nature of the concept of mathematical beliefs, which is why mathematical beliefs are examined in different categories, as mentioned above.

Several adaptation works have been carried out in the existing literature to ascertain beliefs towards mathematics, mostly focusing on pre-service teachers and students, and categorizing mathematical beliefs into three or four categories (Ernest, 1989; Kayan et al., 2013; Pajares, 1992; Raymond, 1997). One notable adaptation study in this regard is Aydın's (2014) adaptation of the mathematical beliefs scale for the international TEDS-M study, focusing on a sample group of prospective primary school teachers. Hacıömeroğlu (2012) conducted an adaptation study of the MBS, which was originally designed by Peterson et al. (1989), to the Turkish context. This adaptation aimed to measure the beliefs of prospective teachers towards mathematics. The purpose of this adaptation was to measure the beliefs of prospective teachers regarding mathematics. Furthermore, Delice et al. (2016) performed an adaptation of the belief scale originally created by Kloosterman and Stage (1992) into Turkish. This adaptation aimed to measure the beliefs of high school students regarding mathematics. However, in the literature review, no current mathematical beliefs scale for Turkish mathematics teachers was found, including their beliefs about teacher and student roles that can only be applied to teachers working in schools. Thus, there is a requirement to adapt a scale that is both valid and reliable so as to assess mathematical beliefs encompassing the nature of mathematics, mathematics teaching and learning, as well as the roles of students and teachers, as proposed by Xie and Cai (2021), for Turkish teachers. The objective of the study is to adapt the mathematics teachers' belief scale (MTBS) developed by Xie and Cai in 2021 to Turkish language, consolidating five distinct beliefs within a single scale, and providing a reliable measurement tool for future research in the field. Moreover, after the adaptation study, this research aims to investigate the variations in mathematical beliefs amongst mathematics teachers in relation to gender and years of teaching experience.

2. Method

In this study, the intention is to adapt a measurement, which has undergone validity and reliability processes in international literature, into Turkish. To achieve this goal, the survey model, a quantitative research method, has been selected. This model allows for the identification of inclinations, attitudes or ideas of a group of people by examining sample of it (Creswell, 2014). To adapt the mathematics teachers' belief scale designed by Xie and Cai (2021) into Turkish, the study group should encompass diversity in relation to gender and years of teaching experiences. Therefore, the selection criteria of the study group were discussed in this study, which also analyzed the changes in mathematical beliefs according to demographic variables.

2.1. Participants

The study group of this study comprises mathematics teachers employed in various regions of Turkey. The study included mathematics teachers who voluntarily participated in the research. First, an adaptation study of the measurement was conducted, and then the Turkish form of this tool and the personal information form were applied together. In this context, the adapted scale was utilized to identify the mathematical beliefs of mathematics teachers in terms of gender and years of teaching. During the scale adaptation process, careful consideration was given to the number of items included in the scale. The sample size was determined based on Büyüköztürk's (2018) recommendation of selecting a sample that is at least five times larger than the scale items, and the acceptable sample size threshold for factor analysis was set at 200 participants (Barrett, 2007). In this context, the adapted scale comprised 26 items, and it was administered to a total of 259 voluntary mathematics teachers. Table 1 presents the demographic information statistics of the participating mathematics teachers, revealing that 70% of the study group comprised female teachers, and a majority of the teachers (56%) had 1-5 years of teaching experience.

Table 1
Demographic information of mathematics teachers

Demographic Information	*f*	%
Gender		
Male	180	70
Female	79	30
Years of Teaching		
1-5 years	139	56
6-10 years	59	21
Over 11 years	61	23

2.2. Ethics

The study adhered to all the regulations and guidelines outlined in the "Research and Publication Ethics Document" throughout the entire process, including the planning, implementation, data collection, and analysis phases. During the writing process of this study, scientific, ethical, and citation rules were adhered to, the collected data was not tampered with, and this study has not been submitted for evaluation to any other academic publication. Prior to using the scale adapted by Xie and Cai (2021) as permission was obtained from the authors of the data collection tool used in this research. Participants were chosen based on their voluntary participation. The study received ethical approval from the Ethical Review Board [Report No: E-18457941-050.99-87547].

2.3. Instruments

Two data collection tools were utilized in this study to focus on the research questions. The first tool employed was the translated version of the "Mathematics Teachers' Belief Scale" into Turkish. The second tool utilized in this study was a personal information form, designed to collect data on the gender and teaching years of mathematics teachers. The objective of including this form was to investigate whether there are any variations in mathematical beliefs based on these demographic variables. The MTSB and the personal information form are described in more detail below.

2.3.1. Mathematics Teachers' Beliefs Scale

The original version of the MTBS was developed in Chinese and later culturally adapted to English by Xie and Cai (2021). The results of the exploratory factor analysis (EFA) provided evidence for the reliability and construct validity of the scale. The Kaiser-Meyer-Olkin (KMO) value improved from 0.769 to 0.867, indicating a higher level of sampling adequacy for factor analysis. Additionally, the cumulative explanation of variance rates increased from 37.682% to 54.694%, suggesting that the extracted factors accounted for a significant portion of the total variance in the scale. These findings support the robustness and validity of the adapted scale in assessing mathematical beliefs. The scale comprises 26 items and is organized into five dimensions: belief in the nature of mathematics, learning, teaching, students, and teacher.

The MTBS utilizes a four-point Likert scale, where respondents indicate their agreement level on a range from 1 (strongly disagree) to 4 (strongly agree). One item in the scale is reverse-coded, meaning that higher scores on that particular item indicate lower levels of agreement. To obtain the belief score for each participant, the item scores are summed. The total possible score on the scale ranges from 26 to 104, with higher scores reflecting higher levels of mathematical beliefs. The Personal Information Form includes two sections: gender and years of experience. Gender information is collected using categories of "female" or "male" and Years of experience are divided into three groups: 1-5 years, 6-10 years, and 11 or more years. These demographic variables provide additional insights into the participants' characteristics and allow for the examination of potential differences in mathematical beliefs based on gender and teaching experience.

2.4. Data Collection Process

The MTBS was adapted to Turkish after obtaining permission from the researchers who had previously adapted it to English. The translation process involved a three-person commission comprising two field experts and one language expert who worked independently and later discussed the translation items in meetings. After the third meeting cycle, there were no items left unresolved in the translation. The scale items were then checked by a Turkish educator, and suggestions were incorporated to ensure accuracy. However, to increase the quality of the translation, back translation was conducted to reveal unexpected meanings or differences in the translated scale (Guillemin et al., 1993; Leplege & Verdier, 1995). The translated items were re-translated into English, and the translation was carried out by a professional translator who had a doctorate in English education from the UK and was fluent in both Turkish and English cultures. Consistency amongst the Turkish and English translated forms was then compared. However, due to the translator's lack of knowledge of the original English version of the scale and the theoretical framework of the research, some differences emerged between the original scale and its back-translation. For instance, item 25 in the original scale was translated as "Each mathematics teacher has his or her own teaching style", but the back-translation rendered it as "Every teacher has their own teaching style". This discrepancy prompted the field experts and linguists to revise the translation to better reflect the original scale's intended meaning. In this case, subject matter experts and language experts have reviewed the Turkish translation again. Indeed, these differences may arise from cultural differences between the translators and the scale developers, as well as the fact that not every word used in English has an exact equivalent in Turkish, or some words may have multiple meanings (Basım & Şeşen, 2006). To ensure the accuracy and equivalence of the Turkish translation, the translation differences were carefully addressed by a language validation commission. The goal was to ensure that the Turkish version of the scale effectively captured the same meaning as the original scale. The commission conducted a thorough review of the translation, taking into consideration linguistic nuances and cultural appropriateness. Any discrepancies or ambiguities in the translation were identified and addressed to ensure the clarity and integrity of the instrument. Additionally, the final Turkish version of the scale underwent grammar checks and received input from field experts who were knowledgeable in the area of mathematics education. Their contributions helped refine and validate the translation, ensuring that it accurately reflected the intended constructs and maintained its validity and reliability.

In the subsequent phase of the research, the adapted scale was administered to a second study group, which comprised 259 mathematics teachers who willingly participated in the study. To enhance accessibility and reach a wider range of participants, the items were presented to the study group using an online platform, specifically a Google form. After collecting the responses, the obtained dataset underwent various analyses to evaluate the validity and reliability of the scale. These analyses aimed to confirm that the scale precisely measured the intended constructs and produced consistent results. By conducting these rigorous statistical analyses, the researchers were able to determine the final form of the tool, which was deemed valid and reliable for measuring mathematical beliefs among the target population of mathematics teachers.

2.5. Data Analysis

The research data analysis followed a systematic approach suitable for a scale adaptation study. The Confirmatory Factor Analysis (CFA) test was executed through the AMOS program to assess the compatibility of the factor structure obtained. To ascertain the reliability coefficient of the confirmed factor structure, the internal consistency test of Cronbach alpha was conducted using the SPSS program.

To evaluate the data obtained from the adapted scale, a statistical significance level of 0.05 was used. Initially, normality tests were conducted to examine the distribution of mathematical beliefs scores among the participating teachers and to identify any significant differences between groups based on demographic characteristics. The Kolmogorov-Smirnov test results indicated that the scores gathered from the MTBS did not follow a normal distribution ($p < .05$). Therefore, non-parametric tests were employed to analyze the data instead.

3. Results

In this part, we provide a detailed account of the process involved in adapting the MTBS to Turkish, along with an overview of the adapted scale. We also present the research findings pertaining to the mathematical beliefs of mathematics teachers with respect to gender and years of teaching experience.

3.1. Findings for Scale Adaptation

3.1.1. Confirmatory factor analysis (CFA) results

The CFA was employed to test the MTBS. Prior to conducting the analysis, the dataset underwent examination to ensure that outliers, missing data, and normality were checked. The results indicated that items M4, ML5, MT2, MT5, and MT6 were significant. However, a significant t-value could not be obtained for item MT7 and the error variance for this item was determined to be high (0.99). The findings regarding CFA are presented in Appendix 1. In other words, the findings of the confirmatory factor analysis for the 26-item version of the scale are provided in the appendix. The removal of six items (M4, ML5, MT2, MT5, MT6, MT7) from the scale was due to the very low standardized regression coefficients, that is to say, factor loading values. It should be noted that each item should have a factor loading value of.30 or higher (Seçer, 2015). However, the factor loading values of the mentioned items are below .1. Moreover, in the analysis that included all items, it was found that some fit indices (RMSEA= .054, CFI= .0788, GFI= .0.862, AGFI = .833, and RMR= .086) fell below the excellent fit criterion of .90. Based on the improvements in the factor loading values and fit indices after the removal of the items, it was decided to exclude them from the analysis. Following this, the fit statistics and modification index were examined to evaluate the appropriateness of the factor structure. The model, as described in CFA, is illustrated in Figure 1.
After testing the model with CFA, the fit indices were examined. The research findings revealed that the Chi-Square value (χ^2/df = 1.484 N=259, $p < .001$) was significant. The fit index values were RMSEA=0.043, CFI=0.913, GFI=0.918, AGFI=0.893, and RMR=0.063. Table 2 presents the fit indices calculated by CFA for the MTBS, along with the indices accepted in the related literature.

The adequacy of the model presented in Table 2 was examined by evaluating the fit indices, and it was found that χ^2/df, RMSEA, CFI, and GFI values showed excellent fit, while AGFI and RMR values were within acceptable limits.

Figure 1
CFA Results for the Five-Factor Model

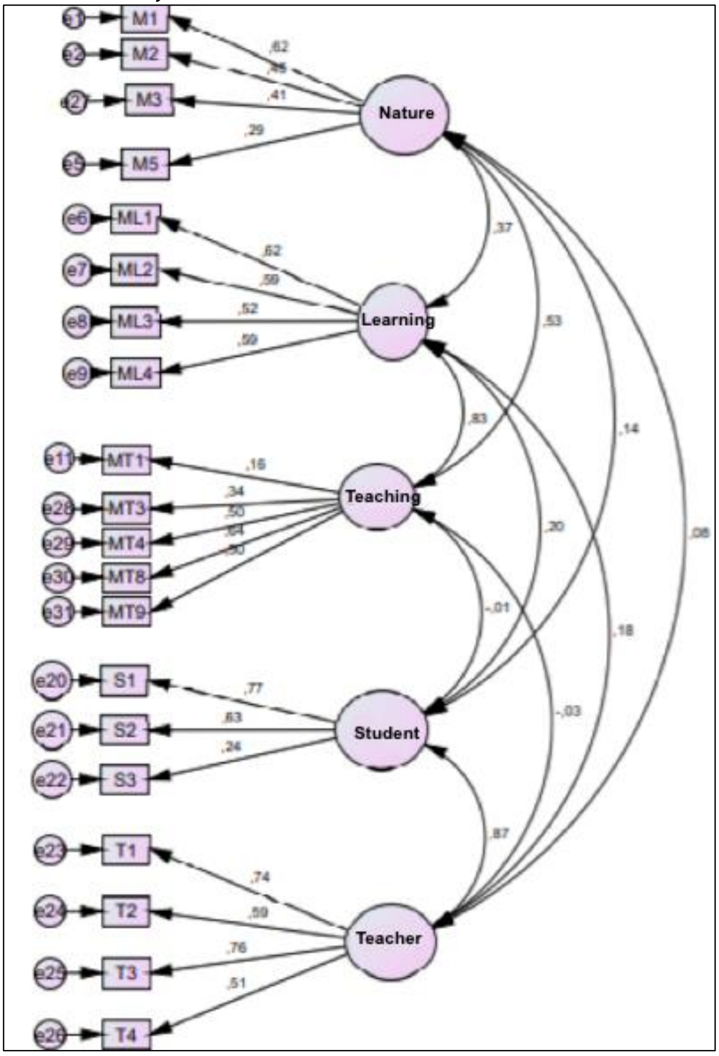

Table 2
Fit index values of the MTBS and acceptance limits of the fit indices

Fit Index Values	*Acceptable fit*	*References*
χ^2/df	1.484	$\chi^2/df \leq 3$ (Bollen, 1989)
RMSEA	0.043	≤ .050 (Marcholudis & Scumacher, 2001)
CFI	0.913	≥ .90 (Marcholudis & Scumacher, 2001)
GFI	0.918	≥ . 90 (Hu & Bentler, 1995)
AGFI	0.893	≥ . 90 (Hu & Bentler, 1995)
RMR	0.063	.080 and < .08 (Marcholudis & Scumacher, 2001)

3.1.2. Reliability Analysis Results

The reliability of the MTBS was determined by computing Cronbach's alpha score (α), which was found to be 0.72. According to Alpar (2018), the adapted/developed measurement tool is considered highly reliable when the α is between 0.69 and 0.79. In addition, Seçer (2015) argues that in scale studies, the α should be above 0.70. The Cronbach's alpha values for the sub-dimensions of the scale range from 0.46 to 0.72. For example, the Cronbach's alpha value for the nature of mathematics is 0.46, for learning is 0.66, for teaching is 0.49, for student is 0.46, and for teacher is 0.72 (Alpar, 2018; Seçer, 2015). As seen, the reliability values of some sub-dimensions are low. However, the reliability values for the sub-dimensions of the adapted scale (Xie & Cai, 2021) range between 0.56 and 0.85.

3.2. Findings Regarding Gender and Years of Teaching

Table 3 presents the findings from the Mann-Whitney U-test and Kruskal-Wallis test conducted to examine potential differences in mathematical beliefs of mathematics teachers based on gender and years of teaching variables.

Table 3
Mann Whitney U-Test comparison results by gender

Group	*N*	*Rank Average*	*Rank Sum*	*U*	*p*
Female	180	131.44	23608.50	6851.500	.641
Male	79	126.73	10011.50		

As shown in Table 3, although the mathematical belief scores of female teachers are slightly higher, no statistically significant difference was found in the mathematical beliefs of teachers according to gender. Table 4 presents the findings of the analysis of mathematical beliefs of teachers based on their years of teaching. It is found that the mathematical belief scores of teachers with 6-10 and 11 and over years of teaching experiences are higher than those of teachers with 1-5 years of teaching. This finding is noteworthy, as the number of participating teachers with 1-5 years of teaching is higher, but their level of mathematical belief scores is lower. However, when examining Table 4, it is evident that the mathematical belief scores of teachers do not vary significantly based on their years of teaching.

Table 4
Kruskal Wallis Test comparison results by years of teaching

Years	*n*	*Rank Average*	*df*	χ^2	*p*
1-5	139	119.55	2	5.802	.055
6-10	59	143.82			
Over 11	61	140.20			

4. Discussion

Effective mathematics teaching involves not only cognitive factors such as technological knowledge, pedagogical knowledge, or content knowledge, but also affective factors. The importance of affective domains such as conceptions, attitudes, and self-efficacy in mathematics education cannot be overstated. Research has shown that these factors significantly influence students' learning outcomes and teachers' instructional practices (Pajares, 1992). Therefore, understanding teachers' beliefs and attitudes towards mathematics is crucial for promoting effective mathematics teaching. This study indicates that the Turkish version of the MTBS is a valid and reliable measurement tool to assess mathematics teachers' beliefs. The instrument is a useful tool for assessing teachers' beliefs in a multidimensional structure specific to the subject area of mathematics. The multidimensional structure of the MTBS allows researchers to obtain a more comprehensive understanding of teachers' beliefs towards mathematics. For instance, the MTBS includes dimensions related to the nature of mathematics, learning mathematics, teaching mathematics, and beliefs towards students and teachers in mathematics. This comprehensive approach enables researchers to identify specific areas where teachers' beliefs may need to be addressed or changed to improve mathematics education. In this part, we will discuss the results related to the translation validity, construct validity, and internal consistency reliability analyses employed in the adaptation process. Additionally, we will examine the application findings and how the adapted scale differs according to demographic variables such as gender and teaching years, within the field of the relevant literature.

Based on the collected data, it was found that six items in the measurement exhibited lower validity and reliability and were subsequently removed. The final version of the MTBS comprised 20 items and demonstrated acceptable reliability, as indicated by a Cronbach's alpha score of 0.72. This indicates that the adapted MTBS is a reliable measure for assessing teachers' mathematical beliefs (Alpar, 2018). The adaptation of the MTBS to the Turkish context is expected to provide valuable data concerning the beliefs of mathematics teachers in five different dimensions, ranging from mathematical knowledge to classroom practice. The CFA analysis conducted to examine the construct validity of the MTBS revealed that the scale demonstrated a good fit. The obtained fit indices (χ^2/df =1.484; RMSEA=0.043; CFI=0.913, GFI=0.918, AGFI=0.893 and RMR=0.063) suggest that the fit of the model is very good (Bollen, 1989; Hu & Bentler, 1995; Marsholudis & Schumacher, 2001). Further research can utilize this scale to investigate various aspects of mathematics teaching and learning, and contribute to the existing literature by comparing the sub-dimensions of the scale with other affective characteristics, such as attitudes, anxiety, and motivation. Additionally, the adapted scale can be used to explore the beliefs of other subject teachers, such as primary school teachers or STEM major teachers, who use mathematics in their professional life. Such investigations can provide insights into the similarities and differences in beliefs and attitudes towards mathematics teaching and learning among different groups of teachers, and inform teacher education programs and professional development activities.

Furthermore, the results of the Mann-Whitney U-test and Kruskal-Wallis test indicated that there were no significant differences in mathematical beliefs among teachers according to gender and years of teaching, but there were some differences according to teaching experiences. In terms of gender differences, although no significant differences were found in mathematical beliefs among teachers, the results showed that the mathematical belief score values of females were slightly higher. While there may be some differences, the existing studies that are consistent with our study suggest that gender differences may not significantly impact teachers' mathematical beliefs (Li, 1999; 2004; Paksu, 2008; Uysal & Dede, 2021). According to Twohill et al. (2023), some differences arising from the gender variable were found to be in favor of female's mathematical beliefs, as in this adaptation study. This situation may be due to the gender role assigned to women in society.

The findings of the study revealed a significant difference in mathematical belief scores among teachers with different years of teaching experience. Specifically, teachers with 1-5 years of experience exhibited lower scores in mathematical beliefs compared to those with 6-10 years of experience and 11 years and above of teaching experience. This finding aligns with prior research conducted by Dede and Uysal (2012), which also indicated that teachers with more experience tend to hold more constructivist beliefs regarding mathematics education compared to their less experienced counterparts. It suggests that as teachers gain more teaching experience, they may develop a deeper understanding and appreciation for constructivist approaches in mathematics education. In his study on mathematical beliefs of beginning elementary teachers, Raymond (1997) found that teacher education programs influenced their beliefs. In this context, the fact that less experienced teachers have more beliefs similar to those found in this study suggests that the updated courses seen in teacher education programs compared to the past may be effective. This suggests that teachers' beliefs can evolve over time and be influenced by their experiences in the classroom. In addition to the teaching experience, socio-economic and academic characteristics of the schools (such as technical equipment, academic achievements of the students etc.) may also affect the teachers' mathematical beliefs, the future studies are needed that also address these parameters.

5. Conclusion and Recommendations

This paper examined the mathematical beliefs of teachers using the MTBS. The findings indicated that the scale had acceptable reliability and validity to measure the Turkish mathematics teachers' beliefs. Although there were no significant differences in mathematical beliefs according to gender, the mathematical belief score values of female teachers were slightly higher. Qualitative and quantitative studies can be conducted together to examine how mathematical beliefs of mathematics teachers change according to gender differences and the reasons behind these changes. Additionally, the results showed that teachers with 1-5 years of seniority had lower mathematical belief scores than teachers with more experience. Since the adapted scale has the potential to determine mathematics beliefs under five dimensions with a small number of items, it has the ease of application (the participants can respond in a short time without falling again), and for this reason, it can be preferred in future studies aiming to measure mathematics beliefs. In addition, in-service trainings that introduce constructivist understanding to highly experienced teachers can be provided, and mathematical beliefs can be examined using the adapted scale used in this study.

Based on the findings obtained in this study, it is recommended that future research endeavors focus on exploring the underlying reasons behind the observed variations in mathematical beliefs based on teachers' years of teaching experience. Understanding the factors that contribute to these differences can provide valuable insights into the professional development needs of mathematics teachers at different stages of their careers. Studies can be conducted comparing the mathematical beliefs and classroom performance of novice teachers with those of experienced teachers. Longitudinal studies could be conducted to explore changes in mathematical beliefs over time and the factors that contribute to these changes. This finding also implies the need for further investigation into the factors that influence gender differences in mathematical beliefs. This can inform the development of strategies to encourage more female students to pursue careers in mathematics and related fields. Finally, future research should also explore the relationship between teachers' mathematical beliefs and their teaching practices, as well as the impact of these beliefs on student learning outcomes.

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Appendix 1. CFA Findings