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Research Article

The Effect of Experiences of Comparing International Mathematics Curricula on Prospective Mathematics Teachers' Views on Primary Mathematics Curriculum

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Abstract – This research was conducted among prospective mathematics teachers during the 2023-2024 academic year at a university in the Central Anatolia Region of Türkiye. The study's primary objective was to investigate the impact of comparative experiences with international mathematics curricula on the perceptions and attitudes of prospective mathematics teachers towards the elementary mathematics curriculum in Türkiye. Specifically, the study aimed to explore how the experiences gained by prospective mathematics teachers through the examination of international mathematics curricula reflected their perceptions and attitudes towards their country's elementary mathematics curriculum. In the study, a one-group pretest-posttest experimental design was used and supported by interviews. The sample consisted of 10 prospective mathematics teachers enrolled in an elective course called "Comparison of Mathematics Teaching Programs." The findings indicate that the experience of analysing international mathematics curricula positively influenced the participants' perceptions and attitudes towards teaching programmes. Prospective teachers suggested improvements such as developing a curriculum closer to international standards, increasing student-centeredness, and diversifying assessment and evaluation methods. The results provide significant insights for developing elementary mathematics curricula and underscore the importance of integrating global perspectives into teacher education programs.

Keywords: Mathematics curriculum, preservice teachers, experimental design.

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Introduction

Mathematics education is a critical aspect of students' academic development, and the curriculum plays a vital role in shaping students' views and understandings of the subject (Wößmann, 2003). Experiences of comparing international mathematics curricula can profoundly impact individuals' views and perceptions of the mathematics curriculum. Comparing different international mathematics curricula can provide opportunities for teachers and educators to gain insights into other approaches, methods and content covered in mathematics education (Atweh & Clarkson, 2002). This can broaden their understanding of effective teaching strategies and help them reflect on the strengths and weaknesses of their curricula.

Furthermore, comparing international mathematics curricula can highlight areas where curricula may be lacking or improved (Tatto & Senk, 2011). By examining the similarities and differences between different curricula, educators can identify gaps or deficiencies in their curricula and try to address them (Atweh & Clarkson, 2002). Moreover, comparing international mathematics curricula can foster collaboration among mathematics educators. Teachers and educators can participate in discussions and exchanges with global colleagues to share experiences, exchange ideas and learn from each other's expertise. This collaboration can develop a more comprehensive and well-rounded mathematics curriculum incorporating best practices from different countries (Cai et al., 2017; Kaiser et al., 2002; Zhou et al., 2020). Overall, experiences comparing international mathematics curricula can have a transformative effect on individuals' views, leading to a deeper understanding of effective teaching methods and an awareness of areas for improvement in their curricula.

Consequently, experiences comparing international mathematics curricula have the potential to foster a collaborative and innovative ecosystem that crosses geographical boundaries and ultimately shapes the future of mathematics education. Furthermore, studying international mathematics curricula can challenge the notion of a global curriculum and instead encourage an international approach to curriculum reform (Atweh & Clarkson, 2002). As the global environment continues to evolve, the field of mathematics education faces new challenges and opportunities. The comparison of international mathematics curricula has emerged as an area of focus of interest for educators seeking to enrich teaching methods and enhance students' learning experiences.

General Overview of Countries' Mathematics Curricula

Mathematics curricula in different countries vary in structure, content and emphasis. Countries like the United States and China have curricula focusing more on computational skills and algorithms, while Finland and Singapore may prioritise problem-solving and critical thinking (Hjalmarson, 2008). Within these curricula, there are also different views on the role of play in mathematics education for young children. In Finland, for example, play is essential to early childhood mathematics education, enabling children to understand mathematical concepts through hands-on exploration (Peter-Koop & Scherer, 2012). In contrast, countries like Japan may have a more formal and structured approach to teaching mathematics at an early age.

A comparison of international mathematics curricula reveals various approaches and emphases. For example, while some countries, such as Japan and South Korea, emphasise rote learning and memorisation in mathematics education, others, like the United States and Finland, prioritise conceptual understanding and applying mathematical principles in the real world (Atweh & Clarkson, 2002). The use of technology in mathematics education also varies across countries. Some countries, such as Indonesia and China, emphasise using technology to understand and simulate abstract ideas in mathematics.

In addition to differences in content and teaching methodologies, the rigour and depth of mathematics curricula also vary from country to country. For example, countries like Singapore and South Korea introduce advanced mathematical concepts earlier, while the United States and Finland may adopt a more gradual and progressive approach to introducing complex topics (KERIS, 2020; Ministry of Education, Singapore, 2020; Nguyen et al., 2019; US Department of Education, 2010). Regarding teachers' readiness and competence in teaching mathematics, there are also different levels of training and preparation across countries. Nations like Japan and Germany have well-trained, confident educators who prioritise mathematics teaching (KMK, 2020; Ministry of Education, Culture, Sports, Science and Technology, Japan, 2020). In contrast, others may need more prepared educators and more confidence in effectively teaching the subject (Clark-Wilson et al., 2020).

Moreover, the role of technology in mathematics education varies across countries. For instance, countries like the United States and Singapore use technology and digital tools as integral components of their mathematics curricula. At the same time, Japan and Germany may maintain a more traditional approach based primarily on paper-and-pencil methods (Atteh et al., 2020). Overall, the mathematics curricula of different countries exhibit a variety

of techniques, ranging from play-based exploration to formal instruction and from an emphasis on rote memorisation to conceptual understanding and real-world application. It is important to note that each country's mathematics curriculum is shaped by cultural, educational, and societal factors specific to that country (Atteh et al., 2020; Zhang et al., 2018).

Recognising and understanding these differences is crucial to comprehensively understanding how mathematics is taught and learned worldwide. By acknowledging the diversity of approaches, educators and policymakers can draw inspiration from best practices in different countries to improve mathematics education in their education systems (Clark-Wilson et al., 2020; Zhang et al., 2018). Moreover, by building bridges between different approaches and experiences, teachers can promote equity and educational effectiveness in mathematics education. Mathematics education is complex and dynamic; technology integration is essential for successful teaching.

Aim of the Study

This study examines the effects of comparing international mathematics curricula on pre-service mathematics teachers' views of the primary mathematics curriculum and how these experiences change and shape their perceptions.

The problems of the study are as follows;

1. Do experiences comparing international mathematics curricula significantly change preservice mathematics teachers' views of the elementary mathematics curriculum?

2. How do experiences comparing international mathematics curricula shape preservice mathematics teachers' views of the primary mathematics curriculum?

This study aims to understand the effects of the experiences of comparing international mathematics curricula on preservice mathematics teachers' views of the primary mathematics curriculum. In other words, the study's primary purpose was to investigate how preservice mathematics teachers' experiences examining international mathematics syllabi reflected their perceptions of their home country's primary mathematics curriculum and how these experiences affected their attitudes towards the curriculum. For this purpose, an in-depth analysis of the participants' experiences evaluating international mathematics syllabi and the effects of these experiences on local mathematics curricula can be conducted.

Method

Research Design

This study used a one-group pretest-posttest experimental design with a combination of quantitative research methods to determine how the experiences of comparing mathematics curricula changed and shaped pre-service mathematics teachers' perceptions of the elementary mathematics curriculum. Interviews supported quantitative research findings. This design aims to provide a more detailed and comprehensive understanding of a phenomenon (Mills & Gay, 2016). With the one-group pretest-posttest experimental design, the statistical significance between the pre-test and post-test scores of the participant group will be determined with the opportunity to evaluate the effect of the application in a single group (Büyüköztürk et al., 2011). Although the one-group pretest-posttest experimental design is generally accepted as a weak design in research, it is considered a preference that should be used when a new training module is developed and implemented. In this study, explaining the cause-and-effect relationship between dependent and independent variables was preferred when a new training module was implemented and evaluated (Creswell, 2018).

In addition to quantitative data, interviews were conducted to obtain in-depth information. Interviews were collected to understand pre-service mathematics teachers' perceptions of the primary mathematics curriculum based on their experiences comparing mathematics curricula (Patton, 2014). In this way, a more holistic understanding of pre-service mathematics teachers' perceptions and experiences of the primary mathematics curriculum was attempted based on their experiences of comparing curricula.

Participants

The study's population is prospective mathematics teachers studying in Türkiye in the 2023-2024 academic year. Within this population, the sample consisted of 10 preservice mathematics teachers who took the elective course "Comparison of Mathematics Curricula" at a university in the Central Anatolia Region of Türkiye in the 2023-2024 academic year. Therefore, the study will focus on the experiences and perceptions of this sample of preservice mathematics teachers. The selection of this sample allows for an in-depth examination of a specific geographical and institutional context.

Material

The scale form described below and a semi-structured interview form prepared by the researcher will be used in the study.

Mathematics programme evaluation scale according to the expert-oriented programme evaluation approach (MPAS)

The Mathematics Curriculum Evaluation Scale, designed based on the expert-oriented curriculum evaluation model developed by Yıldız and Gürgen (2021), will be used in the study. In the process of creating the scale, a draft consisting of 65 items was prepared as a result of the literature review, and this draft was submitted to the evaluation of 4 experts specialised in the field of curriculum and measurement and assessment, as well as three classroom teachers. In line with the expert and teacher opinions, the draft was reduced to 40 items and transformed into a scale form using a 5-point Likert-type scale. The scale consists of 40 items, including the programme's objectives, topics, teaching-learning process and measurement-evaluation dimensions. Participants indicated their opinions by marking one of the options "Strongly Agree (5), Agree (4), Partially Agree (3), Disagree (2) and Strongly Disagree (1)" for each item. The scale's reliability was calculated using the Cronbach Alpha (.95) internal consistency coefficient, and reliability values were obtained separately for different sections. Cronbach Alpha internal consistency coefficient of the scale for this study was calculated as .89. At the beginning of the scale, general information about the purpose of the research and instructions for filling out the questionnaire were given. At the beginning of each section, specific explanatory statements were included. This structure was added to ensure the participants correctly understood and completed the scale.

Semi-structured interview form

The other data collection tools used in the study were the semi-structured interview form and the written opinions of the preservice teachers. The researchers prepared a semi-structured interview form that consisted of five questions. After the interviews with the preservice teachers, the participants submitted a written form to the researchers reflecting their general opinions about comparing mathematics curricula.

Data Collection

The relevant scales used in the study were collected from university students using a written form. In the interviews conducted using a semi-structured interview form, voice recordings were taken with the participant's consent. Afterwards, the voice recordings were converted into written text to prepare them for coding. The collected data were transferred to the computer environment and stored.

Data Analyses

Descriptive statistical analysis, t-tests and effect size calculations were used to analyse the quantitative data. Before statistical analysis, the data were checked for normality and descriptive statistics. The analysis of the interview recordings aimed to reveal the experience of comparing international mathematics curricula realistically and holistically based on pre-service mathematics teachers' perceptions. The participants were regarded as the data source, and the data obtained were organised, categorised and coded (Patton, 2014).

Validity and Reliability

Validity and reliability measures were taken within the scope of the research. The reliability coefficients of the data obtained from the scales were calculated. During the research process, the researcher, who is the instructor of the elective course, adopted the principle of moving away from his prejudices and preconceived ideas about international mathematics curricula. A neutral approach was adopted to prevent the prior knowledge obtained from the literature review from influencing the research.

Four independent coders participated in the data analysis and reached a consensus regarding the coding process. All statements were reviewed for accuracy. that would direct the participants were avoided during the interviews. The data were presented to the reader through direct quotations without adding comments. Relevant comments and harmful data were also presented. Therefore, reliability and validity measures were taken during the research process to ensure the qualitative data were analysed accurately and reliably.

Experimental Implementation Process

Comparison of Mathematics Curricula" elective course was conducted in a weekly 2-hour schedule for 14 weeks. In the first week of the course, an introduction was made to compare mathematics curricula, and information was given about the history and basic principles of different mathematics curricula. The (practical) applications began from the second week onwards, and examples from different mathematics curricula (Singapore, Finland, Japan, and the United States) were presented to the students. We examined these curricula each week by comparing them with the Turkish Mathematics Education Programme. We critically engaged with each country's programme through presentations, discussions, and Q&A activities. In Weeks 2 and 3, environments were created for students to do free work and exploration, and the characteristics of different mathematics curricula were focused on.

In weeks 4-13, the Ministry of National Education Primary 1-8. Grade Mathematics Curriculum (2018) was compared with the curricula of different countries, such as Singapore, Finland, Japan, and the United States. These countries were selected based on their success in international mathematics exams. The preservice teachers in the classroom presented the comparative studies and explained their similarities and differences with our mathematics curriculum. As a result of these comparisons, discussions were held on how to enrich our curriculum, and the strengths and weaknesses of different mathematics curricula were discussed. In the last week of the course, a general evaluation was made, and the knowledge and experiences gained by the students were reviewed.

Before the course, data were collected using the scales determined within the study's scope and a semi-structured interview form. The scales were administered on the 14th.

Findings

Findings Related to Quantitative Measurements

The central tendency measures, skewness, and kurtosis coefficients of the data obtained within the research scope were examined to check whether the data showed a normal distribution. It was accepted that the data showed a normal distribution. In addition, this acceptance was validated by testing with the Shapiro-Wilk test. The results obtained are presented in Table 1.

Table 1 Shapiro-Wilk Test Results of MPDS Scale Data

	Statistics	SD	p
MPDS scale	.989	9	.996

According to Table 1, the data obtained from the scales show a normal distribution ($p>0.05$). In this context, parametric tests were applied to the data. The study analysed whether there was a significant difference between the mean scores of both scales of the participants using the related sample t-test technique. The results are given in Table 2.

Table 2 Paired Sample T-test Results of Pre and Post-test Mean Scores of Preservice Teachers' MPDS Scale

		n	X	s	SD	t	p*
Attitudes towards the outcomes of primary mathematics curriculum	Pre-test	10	23.90	4.43	9	-3.713	.005
	Post-test	10	26.10	3.07			
Attitudes towards the content of primary mathematics curriculum	Pre-test	10	24.70	3.83	9	-2.496	.034
	Post-test	10	26.20	2.78			
Attitudes towards the learning-teaching processes of the primary mathematics curriculum	Pre-test	10	24.20	2.65	9	-4.392	.002
	Post-test	10	25.70	1.70			
Attitudes towards the measurement and evaluation dimension of the primary mathematics curriculum	Pre-test	10	23.30	2.40	9	-2.946	.016
	Post-test	10	25.10	2.55			
Attitudes towards primary mathematics curriculum	Pre-test	10	96.10	7.21	9	-7.826	.001
	Post-test	10	103.10	5.83			

*p<0.05

In a class of 10 students in which the effect of the "Comparison of Mathematics Curricula" course, which is based on the comparison of the mathematics curricula of the countries, on the attitudes of prospective mathematics teachers towards the primary mathematics curriculum was investigated, as a result of the t-test for related samples conducted to determine whether there was a difference between the mean scores of the attitudes towards the primary mathematics curriculum applied at the beginning and end of the course;

It was found that the difference between the mean score of the scale applied at the beginning of the course (pretest = 23.90). The mean score of the scale applied at the end of the course (post-test = 26.10) for the sub-dimension of attitudes towards the objectives of the elementary mathematics curriculum was significant [$t(9) = -3.713$, $p < 0.05$].

For the sub-dimension of attitudes towards the content of the elementary mathematics curriculum, the difference between the mean score of the scale applied at the beginning of the course (pretest = 24.70) and the mean score of the scale applied at the end of the course (post-test = 26.20) was found to be significant [$t(9) = -2.496$, $p < 0.05$].

It was determined that the difference between the mean score of the scale applied at the beginning of the course (pretest = 24.20) and the mean score of the scale applied at the end of the course (post-test = 25.70) for the attitudes towards the learning-teaching processes sub-dimension of the primary mathematics curriculum was significant [$t(9) = -4.392$, $p < 0.05$].

The difference between the mean scale score applied at the beginning of the course (pretest = 23.30) and the mean score of the scale used at the end of the course (post-test = 25.10) was found to be significant for the sub-dimension of attitudes towards the measurement and evaluation dimension of the primary mathematics curriculum [$t(9) = -2.946$, $p < 0.05$].

For attitudes towards elementary mathematics curriculum (the whole scale), the difference between the mean score of the scale applied at the beginning of the course (pretest = 96.10) and the mean score of the scale applied at the end of the course (post-test = 103.10) was found to be significant [$t(9) = -7.826$, $p < 0.05$].

However, according to Green and Salkind (2016), more than the presence or absence of a difference between two mean scores in the t-test for related samples is needed. Because this finding needs to inform us about the difference's magnitude, it is recommended to test statistical significance and give the effect size. In this context, effect sizes are reported in Table 3.

Table 3 Effect Sizes of Prospective Teachers on the MPDS Scale

	s	Cid low	Cid upper	d
Attitudes towards the outcomes of primary mathematics curriculum	1.87	1.974	.338	1.174
Attitudes towards the content of primary mathematics curriculum	1.90	1.490	.057	.789
Attitudes towards the learning-teaching processes of the primary mathematics curriculum	1.08	2.255	.486	1.389
Attitudes towards the measurement and evaluation dimension of the primary mathematics curriculum	1.93	1.665	.164	.932
attitudes towards primary mathematics curriculum	2.82	3.744	1.177	2.475

The effect size for attitudes towards the outcomes of the primary mathematics curriculum was calculated as d= 1.174. According to Cohen (2013) effect size classification, it is at a significant effect level. This shows that the "Comparison of Mathematics Curricula" course, based on comparing countries' mathematics curricula, significantly affects preservice mathematics teachers' attitudes towards the elementary mathematics curriculum.

The effect size for attitudes towards the content of the primary mathematics curriculum was calculated as d=.789. According to the effect size classification, it is at an average effect level (Cohen, 2013). This shows that the effect of the "Comparison of Mathematics Curricula"

course, based on comparing countries' mathematics curricula, on preservice mathematics teachers' attitudes towards the elementary mathematics curriculum is at a medium level.

The effect size of the elementary mathematics curriculum on attitudes towards learning-teaching processes was calculated as d= 1.389. According to the effect size classification, it is at a significant effect level (Cohen, 2013). This shows that the "Comparison of Mathematics Curricula" course, based on comparing countries' mathematics curricula, significantly affects preservice mathematics teachers' attitudes towards the elementary mathematics curriculum.

The effect size for the attitudes towards the measurement and evaluation dimension of the primary mathematics curriculum was calculated as d=.932. According to the effect size classification, it is at a significant effect level (Cohen, 2013). This shows that the "Comparison of Mathematics Curricula" course, based on comparing the mathematics curricula of countries, significantly affects preservice mathematics teachers' attitudes towards the elementary mathematics curriculum.

The effect size for attitudes towards the primary mathematics curriculum was d= 2.475. According to the effect size classification, it is at a significant effect level (Cohen, 2013). This shows that the "Comparison of Mathematics Curricula" course, based on comparing countries' mathematics curricula, significantly affects preservice mathematics teachers' attitudes towards the elementary mathematics curriculum.

Findings Related to Qualitative Measurements

Within the scope of the research, the changes experienced by preservice mathematics teachers during the "Comparison of Mathematics Curricula" course emerged as a 4-stage process. The process is shown in Figure 1.

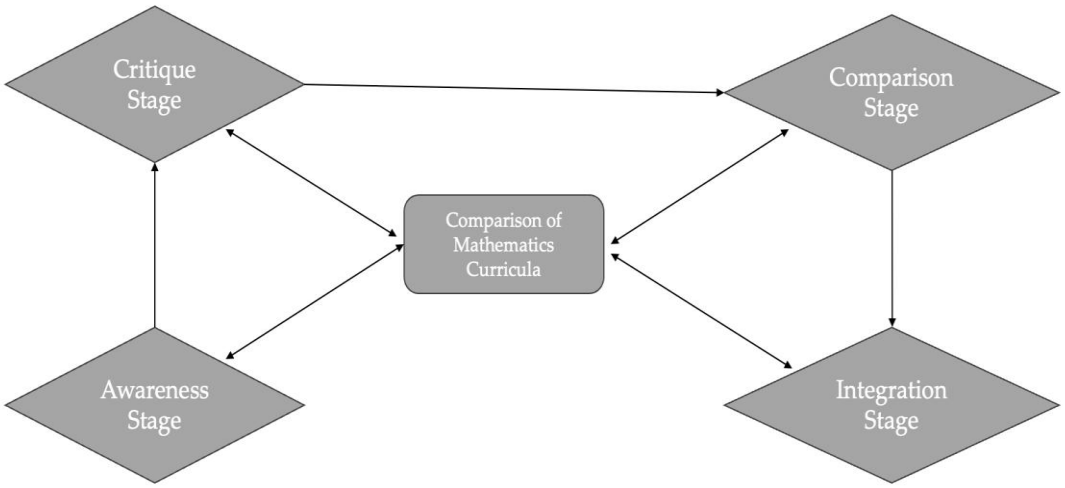

Figure 1 4-Stage Change Process

Phase 1: Awareness Phase

The preservice teachers are in the process of becoming more familiar with and aware of their own country's mathematics curriculum. At this stage, they discovered the characteristics and structures of their mathematics curriculum. The codes of this category are given in Table 4.

Table 4 Codes Related to Awareness Formed by Prospective Teachers' Examination of Mathematics Curriculum

Category	Codes
Awareness	Objectives
	Acquisitions
	Structure of the programme
	Implementation
	Distribution of learning areas according to classes
	Measurement and evaluation

It was understood that the participants needed to be aware of our primary mathematics curriculum before the implementation. It was seen that with the applied lesson, they gained ideas and information about the aims (f: 8), achievements (f: 9), structure (f: 8), implementation (f: 7), distribution of learning areas according to classes (f: 10), measurement and evaluation approaches (f: 8) of the primary mathematics curriculum in Türkiye. Sample participant opinions regarding this stage are as follows:

(K: 10): "Before the class, I had only heard the name of our mathematics programme, but the course made me understand the programme's purpose and what it aims to provide us." - A participant gaining awareness about its objectives.

(K: 5): "I used to know only the general framework of the programme; now I see how diverse and comprehensive the outcomes are." - Gaining detailed knowledge about the outcomes.

(K: 4): "I learned that assessment and evaluation techniques are not just limited to tests, but actually, a variety of more effective methods can be used to track students' development." - Gaining new perspectives on assessment and evaluation approaches.

Phase 2: Criticism Phase

Preservice teachers critically evaluate the mathematics curriculum of their own country. They identified shortcomings, strengths, difficulties in implementation and areas for improvement. The codes of this category are given in Table 5.

Table 5 Codes Related to the Criticism of Preservice Teachers by Examining Different Mathematics Curricula

Category	Codes
Criticism	Weaknesses
	Has its strengths
	Should be simplified
	Repeated acquisitions
	Level
	Difficult in practice
	Ignored individual differences

Participants started to express their criticisms by examining different mathematics curricula. In the course process, they criticised the Turkish elementary mathematics curriculum and the mathematics curricula of other countries together and emphasised that the curricula had weaknesses (f: 1), strengths (f: 9), needed to be simplified (f: 5), had repetitive acquisitions (f: 4), were level appropriate (f: 10), had difficulties in implementation (f: 2), and ignored individual differences (f: 4). Sample participant opinions regarding this stage are as follows:

(K: 1): "I noticed that some concepts are unnecessarily repeated across grades, which could be streamlined to make room for more diverse topics." - Addressing the issue of repetitive outcomes.

(K: 4): "The lack of consideration for individual differences in learning paces and styles is a significant oversight in these programmes. Each student's unique understanding should be addressed more explicitly." - Critiquing the programmes for overlooking individual differences.

(K: 6): "While the curriculum aims at a comprehensive education, the level of difficulty in some areas might not be suitable for all students, leading to potential challenges in classroom implementation." - Discussing level appropriateness and possible difficulties in application.

Phase 3: Comparison Phase

The preservice teachers examined different countries' mathematics curricula and compared them with their curricula. At this stage, they evaluated different approaches, teaching methods and objectives. The codes of this category are given in Table 6.

Table 6 Codes Related to the Comparison Made by Preservice Teachers by Examining Different Mathematics Curricula

Category	Codes
Comparison	Cultural differences reflected in teaching programmes
	Learning areas show differences
	Simplicity
	Acquisitions are distributed to different classes
	Different methods
	Differences in objectives and approaches

Participants made comparisons by examining different mathematics curricula. In the course process, they compared the Turkish elementary mathematics curriculum with the mathematics curricula of other countries and emphasised that cultural differences were reflected in the curricula (f: 8), differences in learning areas (f: 9), differences in terms of simplicity (f: 6), distribution of learning outcomes to different classes (f: 9), different methods (f: 10), differences in objectives and approaches (f: 7), and similarities (f: 10). Sample participant opinions regarding this stage are as follows:

(K:8): "Comparing the programme from Türkiye with those from other countries, it was exciting to see how each reflects its cultural values; for example, some programmes place a greater emphasis on collaboration and group work among students." - Reflecting on how cultural differences manifest in the programmes.

(K:2): "I noticed significant differences in the distribution of learning domains across different countries' mathematics programmes; some prioritise analytical thinking, while others highlight problem-solving skills." - Differences in learning domains.

(K:9): "Interestingly, the same outcomes are assigned to different programme grade levels. This might reflect varying understandings of when students are ready to learn these concepts." - Distribution of outcomes across different grades.

(K:10): "There are also big differences in the methods they use; some programmes rely more on visual and interactive tools, while others prefer traditional teaching methods." - Different methods contained within the programmes.

(K:1): "I observed that there are distinct differences in the objectives and approaches of each mathematics education programme; this diversity enriches the educational experience offered to students." - Differences in objectives and approaches.

Phase 4: Integration Phase

Preservice teachers come to the stage of integrating the knowledge and perspectives gained during the course into their teaching practice and using them in practice. At this stage, they adapted the features of different curricula to their curricula and developed a more effective curriculum. The codes of this category are given in Table 7.

Table 7 Codes Related to the Integration Realized by the Preservice Teachers' Examination of Different Mathematics Curricula

Category	Codes
Integration	By international standards
	Simplified
	Different approaches and methods
	Student-centred
	By the measurement and evaluation approaches of international exams

Participants examined different mathematics curricula and integrated them into their curriculum. During the course process, they recommended improving the Turkish primary mathematics curriculum. They offered integrated suggestions on increasing its compliance with international standards (f: 10), simplifying it (f: 10), including different approaches and methods (f: 10), increasing student-centeredness (f: 10), and making it suitable for the assessment and evaluation approaches of international exams (f: 10). Sample participant opinions regarding this stage are as follows:

(K:6): "I believe our programme should better align with international standards; this way, our students can gain a global perspective and become competitive worldwide." - Integration of recommendations to increase compliance with international standards.

(K:7): "I noticed that our mathematics education programme is overly complex and could be simplified to facilitate easier understanding for students." - Simplification of the programme.

(K:2): "We've realised the need to integrate various approaches and methods into our programme to cater to different learning styles. This can make it easier for each student to learn math in their own way." - Integration of recommendations to include different approaches and methods.

(K:5): "I want to emphasise the importance of a student-centred approach; having more interactive lessons and encouraging student participation can enhance their learning process." - Increase student-centeredness.

(K:9): "Aligning our mathematics programme with the assessment approaches of international exams could help our students perform better in these exams." - Integration of recommendations to align with the assessment approaches of international exams.

Results, Conclusions and Suggestions

This study, conducted with a one-group pretest-posttest experimental design, was supported by interviews and aimed to find more comprehensive and in-depth answers to the research questions. The results provide essential insights for evaluating and developing the primary mathematics curriculum.

Quantitative findings show that the "Comparison of Mathematics Curricula" course significantly impacted preservice mathematics teachers' attitudes towards the elementary mathematics curriculum. When these effects are examined in terms of the curriculum's objectives, content, learning-teaching processes and assessment and evaluation dimensions, it is understood that the course has a comprehensive effect on mathematics teaching. In particular, the high effect sizes of the curriculum on learning-teaching processes and general attitude indicate that significant improvements and changes can be made in these areas.

On the other hand, the interviews' findings reveal the pre-service teachers' in-depth views and experiences about the primary mathematics curricula. The participants' suggestions on how the curricula should better comply with international standards, be simplified, and include a variety of teaching methods and approaches indicate that the current curricula need to be improved. These suggestions emphasize the need to increase student-centeredness in mathematics teaching and to adopt assessment and evaluation approaches suitable for international exams.

The results show the significant impact of primary mathematics curricula on pre-service teachers' attitudes and how the current state of the curricula and potential areas for improvement are perceived from the participants' perspective. This bidirectional perspective provides a solid basis for maintaining the strengths of the programmes and making structured changes in areas that need improvement. Therefore, this study makes valuable contributions to a more effective and inclusive revision of primary mathematics curricula in terms of educational policies and practices.

The quantitative findings obtained in this study indicate that the course "Comparison of Mathematics Teaching Programmes" significantly impacts teacher candidates' attitudes towards primary school mathematics teaching programmes. The substantial effect size of

attitudes towards the teaching-learning processes and the overall programme is particularly noteworthy. This finding is consistent with previous research; for example, Tosuncu (2019) noted the significant effects of mathematics teaching programmes on the pedagogical content knowledge of teacher candidates. Additionally, these findings are in line with the emphasis in TIMSS (2019) and PISA (2018) reports on the critical role of programme quality and content on student achievement (Mullis et al., 2020; OECD, 2019). Furthermore, teachers' perspectives on curriculum are critical in implementing programmes and student achievement. A study by Swars et al. (2009) showed that teachers' positive attitudes towards mathematics teaching can significantly enhance students' mathematics achievement. These findings are consistent with the results obtained regarding the importance of teacher candidates' attitudes towards primary school mathematics teaching programmes in this study. Teachers' positive attitudes towards programmes can contribute to their more effective implementation and thus increase student achievement (Swars et al., 2009).

Moreover, Di Martino and Zan's (2010) research indicates that students' positive attitudes towards mathematics lessons positively affect mathematics achievement. The findings of this study suggest that recommendations such as simplifying curricula and increasing student-centeredness can improve students' attitudes towards mathematics learning. Adopting student-centred approaches can contribute to students developing positive attitudes towards mathematics learning, thereby enhancing their success (Di Martino & Zan, 2010).

The results of international assessment programmes such as TIMSS and PISA demonstrate that the quality of curriculum in mathematics education determines student achievement. For instance, countries like Singapore and Finland consistently achieve high levels of success due to their student-centred learning approaches and emphasis on critical thinking skills (OECD, 2019; Mullis et al., 2020). The findings of this study suggest that similar improvements in primary school mathematics teaching programmes in Türkiye could better align with international standards and enhance student achievements. Moreover, international assessment programmes like TIMSS and PISA reveal the global differences in mathematics education and their impact on student achievement. Particularly, students in Asian countries demonstrate high levels of achievement in mathematics, some of which can be attributed to the attitudes of students and teachers towards mathematics teaching programmes (Cai, 2004; Leung, 2002).

The findings obtained from the interviews provide suggestions for increasing the alignment of pre-service teachers with international standards, simplifying the curriculum

content and strengthening student-centredness in primary school mathematics teaching programmes. These suggestions align with the standards and recommendations published by NCTM (National Council of Teachers of Mathematics, 2020). NCTM emphasises the importance of student-centredness and problem-solving skills in mathematics education and states that the curricula of countries that perform well in international assessments have these characteristics.

Additionally, examining the mathematics curricula of other countries reveals different approaches and emphases. For instance, countries like Finland and Singapore achieve high success levels by emphasising student-centred learning approaches and critical thinking skills (Finnish National Agency for Education, 2014; Ministry of Education, Singapore, 2020). These countries also effectively use technology integration in education (Clark-Wilson et al., 2020). In countries like China, it is observed that focusing on mathematical problems from an early age and the beliefs of teachers are essential (Cai, 2004). These approaches suggest that countries like Türkiye should review their curricula and improve by examining international successes (Atweh & Clarkson, 2002; Tatto & Senk, 2011).

Furthermore, prospective teachers' examination of international mathematics curricula provides them with knowledge about various teaching methods and content, thereby presenting significant opportunities to improve their curricula further (Cai et al., 2017; Kaiser, 2002). Such comparative studies can also enhance educational collaborations and exchanges between countries, thus promoting the development of broader and more inclusive educational programmes (Zhou et al., 2020).

The findings of this study emphasise the need for the development of primary school mathematics curricula and the essential contributions that pre-service teachers can make in this process. Moreover, it is highlighted that curriculum alignment with international standards, student-centredness and diversity can increase students' mathematics achievement. Therefore, it is suggested that educational policies and practices should be shaped according to these findings. Attitudes towards mathematics curricula have essential effects at both teacher and student levels, and these attitudes can directly affect student achievement. Positive attitudes of teachers and students can contribute to more effective implementation of mathematics curricula and increase student achievement. Based on the research findings, the following suggestions can be made:

Develop education programmes that will improve teacher candidates' attitudes towards mathematics teaching programmes and equip them with knowledge about various teaching

methods. These programmes can inform teacher candidates about international mathematics teaching programmes and approaches, enabling them to diversify teaching methods and create student-centred learning environments.

Türkiye's current primary school mathematics teaching programmes should be reviewed and updated in light of international standards and indicators of success regarding their content, teaching-learning processes, and assessment approaches. The importance of student-centeredness and practical applications should be emphasised throughout this process.

Education collaboration should be established with countries ranking high in international achievement rankings. Teacher and student exchange programmes should be encouraged to facilitate the exchange of knowledge about different teaching approaches and educational systems.

Programmes for the continuous professional development of mathematics teachers should be created and promoted. These programmes should help teachers enhance their skills in utilising new teaching methods, assessment approaches, and technological tools.

Research on mathematics teaching and curriculum should be encouraged, and necessary resources should be provided to develop innovative approaches in this field. Integrating research findings into teaching practice will enhance the quality of mathematics education.

Compliance with Ethical Standards

Disclosure of potential conflicts of interest

No conflict of interest.

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CRediT author statement

The study was authored, and the whole process was carried out by the corresponding author.

Research involving Human Participants and/or Animals

The study involves human participants. Ethics committee permission (Date: 10.11.2023, Number: 11- 2023-524) was obtained from Necmettin Erbakan University, Social and Human Sciences Research Ethics Committee.

Uluslararası Matematik Öğretim Programlarını Karşılaştırma Deneyimlerinin Matematik Öğretmen Adaylarının İlköğretim Matematik Programına İlişkin Görüşlerine Etkisi

Özet:

Bu araştırma, 2023-2024 eğitim-öğretim yılında Türkiye'nin İç Anadolu Bölgesi'nde bir üniversitede matematik öğretmeni adayları arasında gerçekleştirilmiştir. Araştırmanın temel amacı, uluslararası matematik ders programlarının karşılaştırılması deneyimlerinin, matematik öğretmen adaylarının Türkiye'deki ilköğretim matematik öğretim programına ilişkin görüşlerine etkisini incelemektir. Özellikle, matematik öğretmen adaylarının uluslararası matematik ders programlarını inceleyerek elde ettikleri deneyimlerin, kendi ülkelerinin ilköğretim matematik öğretim programına yönelik algılarına ve tutumlarına nasıl yansıdığı araştırılmıştır. Araştırma, tek gruplu ön test son test bir yöntem kullanılarak tasarlanmıştır; nicel veriler görüşmelerle desteklenmiş ve analiz edilmiştir. Örneklem, "Matematik Öğretim Programlarının Karşılaştırılması" seçmeli dersini alan 10 matematik öğretmeni adayından oluşmaktadır. Bulgular, katılımcıların uluslararası matematik öğretim programlarını inceleme deneyimlerinin, öğretim programlarına yönelik algılarını ve tutumlarını olumlu yönde etkilediğini göstermektedir. Öğretmen adayları, uluslararası standartlara daha yakın bir program geliştirilmesi, öğrenci merkezliliğin artırılması, ölçme ve değerlendirme yöntemlerinin çeşitlendirilmesi gibi konularda önerilerde bulunmuştur. Araştırma sonuçları, ilköğretim matematik öğretim programlarının geliştirilmesi için önemli iç görüler sağlamaktadır ve öğretmen eğitimi programlarında uluslararası perspektiflerin entegre edilmesinin önemini vurgulamaktadır.

Anahtar kelimeler: Matematik öğretim programı, öğretmen adayları, deneysel desen.

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