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INVESTIGATION OF GRADUATE STUDIES ON THE USE OF ORIGAMI IN MATHEMATICS

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Abstract

The aim of this study is to examine graduate studies on the use of origami in mathematics. Document analysis method was used to examine the graduate studies included in the study. While collecting the data, the thesis classification form developed by Ceylan and Bozkurt (2023) was used. The data were collected from the Council of Higher Education Thesis Documentation system. Criterion sampling was used in the study. Twenty postgraduate studies examined with certain criteria were reached. The data were analyzed using content analysis. Percentage and frequency calculations were made in the study. When the results of the study were examined, it was seen that the most common theme in the studies was the effect of origami on certain variables, the year was 2012, the type of research was master's thesis, and the university where the postgraduate studies were conducted was Ondokuz Mayis University. Methodologically, it is seen that quantitative methods, experimental designs, random sampling, secondary school student sample group, sample size between 1-50, test and personal information form data collection tools, descriptive statistics and parametric test data analysis were mostly used.

Keywords: *Origami, Mathematics, Graduate Studies*

Introduction

Innovations and developments in every field also manifest themselves in education. Education has an important impact on the emergence of these innovations and developments. Various changes in understanding have occurred in education, which affects innovations and developments in society and is also affected by these changes. As a result of these changes, the validity of the rote learning approach has ended (Aykac & Kogce, 2019). Education is now provided not only for knowing but also for feeling and action (MoNE, 2018). This change in understanding in education has also manifested itself in mathematics teaching. These changes are reflected in the mathematics curriculum. When the mathematics curriculum is examined, it is aimed for students to use their individual thoughts in problem solving and reasoning, to develop mathematical literacy, to develop estimation skills and mental processing skills, to express concepts with different representation forms, and to develop metacognitive knowledge. In addition, it is also aimed that students' attitudes towards mathematics become positive,

that they see mathematics as a common value belonging to humanity, and that they understand the relationships of objects with themselves and with people (MoNE, 2018).

Origami is an art and activity that develops spatial ability. Origami activities contribute to the individual in many areas such as developing creativity, developing finger muscle skills, providing hand-eye coordination, developing logical-mathematical thinking ability, developing cooperative learning skills, creating products and revealing the pleasure of success, creating group awareness, and developing a sense of patience. One of the most important problems of the 21st century is that individuals use ideas and products produced by artificial intelligence instead of producing them themselves. The benefits of artificial intelligence such as solving complex problems, increasing work efficiency, compiling and automating work are undeniable, but it is important for the future of society, culture and production that individuals develop and use their own creativity.

Origami, which is an economic activity type, is used in mathematics in order to realize these goals in mathematics teaching and to ensure learning by doing and experiencing (Agirbas, 2023). When origami is examined as a word, it is seen that it means folded paper. With origami, papers are folded and animals, objects, geometric figures are made. Paper, pencil or glue is not used during origami, but it is divided into two types according to the number of paper pieces used. If origami is made from a single piece of paper, it is called classical origami, and if it is made from two or three pieces of paper, it is called modular origami. There are basically two types of origami, but today there are also architectural, pop-up and krigami types (Tugrul & Kavici, 2002). Origami also is handled in three different types: classical origami, modular origami, wet origami (Gur, 2015). The use of origami in education dates back to 1920. In these years, origami was included in the curriculum in Japan (MoNE, 2009). When the use of origami in mathematics in Turkey is examined, its place in the mathematics curriculum published by the Ministry of National Education (2018) is seen directly in the curriculum with the statement "while finding the sum of the measures of the interior angles of triangles and quadrilaterals and finding the angle that is not given". In addition, when the 2009 mathematics curriculum and guide of the Ministry of National Education are examined, it is seen that origami is frequently included. The use of origami in mathematics is mostly in subjects involving geometry. The use of origami is especially prominent in order to concretize abstract concepts. It is possible to say that origami also develops students' two- or three-dimensional thinking skills. Another contribution of origami in mathematics is that it enables students to fully learn Euclidean geometry. In addition, origami also contributes to the teaching of area, volume, algebra, ratio and proportion (MoNE, 2009).

Origami has an important potential as a teaching tool used in mathematics. Traditionally known as the art of paper folding, origami has the potential to be applied in different fields ranging from automotive engineering to medical devices and space flight by examining mathematical principles (Dureisseix, 2012; Lang, 2007). Therefore, origami is not only a craft or an art form, but also of great value in mathematics teaching (Li et al., 2018; Zhao et al., 2020). New mathematics teaching methods such as learning mathematics through modeling from the immediate environment and discovery learning show that the use of origami can improve the learning process and increase student interest and motivation (Budinski, 2015). Origami can help students learn topics such as geometry, ratio and proportion, rational numbers, and first-order equations (Ergene, Masal, Masal, & Takunyaci, 2017). Teachers can also have the opportunity to explain abstract mathematical concepts to students more easily by combining origami with concrete examples in mathematics lessons. Therefore, origami can give students a different perspective in mathematics teaching and increase their interest in mathematics.

It is seen that many postgraduate studies have been conducted in the literature on origami, which has many contributions in mathematics teaching. When the graduate studies on the use of origami in mathematics are examined, it is seen that the first study was conducted by Akan Sagsoz (2008). Afterwards, various graduate studies were conducted on the use of origami in mathematics. Many points were addressed in these studies. There are thematic and methodological differences in these studies. Some studies have been conducted to systematically examine and reveal the differences in the studies. Systematic examination of the studies in the literature provides an idea about a subject and reveals the gaps in the literature (Kanli et al., 2014). When the literature is examined, the study conducted by Dogan and Bayraktar Kurt (2021), which systematically examines the postgraduate studies on the use of origami in mathematics, is seen as the first study on this subject. In this study, various findings and results were found by examining graduate studies on the use of origami in mathematics. This study was conducted in 2020 and includes postgraduate studies until 2020 in terms of content.

In this study, it was aimed to systematically examine the graduate studies on the use of origami in mathematics. This study differs from the study conducted by Dogan and Bayraktar Kurt (2021) in terms of methodology. It is possible to say that this study also differs from Dogan and Bayraktar Kurt (2021)'s study in terms of findings and results. In addition, the fact that the study conducted by Dogan and Bayraktar Kurt (2021) includes studies until 2020 and does not include studies conducted in the last four years on this subject reduces the timeliness of their study. For these reasons, such a study was needed. With this study, a general situation of the graduate studies on the use of origami in mathematics will be revealed and the deficiencies in this subject will be revealed. It is also believed that this study will shed

light on future studies. It is possible to say that this study is original and up to date. Within the scope of this study, graduate studies on the use of origami in mathematics were examined and answers to the following questions were sought:

1. How is the distribution of graduate studies on the use of origami in mathematics according to their types?
2. How is the distribution of graduate studies on the use of origami in mathematics according to years?
3. How is the distribution of graduate studies on the use of origami in mathematics according to the universities in which they were conducted?
4. How is the distribution of graduate studies on the use of origami in mathematics according to themes?
5. How is the distribution of graduate studies on the use of origami in mathematics in terms of research method?
6. How is the distribution of graduate studies on the use of origami in mathematics in terms of research design?
7. How is the distribution of graduate studies on the use of origami in mathematics in terms of sample group?
8. How is the distribution of graduate studies on the use of origami in mathematics in terms of sampling method?
9. How is the distribution of graduate studies on the use of origami in mathematics in terms of sample size?
10. How is the distribution of graduate studies on the use of origami in mathematics in terms of data collection tools?
11. How is the distribution of graduate studies on the use of origami in mathematics in terms of data analysis techniques?

Methodology

Research Model

In this study, document analysis technique, one of the qualitative research types, was used to examine the graduate studies on the use of origami in mathematics. Document analiysis technique is a technique in which records in an official or private form are collected and systematically examined and evaluated (Ekiz, 2020). In other words, document analysis technique is also called documentary scanning (Ocak,

2019). This technique can be used for literature review in general or it can be used to digitize documents by content analysis. (Karasar, 1999; cited in Cemaloglu, 2021)

Data Collection

The studies to be used in this study were determined and collected by criterion sampling method. The sampling method in which various situations, objects, people and events are included in the sample by using certain criteria is called criterion sampling (Buyukozturk et al., 2020c). The criteria used can be taken from somewhere ready-made or created by the researcher (Yildirim & Simsek, 2016). In this study, postgraduate studies with the word "origami" in the title, on mathematics, in the Council of Higher Education Thesis Documentation Center, on education and training, with permission, were taken as criteria. In this study, the thesis classification form developed by Ceylan and Bozkurt (2023) was used as a data collection tool. Data were collected through this form. In the data collection phase, firstly, the word "origami" was searched by logging into the Council of Higher Education Thesis Documentation Center. At the end of the search, 45 graduate studies emerged. The search was repeated by typing education and training in the subject section. The studies were reduced from 45 to 26. Among the 26 studies, those with permission and studies on mathematics were selected and a total of 20 studies were included in the study. The postgraduate studies included in the research were downloaded in the computer environment and entered the thesis classification form from Excel. On February 25, 2024, the data collection process was completed.

Data Analysis

The data in this study were analyzed using content analysis, one of the qualitative research methods. In content analysis, texts are coded with certain rules and some words are summarized by categorizing them. Content analysis is a repeatable, systematic technique (Buyukozturk et al., 2020b). In short, this analysis technique is a technique in which data are deeply analyzed and themes are revealed (Yildirim & Simsek, 2016). The data were collected meticulously, and all stages of the study were tried to be explained. While analyzing the data, percentage (%) and frequency (f) calculations were made and tabulated.

In order to ensure validity and reliability, data were collected and coded meticulously. In order to prevent inconsistencies in coding, consensus was sought among the researchers. In addition, inconsistent statements were discussed by the researchers. In the calculations made by taking into account the formula of Miles and Huberman (1994), Reliability = Consensus/ (Consensus + Disagreement) x 100,

a consistency rate of 81.81% was obtained. According to Miles and Huberman (1994), the consistency rate should be close to 80% (Miles & Huberman, 1994).

Results and Discussion

Table 1 shows the distribution of graduate studies on the use of origami in mathematics according to research types.

Research Type	f	%	Graduate Studies
Master Thesis	20	100	Akan Sagsoz, 2008; Cakmak, 2009; Arici, 2012; Kolayhisar Dundar, 2012; Simsek, 2012; I. Dagdelen, 2012; M.G. Dagdelen, 2012; Arslan, 2012; Bayraktar Kurt, 2012; Takicak, 2012; Ozcelik, 2014; Kandil, 2016; Gelisen, 2017; Guney, 2018; Kartal, 2019; Usta, 2019; Birinci Kara, 2020; Aydın, 2021; Dündar, 2022; Ağırbaş, 2023
Doctoral Thesis	-	-	-
Total	20	100	

Table 1. *Distribution of Graduate Studies According to Research Type*

When Table 1 is examined, it is seen that 100% of the graduate studies on the use of origami in mathematics are master's theses (f=20). From this point of view, all of the graduate studies on the use of origami in mathematics are master's studies.

Table 2 shows the distribution of graduate studies on the use of origami in mathematics according to years.

Year	Master Thesis	Doctoral Thesis	Total	
	f	f	f	%
2008	1	-	1	5,0
2009	1	-	1	5,0
2012	8	-	8	40,0
2014	1	-	1	5,0
2016	1	-	1	5,0
2017	1	-	1	5,0

2018	1	-	1	5,0
2019	2	-	2	10,0
2020	1	-	1	5,0
2021	1	-	1	5,0
2022	1	-	1	5,0
2023	1	-	1	5,0
	20	-	20	100

***Table 2**. Distribution of Graduate Studies by Years*

When Table 2 is examined, it is seen that 5.0% of the graduate studies on the use of origami in mathematics were conducted in 2008 (f=1), 5.0% in 2009 (f=1), 40.0% in 2012 (f=8), 5.0% in 2014 (f=1), 5.0% in 2016 (f=1), 5.0% in 2017 (f=1), 5.0% in 2018 (f=1), 10.0% in 2019 (f=2), 5.0% in 2020 (f=1), 5.0% in 2021 (f=1), 5.0% in 2022 (f=1), 5.0% in 2023 (f=1) From this point of view, the first postgraduate study on the use of origami in mathematics was conducted in 2008, and the most studies were conducted in 2012.

Table 3 shows the distribution of graduate studies on the use of origami in mathematics according to the universities where they were conducted.

University	Master Thesis	Doctoral Thesis	Total	
	f	f	f	%
Atatürk University	2	-	2	10,0
Bartin University	1	-	1	5,0
Bogazici University	1	-	1	5,0
Cumhuriyet University	1	-	1	5,0
Dokuz Eylul University	1	-	1	5,0
Gazi University	1	-	1	5,0
Kastamonu University	1	-	1	5,0
Orta Dogu Teknik University	3	-	3	15,0
Ondokuz Mayis University	8	-	8	40,0
Yuzuncu Yil University	1	-	1	5,0
	20	-	20	100

***Table 3.** Distribution of Graduate Studies according to the Universities where they were conducted*

When Table 3 is examined, it is seen that 10.0% of the postgraduate studies on the use of origami in mathematics were conducted at Atatürk University (f=2), 5.0% at Bartin University (f=1), 5.0% at Bogazici University (f=1), 5.0% at Cumhuriyet University (f=1), and 5, 0% were conducted at Dokuz Eylul University (f=1), 5.0% at Gazi University (f=1), 5.0% at Kastamonu University (f=1), 5.0% at Middle East Technical University (f=1), 40.0% at Ondokuz Mayis University (f=8), and 5.0% at Yuzuncu Yil University (f=1). From this point of view, the postgraduate studies on the use of origami in mathematics were mostly conducted at Ondokuz Mayis University.

Table 4 shows the distribution of graduate studies on the use of origami in mathematics according to the themes.

Themes	Master Thesis	Doctoral Thesis	Total	
	f	f	f	%
Analyzing the use of origami in terms of certain variables	2	-	2	9,5
The effect of origami on certain variables	14	-	14	66,7
Using origami in mathematics teaching	3	-	3	19,0
Origami-related scale development	1	-	1	4,8
	20	-	20	100

Table 4. *Distribution of Graduate Studies According to Themes*

**Since the themes used in the theses are more than one, the total frequency is higher than the number of studies.*

When Table 4 is examined, it is seen that 9.5% of the themes of the postgraduate studies on the use of origami in mathematics are examining the use of origami in terms of certain variables (f=2), 66.7% are the effect of origami on certain variables (f=14), 19.0% are using origami in mathematics teaching (f=3), 4.8% are developing scales related to origami (f=1). From this point of view, in the postgraduate studies on the use of origami in mathematics, the theme of the effect of origami on certain variables dominates the most.

Table 5 shows the distribution of graduate studies on the use of origami in mathematics according to the research methods used.

Research Method	Master Thesis	Doctoral Thesis	Total	
	f	f	f	%
Quantitative Method	8	-	8	40,0
Qualitative Method	5	-	5	25,0
Mixed Method	7	-	7	35,0
	20	-	20	100

Table 5. *Distribution of Graduate Studies According to the Research Method Used*

When Table 5 is examined, it is seen that 40.0% of the graduate studies on the use of origami in mathematics used quantitative methods (f=8), 25.0% used qualitative methods (f=5), and 35.0% used mixed methods (f=7). From this point of view, quantitative methods were mostly used in graduate studies on the use of origami in mathematics.

Table 6 shows the distribution of graduate studies on the use of origami in mathematics according to the research designs used.

Design	Master Thesis	Doctoral Thesis	Total	
	f	f	f	%
Experimental Research	13	-	13	46,4
Case Study	1	-	1	3,6
Action Research	5	-	5	17,9
Öğretim deneyi	1	-	1	3,6
Teaching Experiment	3	-	3	10,7
Not Specified	5	-	5	17,9
	28	-	28	100

Table 6. *Distribution of Graduate Studies According to the Research Design Used*

**Since the designs used in the theses are more than one, the total frequency is higher than the number of studies.*

When Table 6 is examined, it is seen that 46.4% of the graduate studies on the use of origami in mathematics used experimental research design (f=13), 3.6% used case study design (f=1), 17.9% used action research design (f=5), 3.6% used teaching experiment (f=1), and 10.7% used survey research design (f=1). In addition, in 17.9% of the postgraduate studies, the design used was not specified (f=5). From this point of view, experimental research designs were mostly used in postgraduate studies on the use of origami in mathematics.

Sample Group	Master Thesis	Doctoral Thesis	Total	
	f	f	f	%
Primary school student	1	-	1	4,8
Middle school student	15	-	15	71,4
High school student	3	-	3	14,3
Pre-service teacher	1	-	1	4,8
Teacher	1	-	1	4,8
	21	-	21	100

***Table 7**. Distribution of Graduate Studies According to Sample Group*

* *Since the sample group used in the studies is more than one, the total frequency is higher than the number of studies.*

When Table 7 is examined, it is seen that 4.8% of the sample group of the graduate studies on the use of origami in mathematics consisted of primary school students (f=1), 71.4% of secondary school students (f=15), 4.8% of high school students (f=1), 4.8% of pre-service teachers (f=1), and 4.8% of teachers (f=1). From this point of view, the postgraduate studies on the use of origami in mathematics were mostly conducted on the sample group of secondary school students.

Table 8 shows the distribution of graduate studies on the use of origami in mathematics according to the sampling method used.

Sampling Method		Master Thesis	Doctoral Thesis	Total	
		f	f	f	%
Probability	Random	7	-	7	31,8
Non probability	Purposive	3	-	3	13,6
	Maximum diversity	4	-	4	18,2
	Criterion based	1	-	1	4,5
	Easily accessible	1	-	1	4,5
Not specified		6	-	6	27,3
Toplam		22	-	22	100

***Table 8.** Distribution of Postgraduate Studies According to the Sampling Method Used*

**Since the sampling method used in the studies is more than one, the total frequency is higher than the number of studies.*

When Table 8 is examined, it is seen that 31.8% of the sampling methods used in graduate studies on the use of origami in mathematics are random (f=7), 13.6% are purposive (f=3), 18.2% are maximum diversity (f=4), 4.5% are criterion based(f=1), and 4.5% are easily accessible (f=1). In addition, the sampling method of 27.3% of the studies was not specified (f=6). From this point of view, random sampling was mostly used in postgraduate studies on the use of origami in mathematics.

Table 9 shows the distribution of graduate studies on the use of origami in mathematics according to sample size.

Sample Size	Master Thesis	Doctoral Thesis	Total	
	f	f	f	%
1-50	13	-	13	61,9
51-100	4	-	4	19,0
101-150	-	-	-	-
151-200	2	-	2	9,5
201-250	-	-	-	-
250 and above	2	-	2	9,5
	21	-	21	100

Table 9. *Distribution of Postgraduate Studies According to the Sample Size Used*

When Table 9 is examined, it is seen that 61.9% of the sample size of the graduate studies on the use of origami in mathematics is in the range of 1-50 (f=13), 19.0% in the range of 51-100 (f=4), 9.5% in the range of 151-200 (f=2), and 9.5% in the range of 250 and above (f=2). From this point of view, in the postgraduate studies on the use of origami in mathematics, the sample size in the range of 1-50 was used the most.

Table 10 shows the distribution of graduate studies on the use of origami in mathematics according to the data collection tool used.

Data Analysis Tool	Master Thesis	Doctoral Thesis	Total	
	f	f	f	%
Open-ended question	5	-	5	8,8
Questionnaire	1	-	1	1,8
Worksheet	1	-	1	1,8
Observation form	1	-	1	1,8

Interview form	6	-	6	10,5
Diaries	5	-	5	8,8
Personal information form	17	-	17	29,8
Scale	4	-	4	7,0
Test	15	-	15	26,3
Reflection paper	1	-	1	1,8
Other forms	1	-	1	1,8
	57	-	57	100

Table 10. *Distribution of Graduate Studies According to Data Collection Instrument*

**Since there is more than one data collection tool used in the studies, the total frequency is higher than the number of studies*.

When Table 10 is examined, it is seen that 8.8% of the postgraduate studies on the use of origami in mathematics were conducted with open-ended questions (f=5), 1.8% with questionnaires (f=1), 1.8% with worksheets (f=1), 1.8% with observation forms (f=1), and 10% with observation forms (f=10), 5% used interview forms (f=6), 8.8% used diaries (f=5), 29.8% used personal information forms (f=17), 7.0% used scales (f=4), 26.3% used tests (f=15), 1.8% used reflection papers (f=1), and 1.8% used other forms (f=1). From this point of view, personal information form and test data collection tools were mostly used in graduate studies on the use of origami in mathematics.

Table 11 shows the distribution of graduate studies on the use of origami in mathematics according to the data analysis technique used.

Data Analysis Technique	Master Thesis	Doctoral Thesis	Total	
	f	f	f	%
Descriptive analysis	10	-	10	22,2
Content analysis	3	-	3	6,7
Non- parametic test	1	-	1	2,2
Parametic test	13	-	13	28,9
Descriptive statistics	18	-	18	40,0
	45	-	45	100

Table 11. *Distribution of Graduate Studies According to the Data Analysis Technique Used*

Since there is more than one data analysis technique used in the studies, the total frequency is higher than the number of studies.

When Table 11 is examined, it is seen that 22.2% of the postgraduate studies on the use of origami in mathematics used descriptive analysis (f=10), 6.7% used content analysis (f=3), 2.2% used non-parametric test (f=1), 28.9% used parametric test (f=13), and 40.0% used descriptive statistics (f=18). From this point of view, descriptive statistics and parametic test data analysis techniques were mostly used in graduate studies on the use of origami in mathematics.

Conclusion

It is seen that there are many postgraduate studies in the literature on the use of origami, which is an economic and fun activity, in mathematics. Although there are studies that systematically examine these postgraduate studies, there is no study that covers recent studies. For this reason, 20 graduate studies on the use of origami in mathematics were examined.

When the distribution of graduate studies on the use of origami in mathematics is examined according to their types, it is seen that 20 graduate studies were conducted. There is no doctoral study directly on the use of origami in mathematics in the literature. When the literature was examined, it was seen that the doctoral thesis of Agsu (2020) included paper folding with other variables, but it was not accepted as a study directly on origami and was not included in the study. In addition, one of the criteria taken into consideration when determining the studies to be included in this study is the mention of origami in the studies. In this study, data were collected according to these criteria. For this reason, no doctoral study on the use of origami in mathematics was found. The fact that there are no doctoral studies on the use of origami in mathematics shows that this subject has not yet found a wide field of study in academia because doctoral studies are detailed, qualified studies compared to master's studies.

When the postgraduate studies on the use of origami in mathematics are analyzed according to years, it is concluded that the first study was conducted in 2008 and the most studies were conducted in 2012. One of the reasons for the concentration of the studies in 2012 is that 5 theses conducted in this year were conducted at the same university and by the same advisor. For this reason, there may be a quantitative increase in the theses published in this period. In addition, the same finding is also observed in the study of Dogan and Bayraktar Kurt (2021).

When we look at the universities where the graduate studies on the use of origami in mathematics were conducted, the highest number of studies were conducted at Ondokuz Mayıs University. This result can be explained by the specialization areas of the academicians conducting the theses and the interests of the students. In addition, it is also seen that postgraduate studies on the use of origami in mathematics were conducted in only 10 universities. The current number of higher education institutions in Turkey is 208 (CoHE, 2023). The fact that only 10 universities among 208 higher education institutions have conducted studies on the use of origami in mathematics shows that this subject has not become widespread. In addition, in the study of Dogan and Bayraktar Kurt (2021), it is seen that the highest number of postgraduate studies were conducted at Ondokuz Mayis University.

When the themes of the postgraduate studies on the use of origami in mathematics are examined, it is seen that the theme of the effect of origami on certain variables comes to the fore. This may be due to the fact that the researchers wanted to investigate the effect of origami on variables such as skills, achievement, and teaching processes. When the findings of Dogan and Bayraktar Kurt's (2021) study are examined, it is seen that the effect of origami use in mathematics education is the most prominent theme in the studies. It is possible to say that the findings of the studies in the literature overlap with the results of this study.

When the methods preferred in graduate studies on the use of origami in mathematics are examined, it is seen that quantitative methods are used more. Choosing the method of a study is the first step of that study. When choosing a method, a method suitable for the purpose of the research and the solution of the problem situation should be chosen (Coban & Oral, 2020). This result may be related to the fact that researchers think that they can go to the solution of the problem situations they deal with wthe most appropriate quantitative methods and for this reason, they design their studies with quantitative methods.

When the preferred designs in graduate studies on the use of origami in mathematics are examined, it is seen that experimental designs are used more frequently. This is an expected result because the theme of the effect of origami on certain variables is the most prominent theme in the studies. In experimental designs, procedures that can be compared are applied and the effects of the applied procedures are examined (Buyukozturk et al. 2020a). From this point of view, it can be said that there is compatibility between the themes of the studies and the research designs. In addition, the fact that no design belonging to mixed designs is specified in the studies using mixed methods, and that the designs in the study are handled separately as quantitative and qualitative increases the number of experimental designs used in the studies.

When the sample group preferred in the postgraduate studies on the use of origami in mathematics is examined, it is seen that the middle school student group is used the most. It can be said that the primary school student sample group, teacher and pre-service teacher sample group are in the background. In the study of Dogan and Bayraktar Kurt (2021), it is seen that the middle school student sample group is the most used sample group.

When the sampling method preferred in the postgraduate studies on the use of origami in mathematics is examined, it is seen that random sampling is mostly used. This result may be associated with the fact that experimental designs are predominantly used in the studies. When experimental designs, which are frequently used in education, are used in the student sample group, it is possible to say that the experimental and control groups are randomly selected (Cepni, 2014).

When the sizes of the sample groups preferred in graduate studies on the use of origami in mathematics are examined, it is seen that the range of 1-50 is mostly used. This result can be associated with the quantitatively high number of experimental designs (Ceylan & Bozkurt, 2023). It is possible to say that the sample group is smaller in experimental designs.

When the data collection tools preferred in graduate studies on the use of origami in mathematics are examined, it is seen that personal information forms and tests are mostly used. This result can be associated with the fact that most of the studies used experimental designs. In scientific research, it is important to use the right technique to reach the right information (Cemaloglu, 2021). From this point of view, it can be thought that data collection tools suitable for the research were used in the studies on the use of origami in mathematics. In addition, when the findings of Dogan and Bayraktar Kurt's (2021) study are examined, it is seen that the test data collection tool is more than other data collection tools.

When the data analysis techniques used in the postgraduate studies on the use of origami in mathematics were examined, it was seen that descriptive statistics and parametric tests were mostly used. The higher use of descriptive statistics can be explained by the inclusion of demographic data, descriptive statistics such as frequency, mean, skewness, kurtosis. In addition, the higher use of parametric tests can be explained by the fact that quantitative methods and designs are used more in the studies. When the findings of Dogan and Bayraktar Kurt's (2021) study are examined, it is seen that parametic tests are the most commonly used data analysis technique.

Future Developments and Suggestions

- It can be suggested to include more doctoral dissertations in postgraduate studies on the use of origami in mathematics.

- In the studies conducted on the use of origami in mathematics, it is seen that the theme of the effect of origami on certain variables is used more. It can be suggested to study on different themes in future graduate studies.

- It can be suggested that at least one study on the use of origami in mathematics should be conducted in all universities.

- It may be recommended to focus on mixed and qualitative methods as well as quantitative methods in postgraduate studies on the use of origami in mathematics.

- It can be recommended that postgraduate studies on the use of origami in mathematics should include designs other than experimental designs.

- It can be suggested to design studies in which advanced data analysis techniques will be used in terms of data analysis techniques in graduate studies on the use of origami in mathematics.

- A study examining foreign postgraduate studies on the use of origami in mathematics can be recommended.

- Studies examining the interaction between origami and mathematics education can be conducted. In particular, origami-based educational materials that enable students to experience abstract mathematical concepts concretely can be developed and their effects can be investigated.

- The effect of origami activities on problem solving skills can be examined. In this context, studies can be conducted on the effect of using origami activities in students' problem solving processes.

- The effect of origami activities on learning motivation can be investigated. The relationship between students' origami activities and mathematics learning processes can be examined and motivation-oriented educational strategies can be developed in this field.

- Workshops can be included in support education rooms to be used as an alternative to applications that reduce the creativity of the individual, such as artificial intelligence.

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