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THE PRESCHOOL TEACHERS' OPINION ON TEACHING GEOMETRY

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ABSTRACT

Teaching geometry in the early years emerges along with maths activities but might be neglected sometimes. This research aims to identify preschool teachers' opinions on geometry teaching via using semi-structured interviews, and collected data analysed using content analysis. Seven female and three male preschool teachers were participated in the study, who has BA and MA degrees. The data collected data were analysed by separately with each research as considering the aims of content analysis and had common findings. While the participating teachers considered themselves to have self-efficacy to teach geometry, their sufficiency to teach depends on various factors. In terms of shaped included in preschool education programmes, there is some common knowledge around it. In the case of teaching, some difficulties in teaching various shapes, and teaching in various activities are found, and this is related to used materials in teaching. The prominent finding is the participating teachers' opinions on children's geometric thinking levels, and some participants have inadequate knowledge about it, which might be the result of their insufficient undergraduate degree. This is also underlined by teachers as having ineffective modules in their undergraduate in terms of being only theoretical and fundamental information. Thus, it is important to provide some ongoing support for teachers to enhance their knowledge to support teaching geometry.

Keywords: early years, geometry, opinion, teachers

INTRODUCTION

Geometry is part of mathematics, and maths activities are one of ten activities mentioned in the Preschool Education Programme in Turkey (Ministry of National Education, 2013). Sarama and Clements (2009) underline such activities as disregarded activities in early years, and in particular, there is a lack of engagement opportunities for children to have activities based on geometry (Markovits & Patkin, 2021). However, geometry has an important position in maths education because of focusing on abstract objects, images and spatial relations (İvrendi et al., 2018) although it is placed as a sub-heading of mathematics in most cases (Inan & Dogan-Temur, 2010). "The majority of the preschool teachers deemed involving young children in activities connected with the learning of geometry to be important, namely, awareness of the need to engage in geometry does exist" (Markovits & Patkin, 2021, p. 12). This is because teachers are key people to identify suitable teaching

methods for children to learn geometry as well as identifying misunderstanding of children about geometric concepts and developing children's knowledge about geometry (Noviyanti & Suryadi, 2019). Therefore, teaching geometry in preschool age is recommended as children to develop geometric content knowledge (Klim-Klimaszewska & Nazaruk, 2017), and "young children are capable of learning geometric ideas and processes to a surprising degree and depth" (Clements et al., 2018, p. 26). Elia et al. (2003) also mention the necessity of teaching geometry at an early age.

Teachers have responsibilities to deliver the needs of programme (Arumugam et al., 2020), so the approaches of teachers on teaching maths and geometry are key aspects that enable children to learn more about the concepts. Therefore, it is important to provide chances for children to acquire information instead of having didactic learning of geometric shapes etc. (Björklund & Barendregt, 2016). Gür and Kobak-Demir (2017) point out the impact of collaboration and cooperation in learning to enhance the outcomes of the geometry learning process. Having practical experiences of children with scientific methods does not only provide children to connect daily experiences and theoretical concepts of geometry (Novita et al., 2019), but children also understand and construct the physical aspects of the world via their geometric knowledge (İvrendi et al., 2018). The research of Zsoldos-Marchis (2015) indicates that determining various tasks for children considering their proficiency by participatory activities can lead to developing a confident attitude. Although classroom are designed considering the suggestion of the programme, playful opportunities enable children to learn various skills (Erşan, 2017) like social and emotional (San et al., 2021). Parallel to this, such methods like child-led and play-based activities enhance learning outcomes compared to traditional methods (Fisher et al., 2013). However, this leads to some dilemmas between historical heritage in teaching geometry and current approaches (Sinclair & Bruce, 2015) as teachers' practices are affected by their stance on teaching geometry (Zsoldos-Marchis, 2015). Children live in a world surrounded by geometric objects, and buildings, foods and toys, which they engage daily consist of geometric shapes (Aktaş Arnas & Aslan, 2004). Opportunities around children can be used to support learning, so "children move through developmental progressions, building intuitions and perceptually-based competencies and then explicating these early developments through maths talk to connect verbal and abstract thinking – building integrated concrete knowledge of geometry and spatial reasoning." (Clements et al., 2018, p. 26).

In previous research, children in the preschool age are facing difficulties during comprehending the distinct features of shapes and perceiving geometric shapes as a whole (Clements & Sarama, 2011; İvrendi et al., 2018). Therefore, it is important to enunciate the features and properties of geometric shapes as well as state similarities and differences between other geometric figures (Elia et al., 2003). "Even when geometry is addressed in the elementary school years, it typically focuses on shape naming, formulas, and rules, rather than on spatial reasoning" (Casey et al., 2008, p. 44) although "the core curriculum of preschool education stipulates that the child that is prepared to study Mathematics in school can distinguish between basic geometric figures (circles, squares, triangles, rectangles)" (Klim-Klimaszewska & Nazaruk, 2017, p. 345). Inan and Dogan-Temur's (2010) research with kindergarten teachers exhibits that the participating teachers face challenges in designing geometry-related activities because of not having sufficient information about geometry and teaching geometry. This is parallel to Zembat et al.'s (2014) research, participating teachers had a lack of knowledge on the importance of geometry as well as having inadequate ability to teach geometry, organize materials, and evaluate children's geometry knowledge. However, another research by Markovits and Patkin (2021) mentions

preschool teachers' knowledge of geometric language to enhance children's learning on features and materials although there are various types of teacher approach to geometry like having a positive, neutral and negative position to teach geometry in early years.

Besides, school-age children's enthusiasm, interest and positive approach to learning maths and geometry depend on their experiences during the preschool age (Aktaş Arnas & Aslan, 2004; Ompok et al., 2021), and teachers should develop their geometric thinking to support children's geometric knowledge (Çakmak & Güler, 2014). This is because Klim-Klimaszewska and Nazaruk's (2017) research indicates a lack of practice in providing geometry-related activities as a part of maths teaching by the participating teachers. Due to this reason, teachers' professional development should be considered in teaching geometry (Clements & Sarama, 2011) as there is relationship between teachers' self-efficacy and maths education (Erşan et al., 2021). In this case, it is important to identify preschool teachers' opinions on their geometry teaching, so this research aims to explore **'What do preschool teachers think about teaching geometry?'** The following sub-questions are aimed to identify through the research;

i) What are the preschool teachers' opinions on their self-efficacy in teaching geometry?
ii) What are the preschool teachers' opinions regarding the geometrical shapes they include in their activities?
iii) How are the preschool teacher' opinions on the geometrical shapes they find difficult the most?
iv) What are the preschool teachers' opinions on the activities in which they use geometrical concepts the most?
v) How are the preschool teachers' opinions on the materials they make use of teaching geometry the most?
vi) What are the preschool teachers' opinions on the preschool children's geometric thinking levels?
vii) How are the preschool teachers' opinions on whether the courses they took in their BA degree studies help them in teaching geometry?

METHOD

Research Design

This research was designed as a qualitative design to reveal the preschool teachers' opinions on geometry teaching. Qualitative research is defined as a type of research, in which qualitative data collection methods, such as observation, interview, document analysis, etc., are used, and a qualitative process pursued towards revealing the perceptions and incidents in a natural environment, and by a realistic and holistic manner (Creswell, 2007; Yıldırım & Şimşek, 2011).

Research Group

The study group consisted of ten preschool teachers working at preschools, affiliated with the Ministry of National Education throughout the spring term of the educational year of 2020-2021. While selecting the teachers that consists of the study group, the points of concern were balanced distribution of gender distribution, educational levels, and experiences, as well as

being graduated from different universities. Purposive sampling is therefore used to reach the study group (Patton, 2015). Purposive sampling methods emerged in their fullest sense within the qualitative research process, and purposive sampling allows in-depth study of situations that can enhance information (Yıldırım & Şimşek, 2011). In this sampling, the criteria are considered as being important for reaching rich data. It is further aimed that the sample is selected according to these criteria, is capable of representing the research population with all qualities (Tavşancıl & Aslan, 2001).

Table 1
The distribution of the participating preschool teachers as per gender, education level, and experiences.

		T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	TOTAL
Gender	Female	√	√			√	√	√		√	√	7
	Male			√	√				√			3
Educational Level	BA	√	√		√	√		√	√	√		7
	MA			√			√				√	3
Experience	0-5 years								√		√	2
	6-10 years	√			√							2
	11-15 years		√							√		2
	16-20 years			√				√				2
	20 years and more					√	√					2

Upon review of Table 1, among the 10 teachers composing the study group, in terms of their genders, 7 of them are ‘female’ (T1, T2, T5, T6, T7, T9, T10), 3 of them are ‘male’ (T3, T4, T8). In terms of their educational levels, 7 of them are ‘BA’ graduates (T1, T2, T4, T5, T7, T8, T9), 3 of them are ‘MA’ graduates (T3, T6, T10). In terms of their experiences, 2 of them have ‘0-5 years’ (T8, T10), 2 of them have ‘6-10 years’ (T1, T4), 2 of them have ‘11-15 years’ (T2, T9), 2 of them have ‘16-20 years’ (T3, T7), and 2 of them have ‘20 years and above’ (T5, T6) of experiences as preschool teachers.

Data Collection

Data of the research were collected from ten preschool teachers by employing the interview technique during May 2021. The teachers to be interviewed were briefed regarding the issue of the interview beforehand, and the interview appointment was made to the place and time considering the teacher’s availability and choices. Interviews were recorded by a voice recorder within the knowledge of the participants. Each interview lasted for 50-60 minutes. The voice records were thereupon transcribed into word documents by the researchers, the printouts thereof were taken, and asked participating teachers to approve of details.

Data Collection Tools

Semi-structured interviews consisted of eight questions, which had been developed by the researchers, and were used as the data collection tool intended to explore the preschool teachers' opinions on geometry teaching. A pool of questions was created during the preparation of the form to choose the questions that can serve the purpose of the research. The determined questions were articulated as per the data source. Considering the sorting principles determined in the literature, sub-questions were also included while the questions were being arranged (Patton, 2015; Yıldırım & Şimşek, 2011). While preparing the interview form, attention was paid to ensure that the questions were open-ended, instead of not being multi-dimensional or leading the participants in a certain direction, as well as being easy to be understood by the participants. The prepared form was checked in terms of content and face validity by way of being put to the attention of three scholars (two professors, one associate professor) with expertise and experience regarding the issue in question, two of whom were from preschool education, and the remaining one from primary school education. Pre-application of the question form was piloted with four preschool teachers, and three questions, in which incomprehensibility and incoherency were detected. Therefore, those questions were undergone respective corrections.

Data Analysis

Content analysis was used to analyse the obtained data. The process is performed in content analysis, is to gather similar data within the frame of certain concepts and themes, and to interpret them by arranging the data in a way that the reader can understand. Content analysis is used in four stages for the procession of qualitative research data obtained from documents: (1) Coding the data, (2) Finding the themes, (3) Arranging the codes and themes, and (4) Defining and interpreting the findings (Yıldırım & Şimşek, 2011). The data obtained in this study were analysed by way of performing separate coding for each researcher. While coding, the purpose of the research was considered, and codes were created in this direction. The open coding method was applied in the creation of the codes. Respectively obtained codes were tabulated first and interpreted thereafter. Including direct quotations from the individuals interviewed, and criticising results based on such quotations is important in terms of validity in research where descriptive analysis is used (Kabapınar, 2003; Yıldırım & Şimşek, 2011). Furthermore, the data were not only described in detail, but also reinforced with direct quotations to support results. During this period, both researchers analysed data, and had an online meeting to make a compromise on the collected data. The real names of the participants were kept confidential and were expressed as T1, T2… in the direct quotations. The researchers quoted the parts they deemed important while combining similar statements made by different people.

FINDINGS

The findings of the research are categorised regarding interview questions to explore and exhibit the participating teachers' opinions in depth. Therefore, the findings are represented under seven sub-titles, which are mainly sub-research questions, and that constituted the general structure of interview questions.

Findings regarding the sub-question: What are the preschool teachers' opinions on their self-efficacy in teaching geometry?

Table 2

The distribution of preschool teachers regarding their feeling of self-efficacy about teaching geometry.

Teacher	Yes	No
T1	√	
T2	√	
T3	√	
T4	√	
T5		√
T6	√	
T7	√	
T8	√	
T9	√	
T10		√
Total	8	2

Upon review of Table 2, it can be seen that, while the teachers numbered "T1, T2, T3, T4, T6, T7, T8, T9" felt self-sufficient to teach geometry, they were the teachers numbered "T5, T10" who felt not self-sufficient to teach geometry.

Table 3
Opinions of the teachers who felt themselves self-sufficient to teach geometry.

Theme	Opinions
Using materials	"*There are adequate number of materials available at the school, and I may support teaching via visual materials*" T1 "*I can teach geometrical shapes with using materials as examples*" T6 "*There are a lot of educatory materials and tools available to teach the geometrical shapes, so that I can use quite a few examples from them*" T7 "*I think that there are a sufficient number of materials in my classroom*" T4
Being experienced	*"Since I have been teaching geometric shapes for a long time, it does not seem difficult anymore*" T2 "*I have discovered in what ways the children can learn such shapes because of my experiences throughout my career*" T3
Programme knowledge	"*I think MoNE's preschool education programme 2013 is at the appropriate level for the children's development and age characteristics*" T8
Using integrated activities	"*I use a few sorts of activities including music, art, drama, etc., while teaching geometry*" T9

Table 4
Opinions of the teachers not feeling self-sufficient to teach geometry.

Theme	Opinions

Not knowing a Method/Technique	"*I always use the same method while teaching children the geometric shapes. I wish, I could have learned different methods, and be able to implement them in my class*" T10
Lack of adequate knowledge/Insufficient sources	*"I think that I have not accessed the necessary education and learning on teaching children geometry. The lack of necessary tools and equipment adds to that inadequacy of mine"* T5

Findings regarding sub-question: What are the preschool teachers' opinions regarding the geometrical shapes they include in their activities?

Table 5
The distribution of preschool teachers' inclusion of geometrical shape concepts that are included in MoNE's programme of 2013.

	Circle	Round	Triangle	Square	Rectangle	Ellipse	Side	Corner
T1	√		√	√	√	√		
T2	√		√	√	√	√		
T3	√		√	√	√			
T4	√		√	√	√			
T5	√		√	√	√			
T6	√	√	√	√	√			
T7	√	√	√	√	√			
T8	√	√	√	√	√	√	√	√
T9								
T10	√	√	√	√	√	√		
Total	9	4	9	9	9	4	1	1

Table 5 shows that the participating teachers include '*circle, triangle, square, and rectangle*' among the geometrical shape concepts that are included in MoNE's programme of 2013, while '*side, corner*' are those they include the least among the explained concepts.

Table 6
The distribution of preschool teachers' inclusion of geometrical shape concepts that are not included in MoNE's programme of 2013.

	Pentagon	Hexagon	Star	Oval	Cube	Prism	Globe	Cone
T1	√	√		√	√	√	√	√
T2	√	√		√				
T3	√							
T4								
T5	√	√	√	√				
T6	√		√					
T7	√	√						
T8								
T9	√	√						
T10								
Total	7	5	2	3	1	1	1	1

As it can be seen from Table 6, the participating teachers include '*pentagon and hexagon*' among the geometrical shape concepts that are not included in MoNE's programme of 2013.

Findings regarding sub-question: How are the preschool teachers' opinions on the geometrical shapes they find difficult the most?

Table 7
Distribution of the preschool teachers' opinions about the geometrical shapes they find difficult to teach.

	Rectangle	Square	Circle	Round	Ellipsis	Pentagon	Hexagon	Cone	Globe	Prism	Star
T1								√	√	√	
T2						√	√	√	√	√	
T3	√	√									
T4	√	√									
T5	√	√				√	√				√
T6	√										
T7	√	√			√						
T8			√	√							
T9	√	√	√	√							
T10	√	√	√	√							
Total	7	6	3	3	1	2	2	2	2	2	1

Table 7 indicates that teachers have difficulty the most in teaching '*rectangle, square, circle, and round*'.

Table 8
Preschool teachers' opinions regarding the geometric shapes they have difficulty with the most while teaching.

Theme	Opinions
Rectangle, Square	"*They (children in classroom) have difficulty drawing the border lines of squares and rectangles at correct lengths"* T5 *"Children do not fully comprehend that the four lines of the square are equal*" T6 "*The fact that the square and rectangle have the same number of sides and corners confuse the children, and causes me do more repetitions*" T7 "*They (children in classroom) have difficulty comprehending the difference between the square and rectangle*" T3, T4, T9, T10
Circle, Round, Ellipsis	"*They (children in classroom) cannot perceive the difference between the round and circle, so that they may confuse them*" T8, T9, T10 "*They may call the ellipsis as round, so that it becomes harder to*

	exemplify" T7
Pentagon, Hexagon	"*The higher number of sides and corners in pentagon and hexagon leads to have difficulties in teaching them*" T2 "*They have difficulty drawing the side lines of the pentagons and hexagons at their correct lengths*" T5
Cone, Globe, Prism, Star	"*I have difficulty finding visual materials for shapes like cone, globe, prism*" T1 "*They have difficulty drawing the side lines of the stars at their correct lengths*" T5

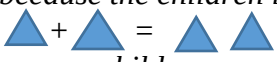
Findings regarding sub-question: What are the preschool teachers' opinions about the activities in which they use geometrical concepts the most?

Table 9
The distribution of the preschool teachers' activities in which they use geometrical concepts the most.

	Maths	Play	Art	Drama	Turkish	Music	Prep. Works for Read./Writ.
T1	√	√					
T2		√	√			√	√
T3	√						
T4		√	√				
T5	√	√		√			
T6	√		√		√	√	
T7	√	√		√			
T8							
T9	√	√	√				
T10	√				√		
Total	7	6	4	2	2	2	1

As it can be seen from Table 9, the participating teachers used geometrical shapes the most in their '*Maths, play, and art*' activities.

Table 10
Preschool teachers' opinions regarding the geometrical concepts they have in activities mostly.

Activity	Opinions
Maths	"*...because the children learn both the shapes, and the operations. i.e.*  " T3 "*Anyway, children may encounter geometry concepts in all maths activities"* T6 *"Geometry cannot be separated from maths, geometry is intertwined with maths, I introduce the shapes in the maths activities, and may thereby associate then with the daily life*" T1, T5, T6, T7, T10
Play	"*The game causes the children learn by doing and experiencing, so that their knowledge becomes more permanent*" T4, T5

	"*The game adds more fun to it, and this reinforces learning*" T1, T2, T7, T9
Art	"*I use it in the art activities, while making shapes with play doughs*" T2, T6 "*I may make use geometric shapes while building houses, towers, etc.*" T9
Drama	"*They (drama activities) provide active participation of the children, such as animating*" T5 "*I use geometric shapes to reinforce learning*" T7
Language (Turkish)	"*I use puppets in Language (Turkish) activities for ease of comprehension, so that they may comprehend the shapes more easily*" T10 "*Shapes are used, and analogies are made so much in the stories, and I use them in rhymes and riddles*" T6
Music	"*Children may learn more easily through songs, which make their knowledge more permanent*" T2, T6
Prep. Works for Read./Writ.	"*I use works related to shapes in the workbooks*" T2

Findings regarding sub-question: How are the preschool teachers' opinions on the materials they make use of teaching geometry the most?

Table 11
The distribution of the materials that the participating preschool teachers make use of teaching geometry the most.

Material	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Total
Play dough					√	√	√				3
Sticks					√	√	√				3
Background cardboard			√		√	√					3
Daily life Examples	√			√			√	√			4
Lego/Puzzle			√							√	2
Storybook		√				√					2
Educatory play cards		√									1
Shapes being drawn on paper							√				1
Beads							√				1
Videos		√									1
Coloured tapes					√						1

As Table 11 indicates, the participating teachers used '*play dough, sticks, background cardboard, and examples from daily lives*' in teaching geometry the most.

Table 12
Preschool teachers' opinions regarding the materials they make use of teaching geometry the most.

Material	Opinions
Play dough/Sticks	"*Geometric shapes provide children with the opportunity to do themselves, and lead them to learn by doing and experiencing*" T5, T7 "*They can resemble (play doughs and sticks) to different shapes, and can thereby create new shapes*" T6
Background cardboard	"*Not only I can create shapes more easily with background cardboard, but children can also use them too*" T3, T6 "*The easiest to reach and the most practical ones are the background cardboard*" T5
Daily live Examples	"*Since all objects around us have geometric shapes, giving concrete examples from life makes teaching geometry more permanent*" T8 "*I give examples from the daily life, such as the shape of the table, the shape of the window, etc., or I can teach triangle more easily while drawing a sailboat*" T4 "*Everything around us serves as a material for teaching geometry*" T1
Lego, Puzzle	"*I use wooden puzzles, which leads them to recognize the shapes both visually, and sensually*" T10 "*I teach the shapes by reuniting the respective Legos in the classroom*" T3
Storybook	"*There are so many shape expressions in the storybooks, which draw attention of children more*" T2, T6
Educatory play cards, Shapes being drawn on paper, Beads, Videos, Coloured tapes	"*They may show the shapes (triangle, rectangle, etc.) when I draw them on paper"* T7 *"I draw shapes on the floor by using coloured tapes*" T5 "*Teaching geometric shapes may be supported by various videos*" T2

Findings regarding sub-question: What are the preschool teachers' opinions on the preschool children's geometric thinking levels?

Table 13
The distribution of the preschool teachers' opinions regarding the preschool students' geometric thinking levels.

Material	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Total
I do not have too much information		√	√	√			√				4
They learn from the concrete to the abstract	√				√			√		√	4
They know the basic shapes						√			√		2

From Table 13, it may be seen that teachers give the answers of "*I do not have too much information,*" and "*they learn from the concrete to the abstract*" the most.

Table 14
The preschool teachers' opinions regarding the preschool students' geometric thinking levels.

Theme	Opinions
I do not have too much information	"*I actually do not have so much knowledge in the theoretical sense*" T3, T4, T7 "*The things I do are mostly the things I produce myself*" T2
Learning occurs from the concrete stage to the abstract stage	"*Since the preschool children think concretely, they should be supported with more materials, and visual tools which should further be used*" T1, T10 "*We should give examples such as triangular roofs, circular tires, etc. while teaching geometric shapes*" T5 "*Children in the concrete thinking stage are more successful in geometric thinking*" T8
They know the basic shapes	"*Children come up with knowledge of basic shapes*" T6 "*They may show square, rectangle, circle, triangle shapes among the shapes being drawn on papers*" T9

Findings regarding sub-question: How are the preschool teachers' opinions on whether the courses they took in their BA degree studies help them in teaching geometry?

Table 15
The distribution of the preschool teachers' opinions on whether the courses they took in their BA degree studies help them in teaching geometry.

Teacher	Yes	No
T1		√
T2	√	
T3		√
T4	√	
T5		√
T6		√
T7		√
T8		√
T9	√	
T10		√
Total	3	7

As it can be seen from Table 15, while teachers numbered 'T2, T4, T9' think that the courses they took in their BA studies help them in teaching geometry, those numbered 'T1, T3, T5, T6, T7, T8, T10' think that the courses they took in their BA studies do not help them in teaching geometry.

Table 16
The preschool teachers' opinions on whether the courses they took in their BA degree studies help them in teaching geometry.

Theme	Opinions
I think that they are helpful	"*I suppose maths teaching module is adequate*" T2, T4 "*I suppose it is helpful, but different methods should also be used in parallel to the technology that develops and changes through time*" T9
I do not think they are helpful	"*Since the modules I took for maths teaching were mostly theoretical, they did not help much in practice*" T1, T3, T8, T10 "*We were given the geometric shapes narrowly and insufficiently within the scope of literacy skills" T5* *"I did not take my maths teaching module from a specialized instructor*" T7 "*It is not sufficient, since it is told that, only the shapes need to be told*" T6

DISCUSSION

The participating teachers' opinion on geometry teaching categorised by seven different questions from interviews. The participating teachers' self-efficacy to teach geometry are around knowledge on using materials, experience-based approach, programme knowledge and integrating geometry with different activities. This finding is parallel to Markovits and Patkin's (2021) statement about recognising the importance of geometry in teaching. Therefore, it is parallel to the current research that teachers are aware of using various aspects in teaching. However, having insufficient information on teaching methods and lack of resources lead teachers to consider themselves as not self-sufficient to teach geometry because self-efficacy is a key component to deliver educational targets (Wai Leng et al., 2021). Related to types of geometric shapes the participating teachers used, main shapes like circle, triangle, square and rectangle are commonly used, which are identified in Preschool Education Programme (see Ministry of National Education, 2013). In addition to this, the participating teachers claimed that they are teaching pentagon and hexagon, which are not included in the preschool education programme. The participating teachers' personal initiatives might be only about naming and teaching the rules of geometric shapes (Casey et al., 2008) because the preschool education programme leads teachers to teach in turn as from basic shapes to complex ones. Rectangle and square were claimed as most difficult shapes to children by the most of participating teachers, and *Cone, Globe, Prism, Star, Pentagon and Hexagon* were mentioned only couple of times. The reason for the differences can occur because of the lack of background information of teachers about the programme (Mart, 2020).

The common activities to deliver knowledge about geometric shapes are maths, play and art. From these activities, play directly provides play-based opportunity for children (Fisher et al., 2013), but art activities in Turkey are more like working on a specified task rather than having child-centred opportunities, and maths activities depend on teachers' assignments for the activity. However, children's independent and creative opportunities should be supported within such activities (Erşan, 2017). Having geometry teaching in three

different activities is more about teachers' lack of knowledge and ability to teach geometry (Zembat et al., 2014). Regarding this, the participating teachers underlined maths activities mostly, and then it was followed by play, art, drama and so on. Particularly, some of the participating teachers underlined the impact of play to have permanent geometric learning. Explanations regarding other activities are about what they do in daily activities instead of impact. While language activities are mentioned by only two participants, Markovits and Patkin (2021) underline the importance of geometric language on features and materials. This can also be supported with drama, music etc., but the statements of the participating teachers focus on only prominent activities (maths as the topic is geometry, and play as curriculum based on).

In terms of the materials used to teach geometry, the participating teachers mentioned about play dough and sticks. Using such materials provide children to comprehend geometric shapes as teachers design activities considering variety of materials (Markovits & Patkin, 2021). Björklund and Barendregt (2016) indicate in their research that there is no need to have advanced knowledge on kindergarten level skills, so teachers are required to be encouraging and leading associates in activities for children to explore features. However, the participating teachers adhere to mostly constructed materials, and tend to be traditional methods such as storybooks, play cards, shaped drawn on papers. In other case, using daily life examples to teach geometry is a common response from the participants, and this becomes more of an issue to associate with practice and knowledge (Novita et al., 2019).

The use of materials can be related to children's geometric thinking levels, and the participating teachers are likely to consider children's level to plan activities and materials to teach. As the findings show, nearly half of the participating teachers have no idea about children's geometrical thinking level, and others underline the foundational approach in early years as stating that children know basic information about geometry and learn concrete examples first. However, Korkmaz and Şahin (2020) point out in their research that children in early years have issues with even identifying basic geometric shapes and terms as well as categorising. In this case, other research examples about children having a problem with mis-identifying triangle because of locating it differently (Aslan & Aktaş Arnas, 2007). To avoid children having lack of geometric thinking and having mistaken, it is important to start teaching geometry in early age (Elia et al., 2003; Maričić & Stamatović, 2017). Therefore, preschool teachers are needed to know about children's geometric knowledge, and they should be addressing each child's needs accordingly.

Therefore, the following question was about the impact of module, teachers took in their undergraduate degree. Although there is a module: Maths Teaching in Early Childhood Education, most of the participating teachers are considered that there is no positive impact of the modules in their geometry teaching. Markovits and Patkins' (2021) research shows various stance of teachers to geometry, but the point to teach is explained as engaging with children and activities so that children can learn more. The point to teach in early years is to provide children having real life experiences instead of teaching only names of geometric shapes etc. (Björklund & Barendregt, 2016). Therefore, teachers are needed to know how to engage children in different tasks rather than directly learn how to teach. However, some statements from the participating teachers exhibit the inadequacy of module from their undergraduate degree because of containing theoretical and grounding aspects instead of practical information. In other respects, another research indicates that most of the early years teachers representing required geometric shapes in accordance with the curriculum rather than teaching them (Casey et al., 2008; Klim-Klimaszewska & Nazaruk, 2017).

CONCLUSION

Considering the aims of the research, the participating teachers' perceptions to teach geometry are more related to using materials and combining geometry with other activities, but the consideration of them as having insufficient knowledge leads teachers to focus on prominent shapes. The used activities, materials and approaches are varied considering children's geometric thinking levels. These mentioned aspects are expected to be developed by the modules, teachers attend during their undergraduate degree, but there was a criticise of the module in terms of inadequacy to enlighten teachers for future. Therefore, there is an ongoing aspect to provide a wider opportunity to teach geometry in the early years. The participating teachers' opinions on teaching geometry are related to their opportunities at schools, preschool education programme and their educational background.

In light of above aspects, the participating teachers' teaching of geometry is limited with representing geometric shapes instead of teaching them as using various experiential and concrete methods like play-based approach in early years. Therefore, teachers' knowledge to teach geometry is needed to be supported via some in-sessional courses and there is a requirement to enhance the quality of maths teaching in early childhood education module in undergraduate degree. It is also important to underline the use of materials as well as including examples from life for teaching geometry in various professional development sessions. In overall, the importance of geometry teaching in early years should be underlined in various aspects to reach teachers.

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