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An Investigation of Mathematics Education Studies Conducted with Turkish Primary Teachers

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Abstract

The studies utilized with inservice and preservice primary teachers in the field of mathematics teaching are among the research areas that are important and will not lose their importance soon as the outcomes of these research areas are critical for teaching mathematics in primary education and restructuring teacher education programs. As the number of studies in this field conducted in recent years increases, the necessity of reference research that will guide future studies and evaluate the status of current ones comes to the front. Using the method of systematic reviewing, research studies on mathematics education, that are published in the journals indexed in ULAKBİM, conducted between 2010-2021 years, and conducted with in-service and preservice primary teachers in Turkey, were examined. A total of 100 research studies were analyzed by utilizing content analysis. All the studies were examined focusing on their research area, learning area, research method, data collection instruments, samples, sample size, and their data analysis methods. This study aimed to reveal the research trends in Turkey first. The secondary goal of the study is to guide the future research studies by revealing what is highlighted and missing in the field. Considering research results, researchers can expand and improve research in primary mathematics education.

Keywords: Primary teachers, preservice primary teachers, primary education, mathematics, mathematics education.

Türkiye'deki Sınıf Öğretmenleriyle Yapılan Matematik Eğitimi Çalışmalarının İncelenmesi

Öz

Matematik öğretmenliği alanında hizmet içi ve öğretmen adayları ile yapılan çalışmalar, önemli araştırma alanları arasındadır ve bu araştırma alanlarının çıktıları ilkokul matematik öğretimi ve öğretmenin eğitimi programlarının yeniden yapılandırılması için kritik olduğu için önemini kaybetmeyecektir. Bu alanda son yıllarda yapılan çalışmaların sayısı arttıkça, gelecekte yapılacak çalışmalara yön verecek ve mevcut olanların durumunu değerlendirecek referans araştırmaların gerekliliği ön plana çıkmaktadır. Sistematik inceleme yöntemi kullanılarak, Türkiye'de 2010-2021 yılları arasında ULAKBİM'de indekslenen dergilerde yayınlanan, matematik eğitimi ile ilgili hizmet içi ve öğretmen adayları ile yürütülen araştırmalar incelenmiştir. Toplam 100 araştırma çalışması içerik analizi kullanılarak analiz edilmiştir. Tüm çalışmalar öğrenme alanı, araştırma alanı, veri toplama araçları, araştırma yöntemi, örneklem büyüklüğü, örneklem ve veri analiz yöntemlerine odaklanarak incelenmiştir. Bu çalışma, öncelikle Türkiye'deki araştırma eğilimlerini ortaya koymayı amaçlamıştır. Çalışmanın ikincil amacı, alanda vurgulanan ve eksik olan yönleri ortaya çıkararak gelecek araştırmalara yön vermektir. Araştırma sonuçları dikkate alındığında, araştırmacılar ilköğretim matematik eğitiminde araştırmaları genişletebilir ve geliştirebilir.

Anahtar kelimeler: Sınıf öğretmenleri, sınıf öğretmeni adayları, matematik, matematik eğitimi

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INTRODUCTION

Content analysis studies are performed to reveal the themes mentioned and not referred to in the literature and to describe the profiles for the contents of these themes (Fraenkel and Wallen, 2000). These studies present important data for researchers and educators as they illustrate themes that are studied extensively or left incomplete. Content analysis studies help to systematize existing studies, which are essentially independent of each other, by establishing a relationship within the scope of their themes, methods, frameworks, and research questions dealt with. For content analysis studies to contribute to the field, the studied field should be reviewed regularly, and systematically, and its scope should be broadened and updated. Staton-Spicer and Wulff (1984) stated that the most appropriate way to define a field is to study research trends in that field. By examining the research studies conducted in any discipline, the research trends in that discipline can be determined. Lee, Wu, and Tsai (2009) indicated that analyzing the scientific studies on a topic can provide substantial information about the depth and extent of that topic and it unveil a panorama of the studied field. Studies conducted on research trends can be used to describe the past status of the discipline investigated or to predict the future status of the field.

Content analysis studies in Turkey differ in their fields and scopes. Several sub-disciplines in educational research have been reviewed (Çalık and Sözbilir, 2015) in these studies. Review of research on educational science (Erdem, 2011), research on educational technologies (Alper and Gülbahar, 2009; Küçük, Aydemir, Yıldırım, Arpacık, and Göktaş, 2013), research on science education and environmental education (Çalık, Ünal, Coştu, and Karataş, 2008; Erdoğan, Uşak, and Bahar, 2013; Sözbilir, Kutu, and Yaşar, 2012) has been conducted as content analysis studies. The scope of these studies has some similarities. Though the period of studies and databases that selected field of research studies published varied, there were commonalities in the methods of analysis of content. Years, designs of research, types of data collection methods and tools, samples and populations, types of data analysis methods, and the subject matters under the research fields are the common parameters focused on those studies.

In the field of mathematics education, though limited in number, there are some content analysis studies conducted in Turkey. In these studies, the mathematical education research studies published from 1987 to 2014 in journals in Turkey had been analyzed at various time intervals and with various dimensions. For example, Kayhan and Özgün-Koca (2004) examined the research done in mathematics education between 2000-2002. Their research samples consist of research articles on mathematics education in the Current Index to Journals in Education (CIJE) database, doctoral dissertations and master's thesis in the Dissertation Abstract database, and theses on mathematics education in the Turkish Higher Education Institution–Türkiye Yüksek Öğretim Kurumu (HEI-YÖK) database. According to the findings of this study, research articles in 2000-2002 were carried out mostly by focusing on cognitive aspects, subjects in the mathematics curriculum, and methods of teaching. In another study, Tatar and Tatar (2008) analyzed the articles published in Turkey on mathematics and science education descriptively. They explored the keywords of the 680 articles that were published in 26 refereed journals between 2000 and 2006. Researchers revealed that keywords specific to science and mathematics curriculum subjects had a low frequency of use. Besides, subjects in science and mathematics curriculum at the primary level were found less studied than those at the secondary and university level. It was also revealed that the researchers focused more on the misconceptions in the field of science education and attitude studies in the field of mathematics education. In another study, 129 articles on mathematics education published in four journals between 2000-2006 were analyzed by Ulutaş and Ubuz (2008). Based on their findings, much of the studies done in the field of mathematics education between 2000 and 2006 were conducted with elementary school students and preservice teachers as samples; and conducted on cognitive and affective dimensions, and teaching methods as research topics. It was determined that many of the investigated studies were experimental, done by using quantitative methods, used tests and questionnaires as data collection instruments, and conducted on the topics of numbers and geometry. And most of the publications were found to belong to the education faculty members of universities in the Central Anatolia Region. Another content analysis study with articles published in mathematics education by Turkish researchers conducted by Çiltaş, Güler, and Sözbilir (2012). Researchers examined a total of 359 articles on mathematics education published in 32 different international journals between 1987 and 2009. Result of their analysis indicated that there was an important increase in mathematics education research studies after 2002. Researchers also found that there was a dominance of quantitative methods in the field; learning studies

were indicated as the forefront research subject; use of a single data collection instrument was more prevalent and utilizing descriptive statistical techniques (percentage and frequency) stand out primarily.

Considering the studies conducted, it can be claimed that content analysis studies on mathematics education were not conducted in regular time intervals. With different research, trends in mathematics education until 2009 were investigated. Limited amount of research focused research after 2010. Moreover, existing studies are not consistent in the manner of analyzes conducted; the journals and themes focused on the studies seemed to differ from each other. Consequently, studies are inadequate in terms of describing general trends in mathematics education and its' change over the years and demonstrating a detailed analysis of specific areas (for example, primary teaching) in mathematics education studies conducted in Turkey. Additionally, existing studies suggested that more comprehensive studies should be done. Based on these premises, the present study intended to determine the research trends between 2010-2021 in mathematics education studies carried out with in-service and preservice primary teachers in Turkey. Many of the eligible studies conducted in Turkey were taken part in the journals indexed in the ULAKBİM database so that mathematics education research studies published in these journals were examined.

Research Questions

The followings are the research questions guiding this study.

1. How is the distribution of the studies according to learning areas?
2. In which research areas are the studies conducted frequently?
3. What are the research methods commonly used in the studies?
4. What are the data collection instruments frequently used in the studies?
5. What are the samples and sample sizes frequently used in the studies?
6. What are the methods for analysis data frequently used in the studies?

METHOD

The goal of this study is to investigate research studies in the field of mathematics education performed with in-service and preservice primary teachers. This study is a qualitative case study in nature. The study uses document analysis to identify relevant research studies and content analysis to identify themes and concepts covered in those studies. The mathematics education research studies conducted with Turkish primary teachers published in journals indexed in ULAKBIM database between 2010-to-2021 were identified and they constitute the data collection instrument of the present study.

Sample and Data Collection

For obtaining the research studies as samples for this study, the ULAKBİM database was used. The method of selection for the ULAKBİM database was purposive. Since this database contains quite a lot of research studies conducted by researchers in Turkey, it is convenient to use it to portray the status of research in the selected field. The ULAKBİM database was searched both in an inductive and deductive manner. First, a list of journals indexed in the database was attained. The journals in which an educational research study can be published were investigated. Then, journals were surveyed from 2010 to 2021. That is all issues of each journal published between 2010 to 2021 were examined one by one and article by article. The articles which were related to mathematics education and conducted with in-service or preservice primary teachers were selected and included in this study. Besides this deductive searching technique, an inductive searching technique was adapted, too. The keywords, such as 'teacher', 'primary school teacher', 'school mathematics', 'primary teacher', 'primary school', 'mathematics', 'education', 'mathematics education', 'mathematics teaching', 'mathematics learning', 'preservice teacher', in-service teacher', 'preservice primary teacher', 'in-service primary teacher' and 'teacher education' were determined. Each keyword and all combinations of keywords were used to search the ULAKBİM database. Using two searching techniques allows us to cross-check and not leave any related article outside of this study. A total of 100 mathematics education research articles, conducted with preservice and in-service primary teachers, published in 36 different journals were obtained (check Appendix for the list of articles). In Table 1, the frequencies of the distribution of the 100 articles for each year are given.

Table 1. Distribution of Articles

Year	# of Articles
2010	7
2011	12
2012	9
2013	14
2014	6
2015	17
2016	12
2017	9
2018	2
2019	6
2020	6

As presented in the Table 1, the highest number of related articles in the ULAKBIM database was published in 2015. The number of articles decreased gradually after this year. The least number of articles was published in 2018. The list of the articles is given in the appendix with references. In Table 2, journals names and the number of articles attained in each journal are presented.

Table 2. ULAKBIM Journal List

	Name of the journals	# of Articles
1.	"Abant İzzet Baysal University Journal of Faculty of Education"	4
2.	"Adıyaman University Journal of Educational Sciences"	1
3.	"Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi"	4
4.	"Mediterranean Journal of Educational Research (MJER)"	1
5.	"Bartın University Journal of Faculty of Education"	2
6.	"Bayburt Eğitim Fakültesi Dergisi"	2
7.	"Cumhuriyet International Journal of Education"	6
8.	"Dumlupınar University Journal of Social Sciences"	1
9.	"Ege Journal of Education"	3
10.	"Education and Science"	6
11.	"Journal of Education and Humanities: Theory and Practice"	1
12.	"Electronic Journal of Social Sciences"	2
13.	"Erzincan University Journal of Education Faculty (EUJEF)"	2
14.	"Gazi University Journal of Gazi Educational Faculty"	3
15.	"Gaziantep University Journal of Social Sciences (GAUN-JSS)"	2
16.	"Hacettepe University Journal of Education"	3
17.	"International Journal of Eurasia Social Sciences (IJOESS)"	3
18.	"Elementary Education Online"	4
19.	"Inonu University Journal of the Faculty of Education (INUJFE)"	2
20.	"Kastamonu Education Journal"	11
21.	"Journal of Theoretical Educational Science (JTES)"	4
22.	"Marmara University Atatürk Education Faculty Journal of Educational Sciences"	2

23.	"Mehmet Akif Ersoy University Journal of Education Faculty"	2
24.	"Mersin University Journal of The Faculty of Education"	2
25.	"Milli Eğitim Dergisi"	2
26.	"Mustafa Kemal University Journal of Social Sciences Institute"	2
27.	"Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education"	1
28.	"Ondokuz Mayıs University Journal of Education Faculty"	1
29.	"Pegem Journal of Education and Instruction"	2
30.	"Sakarya University Journal of Education"	1
31.	"The Journal of Turkish Educational Sciences"	3
32.	"Trakya Journal of Education"	1
33.	"Turkish Journal of Computer and Mathematics Education (TURCOMAT)"	8
34.	"Turkish Journal of Giftedness and Education (TJGE)"	1
35.	"Journal of Uludag University of Faculty of Education (JUUFE)"	3
36.	"International Journal of Curriculum and Instructional Studies (IJOCIS)"	2
	Total Number of Articles	100

Table 2 shows the journal names which were used during the content analysis. A total of 36 journals were searched and as a result, 100 articles which were published in these journals were determined and included for the analysis. The number of articles in each journal was between 1 and 11.

Data Analysis

In the process of data analysis, categorical analysis, which is one of the content analysis processes, was utilized. A form developed by Sözbilir et al. (2012) as Publishing Classification Form was used to analyze the research articles included in the study. The Publishing Classification Form has originally been developed to classify articles related to educational sciences and sub-domains. For this study, however, the form was revised for mathematics education research studies and used to classify 100 research articles performed with in-service and preservice primary teachers. Using the publication classification form for mathematics education studies, articles were classified according to their 'learning areas', 'research areas', 'research methods', 'data collection tools', 'samples and sample sizes', and 'data analysis methods'. Microsoft Excel program was used to organize the data obtained from the articles. Each article was investigated and coded separately by two researchers. The degree of agreement between the categories that each researcher identified for articles means that the inter-coder reliability (Miles & Huberman, 1994) of this study was 0.92. After the consensus was reached between differently coded categories, frequency and percentage tables were formed.

FINDINGS

The results obtained from the analysis of the 100 research articles published in 36 journals are presented in this study. Related articles were investigated in terms of their mathematics learning areas, research areas, research designs, data collection tools (instruments), sample and sample size, and data analysis methods. Results related to each of these domains are given in the following sections, respectively.

Learning Area and Research Area

100 research articles published in 36 journals are explored by learning areas. These learning areas are related to the Turkish National Mathematics Curriculum learning areas. The distribution of articles by learning areas is given below.

Table 3. Distribution of Articles by Learning Areas

Learning Area	# of Articles	(%)
Arithmetic	1	1
Geometry	15	14.9
Fractions	4	4
Numbers	2	2
Operations, Ratio-Proportion	4	4
Statistics and Probability	1	1
Graphs	1	1
Logic	1	1
Measurement	1	1
No Learning Area	71	70.3

According to the findings presented in the Table 3, 70.3 % (n = 60) of the studies examined did not address a mathematics learning field. When looking at the articles about a mathematics learning area, it is noteworthy that the number of articles about geometry (14.9 %) is more than other learning areas. The proportion of articles in other learning areas is very low, varying from 1 to 4 %. The distribution of the articles according to their research areas is given in Table 4.

Table 4. Article Distribution across the Research Areas

Research Areas	# of Articles	(%)
Subject Matter and Pedagogical Content Knowledge	24	22.9
Perception-View	29	27.6
Anxiety-Attitude-Belief	26	24.8
Mathematics Achievement-Knowledge – Ability	19	18.1
Scale Development	5	4.76
Teaching Practices	2	1.9

As indicated in the Table 4, six research areas were found as a result of analysis. The studies focus mostly on perception-view (27.6%) as a research area. This research area was followed by anxiety-attitude-belief (24.8%) and subject matter knowledge and pedagogical content knowledge (22.9%) areas.

Research Designs

In Table 5, The distribution of articles by their research designs is presented.

Table 5. Distribution of Articles According to Their Research Designs

Research Designs	# of Articles	(%)
Semi-Experimental Study	3	3
Phenomenology	6	6
Relational Survey	26	26
Content Analysis	12	12
Case Studies	22	22
Descriptive Survey	26	26
Factor Analyses	5	5

In line with the data obtained and presented in Table 5, it was revealed that many of the studies used non-experimental designs (97%). When the designs of the studies were analyzed, almost all the experimental studies were semi-experimental designs (weak experimental design) (3%), while in non-experimental studies the survey designs (52%) (Descriptive survey design 26%; relational survey design 26%) were used more than other designs.

Data Collection Tools

The distribution of articles in line with their data collection tools is given in Table 6 and Table 7.

Table 6. Distribution of Articles Using one or more Data Collection Tools

# of Data Collection Tools	Data Collection Tools	# of Articles	(%)
Articles using one data collection tool	Survey	28	58
	Interview	15	
	Test	15	
Articles using multiple data collection tools	Survey	29	42
	Interview	15	
	Test	12	
	Observation	5	

As indicated in Table 6, it was discovered that 58% of the research studies use only one data collection tool (instrument); mainly survey, interview, and test. 42% of the studies on the other hand use more than a single data collection tool (instrument) together. It should be noted that different than studies using one data collection tool, observation is used by studies using multiple data collection tools

Table 7. Article Distribution across the Data Collection Tools

Data Collection Tools	# of Articles	(%)
Survey	57	45.2
Interview	30	23.8
Test	26	20.6
Observation	5	3.9
Alternative measuring tools	8	6.3

As observed in the Table 7, the most preferred data collection tools by the research studies are survey (45.2%), interview (23.8%), and test (20.6%), respectively. While alternative measurement tools (such as diary, picture, concept map, field notes, lesson plan, reflective report, etc.) were used in 9.3% of studies, the least used data collection tool was observation (5.8%).

Sample and Sample Size

The distribution of articles along with the sample is given in Table 8.

Table 8. Article Distribution across Sample

Sample	# of Articles	(%)
Preservice Primary Teachers and Primary Teachers	2	2
Primary Teachers	28	28
Preservice Primary Teachers	70	70

The findings as presented in Table 8 show that research studies were mostly conducted with preservice primary teachers (70%). While studies involving primary teachers constitute nearly one-fourth of the studies (28%), studies

involving both groups (2%) are quite rare. Table 9 shows the distribution of the articles according to their sample size.

Table 9. Distribution of Articles by Their Sample Size

Sample Size	# of Articles	(%)
From 1 to 10	13	13
Between 11-30	11	11
Between 31-100	21	21
From 101 to 300	39	39
Between 301-1000	14	14
Over 1000	2	2

Table 9 indicates the sample size of the research studies. It was exposed that the most preferred sample size was a group of 101-300 participants (39%). This sample size was followed by studies in which 31-100 (21%) and 301-100 (14%) participants were included. It was observed that very large sample sizes (2%) were avoided while very small sample groups were 13% in sample selection.

Data Analysis Methods

Distribution of articles concerning their research method is given in Table 10.

Table 10. Article Distribution concerning Data Analysis Method

Data Analysis Method	# of Articles	(%)
Quantitative	53	53
Qualitative	42	42
Mixed	5	5

As presented in Table 10, it was revealed that in the data analysis of the studies examined quantitative methods were used in 53% of and qualitative methods were used in 42% of the articles according to the results of the analysis. Articles using mixed methods were very low (5%).

DISCUSSION AND CONCLUSION

Research trends between 2010-2021 in mathematics education studies carried out with in-service and preservice primary teachers in Turkey were aimed to investigate in this study. For this content analysis of related research articles obtained from the ULAKBİM database was carried out focusing on learning areas, research areas, research designs, data collection instruments, samples and sample size, and data analysis methods.

Within the scope of this research, firstly, the distribution of the studies according to their learning areas was investigated. The results showed that no learning area has been targeted in most of the research studies on mathematics education conducted with preservice and in-service primary teachers. In studies where a learning area is specified, geometry, as a learning area comes to the forefront. However, articles in other learning areas were inadequate. Similarly, in Ulutaş and Ubuz (2008)'s study investigating the research trends and tendencies in mathematics education, numbers and geometry was found as learning areas that many research studies were focused on. They stated that studies on other subjects were quite insufficient. The results reached about learning areas in this research have similarities with Çiltaş, Güler, and Sözbilir (2012)'s study. They found that subject-based studies were few (Çiltaş, et al., 2012).

In addition to their learning areas, it was unveiled that the studies were conducted mostly with the preservice teachers. This result is quite consistent with the results of the study conducted by Çiltaş et al. (2012). Also, this result supports the findings of the research made by Lubiensky and Bowen (2000). In both research, the main factor in conducting mathematics education studies mostly with preservice teachers was explained in such a way

that the researchers mostly work in universities, and it is easy to reach preservice samples as a convenient sampling methodology.

When looking at the distribution of the research methods utilized in the articles, the general trend was toward the use of non-experimental research designs. While the most prominent methods among these were descriptive and relational surveys, the case study design was also observed to be widely used in the research studies. Additionally, quantitative analysis methods were mostly conducted while the use of mixed methods (quantitative and qualitative together) were very rare. These results are consistent with the results proposed in the other studies. Çiltaş et al. (2012) stated that quantitative methods (59.6%) were used more than qualitative methods (35.1%) followed, and mixed studies were very rarely. Moreover, Ulutaş and Ubuz (2008) determined that many of the studies published similarly are quantitative studies. Hart, Smith, Swars, and Smith (2009), on the other hand, reached a different conclusion in their study examining the methods in the research studies conducted until 2005. Researchers stated that approximately half of the studies were built on the qualitative research design and the most used research pattern after qualitative research is mixed designs, not quantitative. In other words, contrary to studies in Turkey, mixed patterns and qualitative studies are given more importance in international literature, while quantitative methods are mostly used in studies in Turkey.

Besides the data analysis method of the studies, data collection tools were also examined. According to the results obtained, surveys were used more than other data collection tools. In addition to surveys, interviews and tests were frequently used in studies as the main data collection tools. On the other hand, alternative assessment tools were less used. Also, the distribution of data collection methods of the studies is another dimension examined. Results showed that more than half of the research studies rely on only a single data collection instrument.

In conclusion, the present study was conducted to investigate the trends in the field of mathematics education research focusing on inservice and preservice primary teachers in Turkey between 2010 and 2021. As stated at the beginning, content analysis studies portray the themes mentioned and those remain missing in the literature. This research highlighted that mathematics education research studies in Turkey, conducted with preservice and inservice primary mathematics teachers are surveyed studies and half of them were descriptive. As revealed, these studies generally used preservice teachers as samples, conducted with a sample size of 101-to-300 participants. Additionally, studies specific to a learning area were very rare. Research areas such as “perception-view” and “anxiety-attitude” constituted more than half of the existing studies. Moreover, in more than half of the studies, single data collection instrument (mostly surveys), and quantitative data analysis methods were utilized.

With these results in hand, several recommendations for future research studies can be made. First, more studies conducted with in-service teachers are needed. Also, the dominance of non-experimental study designs put forward a necessity for experimental design studies in the field. Besides these, studies conducted with larger sample sizes would be designed. Another important suggestion can be made on the teachers’ classroom practice which is a research area very much neglected in previous studies. More studies are needed on in-service primary teachers’ classroom practice and future studies should focus more on this area.

Statements of Publication Ethics

The authors declare that they obey the principles of publication ethics. Since this study involves open-access journals in the ULAKBİM database, Ethics Committee approval is not required.

Researchers’ Contribution Rate

Researchers’ Contribution Rate

Authors	Literature review	Method	Data Collection and Analysis	Results	Conclusion	Translating English	Editing English version
Author 1	☒	☒	☒	☒	☒	☐	☒
Author 2	☐	☒	☒	☐	☐	☒	☒

Conflict of Interest

The authors declare that they have no conflicts of interest.

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APPENDIX

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