

## Middle School Mathematics Teachers' Activities Related to Mathematics Education<sup>1</sup>

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**Abstract:** The purpose of this research is to determine the activities carried out by middle school mathematics teachers related to learning and teaching mathematics. The study employed a case study method as one of the qualitative research designs. The research group consisted of 20 middle school mathematics teachers. Data were collected through semi-structured interviews. The data obtained were analyzed using descriptive and content analysis techniques. The research findings revealed that the activities carried out by teachers for learning and teaching mathematics were grouped into the following categories: material preparation activities, computer-assisted instruction activities, scientific activities, intellectual activities, professional development activities, and social activities. In this context, the creation of digital and face-to-face professional development communities is recommended to increase teachers' participation in activities related to learning and teaching mathematics. Furthermore, increasing the variety of activities and facilitating teachers' access to these activities is of great importance for professional development processes.

**Keywords:** *Mathematics Education, Learning Mathematics, Teaching Mathematics, Activity.*

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### 1. INTRODUCTION

In Turkey, students do not have the necessary competencies to understand mathematics in depth and use it effectively, both in international exams such as PISA (Program for International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study) and in national exams administered for high school and university entrance (Ministry of National Education [MoNE], 2019). Due to students' belief that mathematics is complex, teachers must be careful in teaching mathematics (Yenilmez & Özbey, 2006). Positive changes in teachers' attitudes and thoughts toward mathematics can also have a positive impact on school mathematics (Baki, 2019). These positive changes can lead to students' understanding of mathematics and a decrease in negative ideas about it.

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Teachers' pedagogical and professional competencies are crucial in the process of transferring mathematical knowledge. Indeed, teaching mathematics is a process based on a teacher's teaching knowledge and experience (Baki, 2019). Learning mathematics involves not only acquiring basic concepts and skills, but also thinking critically about mathematics, developing problem-solving strategies, and recognizing that mathematics is an integral part of the activities we engage in daily (Köğce et al., 2019; MoNe, 2009). Therefore, the teacher needs to consider the holistic process of learning and teaching mathematics in order to enhance the quality of instruction.

Undoubtedly, one of the most fundamental elements of education is teachers. The quality of teaching depends on teachers. Teachers are the ones who carry out instructional activities in a programmed and planned manner in learning environments (Ünlü, 2023). According to Ball et al. (2008), an individual who teaches mathematics should have a broad perspective on the field of mathematics. Teachers' learning is often referred to as professional learning (Kwakman, 2003). Professionally trained teachers can provide quality learning environments for their students (Seferoğlu, 2004). In this context, teachers should enable students to experience the relaxing and enjoyable aspects of mathematics and actively engage them in the learning process through activities (Köğce, 2020; Sarpkaya-Aktaş, 2018). At the same time, the teacher should increase students' motivation to enable them to learn subjects more effectively and support them in their learning process by designing various activities (Duman, 2023).

Activity can be defined as a learning or studying process in which an individual interacts with their environment and participates willingly (Uğurel & Bukova-Güzel, 2010). The concept of mathematical activity can be explained as the individual taking responsibility and fulfilling a mathematical task with the help of various tools and equipment (Bozkurt, 2012). The concept of activity, which holds a significant place in the scope of the Turkish Century Education Model Middle School Mathematics Curriculum, exhibits a multifaceted structure encompassing different meanings and areas of implementation both in daily life and in the educational process. How middle school mathematics teachers participate in learning and teaching activities not only contributes to their professional development but also carries a critical dimension that directly affects students' attitudes toward mathematics, problem-solving skills, and achievement. Indeed, it is known that professional development programs for teachers in mathematics and science significantly improve teachers' knowledge levels and teaching practices in a significant manner, and that this development is positively reflected in student achievement (Lynch et al., 2025). The activities that teachers participate in increase the quality of teaching by supporting their pedagogical content knowledge and classroom practices. In this context, identifying the activities in which teachers participate is crucial. Identifying the activities that teachers participate in can be seen as an important requirement for evaluating the quality of teaching processes and informing professional development policies. Within the scope of the Primary School Mathematics Teaching Undergraduate Program updated in 2018, prospective teachers take courses such as "Instructional Technologies", "Extra-curricular Activities in Education", "Project Preparation in Education", "Out-of-school Learning Environments in Mathematics Education", "Computer-Assisted Mathematics Teaching",

“Culture and Mathematics”, “Activity Development in Mathematics Teaching” and “Material Design in Mathematics Teaching” (Council of Higher Education [CoHE], 2018). Through these courses, teacher candidates aim to gain knowledge and experience in areas such as utilizing educational technologies, planning and managing social, cultural, sporting, and artistic activities, preparing and executing projects, organizing teaching activities in out-of-school learning environments, and producing and implementing interactive activities using computer-based software. In addition, it is aimed at prospective teachers to gain competence in developing classroom activities for different cultural contexts and designing various teaching materials, as well as the importance and purpose of using activities in mathematics teaching. However, there is a need for up-to-date and detailed data on the extent to which the knowledge and skills that prospective teachers acquire during their undergraduate studies are applied in their professional lives, as well as the degree to which teachers participate in such activities. This situation is important for evaluating the effectiveness of teacher preparation programs.

The importance placed on teachers' activities is evident not only in curricula but also in international research examining teachers' professional development. The Teaching and Learning International Survey (TALIS) is an important international study on teachers, school administrators, and learning environments (Ceylan et al., 2020). Findings in the TALIS 2018 Türkiye report show that teachers have a high level of participation in professional development activities. Furthermore, the report noted that 86% of teachers in Turkey had attended a course or seminar within the past year, and 33.3% had participated in a program that provided formal qualifications. Furthermore, the same report determined that 85.9% of teachers stated that the training they attended included curriculum knowledge issues (Ceylan et al., 2020). However, although the TALIS report includes teachers' participation in professional development activities, it points out that teachers are inadequate in examining different types of activities, such as teaching material preparation, computer-aided teaching, scientific, intellectual, social, and professional development activities. Determining teachers' participation levels in these activities is crucial for improving the quality of the teaching and learning process. Identifying such activities can provide valuable data for identifying and developing teacher competencies. Furthermore, determining teachers' participation levels in these activities can also help shape educational policies. This study, which examines the activities of teachers in learning and teaching mathematics, offers important insights and clues for understanding and addressing the current situation. In this context, the study aims to determine the activities of middle school mathematics teachers related to learning and teaching mathematics. By examining these activities, the study aims to make significant contributions to the evaluation of teacher training programs and the quality of education.

## **2. LITERATURE REVIEW**

Upon examining the literature, it became apparent that teachers had limited experience in utilizing the activities effectively (Balcıoğlu, 2013; Uğurel et al., 2010). In some studies, it has been found that teachers generally prefer activities that require passive participation (Can et al., 2012; Öçalan et al., 2013). In contrast, Kul (2019) revealed in his study that female teachers were more involved in activities that required active participation. In Avcı's (2009) study, it was observed that teachers engaged in active participation activities such as physical exercises,

painting, playing musical instruments, and gardening, while they participated in passive activities such as watching television, listening to the radio, and going to the cinema and theatre. In studies, it was determined that the activities in which teachers participate most are reading books, newspapers or magazines, watching TV, listening to music, going to the cinema or theatre, participating in sports activities, surfing the internet, participating in online chats, playing computer games, relaxing and spending time with friends (Aşkın, 2016; Biçimli, 2019; Can et al., 2012; Eroler, 2015; Kaya & Tural, 2005; Kul, 2019; Öçalan, Altay-Öcal & Yörübulut, 2013; Selçuk & Akdağ, 2020; Tunçel, 1999). In contrast, teachers were found to be less likely to participate in activities such as gambling, participating in astroturf tournaments, hunting, and shooting. Öçalan et al. (2013) emphasized that teachers generally do not prefer social, cultural, and sportive activities. Selçuk and Akdağ (2020) found that teachers predominantly preferred artistic activities such as music, painting, theatre, handicrafts, and photography during their leisure time. Kaya and Tural (2005) also revealed that teachers participated in scientific activities that they were interested in during their free time. In studies on professional development activities, it has been determined that teachers mostly attend seminars, workshops, conferences, and panels; they also engage in activities such as preparing teaching materials, visiting a different school, reading publications related to their field, and participating in blogs and forums (Doğan et al., 2023; İlğan, 2013; Özdemir, 2013; Yirci, 2017).

In conclusion, studies examining the activities attend by middle school mathematics teachers in detail are pretty limited. This demonstrates the need for qualitative research that will reveal in-depth the activities middle school mathematics teachers engage in for learning and teaching mathematics. In this context, the current study aims to make significant contributions to the literature by qualitatively examining the types of activities that secondary school mathematics teachers perform.

### **3. METHODOLOGY**

#### ***3.1. Research Design***

In this study, the special case study method was used. A case study is one of the qualitative research designs that aims to examine a particular individual, group, or process in depth and to understand the situation within its natural context (Fraenkel et al., 2012). In the study, the activities carried out by teachers regarding learning and teaching mathematics were determined through interviews with middle school mathematics teachers.

#### ***3.2. Participants***

The research group was purposefully selected from middle school mathematics teachers. The study group consisted of 20 middle school mathematics teachers, 13 of whom were female and 7 of whom were male, who volunteered for participation. Seven of these teachers had master's degrees, and 12 were graduate students. Teachers who were currently pursuing or had completed their master's degree participated in a variety of activities, including teaching material preparation activities, computer-assisted teaching activities, and professional development activities, as well as scientific, intellectual, and social activities.

### **3.3. Data Collection**

In this study, data were collected through semi-structured interviews. This method does not have the exact clear boundaries as structured interviews, nor is it as flexible as unstructured interviews (Karasar, 2012). Interviews were conducted face-to-face. In the interviews, the teachers were asked the question “What kind of activities do you do as a teacher to learn and teach mathematics?” Participants were informed before the interviews that their names would be kept confidential and that the data collected would be used solely for research purposes. To prevent data loss, the interviews were audio-recorded, then transcribed and edited. Each interview lasted approximately 20-30 minutes, and participants were allowed to express their opinions freely.

### **3.4. Data Analysis**

The analysis of the interview data was conducted using descriptive and content analysis methods in accordance with the qualitative research design. Yıldırım and Şimşek (2008) outline content analysis in four basic stages: coding the data, identifying the themes within the coded data, organizing the codes and themes, and defining and interpreting the findings. Firstly, the interview records were transcribed, and a raw data set was created. Then, the data were coded by two researchers. In analyzing the interview data, groups were formed based on the similarity of the statements. The teachers whose opinions were consulted were given numbers in the form of T1, T2, T3, ..., and T20.

During the coding process, the key concepts that emerged in the participants' opinions were identified, codes appropriate to these concepts were developed, and categories were formed by combining similar codes. The codes obtained from the interviews were presented in tables. In the study, the data were divided into meaningful pieces. After the teachers' opinions were coded to ensure internal validity, the codes were supported with direct quotes within the scope of descriptive analysis. To ensure the reliability of the data, the codes were repeatedly reviewed, and the findings obtained at the end of the analysis process were presented in accordance with the research purpose. Furthermore, Miles and Huberman's (1994) formula, “Consensus Percentage = (Consensus / (Consensus + Disagreement) x 100,” was used to ensure the reliability of the research. The reliability of this coding was calculated as 94.0%.

## **4. FINDINGS**

This section presents the activities middle school mathematics teachers engage in for learning and teaching mathematics.

The teaching material preparation activities performed by teachers are listed in Table 1:

**Table 1.** *Teaching Material Preparation Activities Performed by Teachers*

Category	Codes	<i>f</i>
<b>Instructional Material Preparation Activities</b>	1. Preparing concrete materials	5
	2. Preparing mathematics-related games	3
	3. Preparing mathematics-related exhibitions	2
	4. Adapting traditional games to mathematics	1
	5. Adapting mind games to mathematics	1
	6. Preparing digital materials	1
	7. Preparing mathematics boards	1
	8. Writing mathematical questions	1

According to Table 1, preparing concrete materials is the most frequently used teaching material preparation activity by mathematics teachers, mentioned 5 times. Preparing mathematics-related games (*f*:3) and creating exhibitions (*f*:2) are less frequently performed activities. Writing mathematics problems, adapting traditional games and mind games to mathematics, and preparing digital materials and math boards are the least frequently performed instructional material preparation activities.

In the performed interviews, some teachers expressed their opinions about their instructional material preparation activities as follows:

*“I prepare materials and take them to class. For fractions, I prepare rods and use fraction blocks. It depends on the topic. I make geometric objects like cubes and prisms myself”. (T19)*

*“We hold competitions using mind and intelligence games in class. We use games from our own culture, such as chess and mangala. We held a mind games tournament”. (T7)*

*“We hold project exhibitions at the end of each year. With these projects, students design games that address a learning outcome related to mathematics”. (T16)*

*“We hold exhibitions every year in schools for TÜBİTAK projects”. (T13)*

T19 emphasized that he used rods and fraction blocks as concrete materials when teaching fractions and that he also prepared geometric objects such as cubes and prisms himself. T7 explained that he held tournaments among students using mind games such as chess and mangala. T16 stated that they organize annual project exhibitions to showcase the games they designed to address students' mathematical learning outcomes. Similarly, T13 explained that they hold annual exhibitions for TÜBİTAK projects.

The computer-assisted teaching activities implemented by teachers are presented in Table 2:

**Table 2.** *Computer-Assisted Teaching Activities Implemented by Teachers*

Category	Codes	<i>f</i>
<b>Computer-Assisted Teaching Activities</b>	1. Participating in online meetings	4
	2. Researching websites	2
	3. Showing students videos about the biographies of famous mathematicians	2
	4. Learning how to use mathematical software	1
	5. Creating games using Web 2.0 tools	1
	6. Learning how to use Web 2.0 tools	1
	7. Visiting online mathematics museums	1

According to Table 2, it is understood that attending online meetings is the most frequently performed computer-assisted teaching activity, mentioned 4 times. Conducting research on websites (*f*:2) and having students watch videos about the biographies of famous mathematicians (*f*:2) were less frequently performed activities. It is seen that learning how to use mathematical software and Web 2.0 tools, creating games using Web 2.0 tools, and visiting online mathematics museums were the least frequently performed computer-assisted instruction activities.

In the interviews, some teachers expressed their opinions about the computer-assisted instruction activities they conducted with the following statements:

*“I participate more in online meetings held on social media”. (T9)*

*“I keep track of what I can do online. I look for pages that mention such activities”. (T6)*

*“When it is relevant to the topic, for example, when there is a topic on Pythagoras in 8th grade, I show students a video about Pythagoras’s life. I think it is effective in showing students how the Pythagorean theorem emerged, how it was discovered, and what conditions were involved”. (T13)*

T9 stated that he participated in online meetings via social media. T6 said that he researched activities that could be used in mathematics classes on websites. T13 stated that when teaching Pythagoras, he showed a video about Pythagoras’ life and works. He emphasized that he found these videos effective in conveying the history of mathematical concepts to students.

The scientific activities conducted by teachers are shown in Table 3:

**Table 3.** *Scientific Activities Conducted by Teachers*

Category	Codes	<i>f</i>
<b>Scientific Activities</b>	1. Participating in TÜBİTAK projects	10
	2. Reading articles about mathematics	4
	3. Reading dissertations about mathematics	3
	4. Writing dissertations about mathematics	2
	5. Participating in TEKNOFEST	2
	6. Participating in e-twinning projects	2
	7. Participating in science fairs	2
	8. Participating in science festivals	2
	9. Writing proceedings about mathematics	1
	10. Participating in mathematics conferences	1
	11. Participating in mathematics congresses	1
	12. Participating in mathematics panels	1
	13. Writing projects about mathematics	1
	14. Participating in mathematics symposiums	1
	15. Organizing science festivals	1

According to Table 3, participating in TÜBİTAK projects was the most frequently engaged scientific activity, mentioned 10 times. This activity was followed by writing mathematics-related articles ( $f:4$ ) and reading theses ( $f:3$ ). Writing mathematics-related theses and participating in TEKNOFEST, e-twinning projects, science fairs, and science festivals ( $f:2$ ) were activities of the same frequency but occurred less frequently. Writing mathematics-related proceedings and projects, attending mathematics-related conferences, congresses, panels, symposiums, and organizing science festivals were the least frequently engaged scientific activities.

In the interviews, some teachers expressed their opinions about the scientific activities they participated in with the following statements:

*“As a school, we have been participating in TÜBİTAK projects like 4006 for about four years. We have had some great work done on this”. (T13)*

*“I have been reading, reading doctoral and master’s theses. I read and review articles”. (T15)*

*“I benefit from articles, books, and theses by experts”. (T2)*

*“I think a topic can be explained by avoiding monotony, making it active and gamifying, and also involving children in the activity. I mentioned these in my thesis study. I also researched mathematical thinking methods. I think this has been effective in increasing my learning and teaching tendencies”. (T13)*

T13 emphasized that he participated in TÜBİTAK projects for four years. T15 and T2 stated that he read theses and articles on mathematics. T13 stated that his thesis was effective in increasing his tendencies in learning and teaching mathematics.

The intellectual activities engaged in by the teachers are presented in Table 4:

**Table 4.** *Intellectual Activities Engaged by the Teachers*

Category	Codes	<i>f</i>
<b>Intellectual Activities</b>	1. Reading books about mathematics	6
	2. Playing mind and intelligence games	6
	3. Organizing math competitions	3
	4. Solving intelligence questions	1

According to Table 4, reading books about mathematics and playing mind and intelligence games are the most frequently engaged intellectual activities, mentioned six times. Organizing math competitions is a relatively underutilized intellectual activity. Solving intelligence questions is the least frequently engaged intellectual activity.

In the interviews, teachers expressed their opinions about the intellectual activities they engage in with the following statements:

*“I had two books that I really enjoyed reading. One was “Mathematics Without Numbers”, for example, which I had read before”. (T7)*

*“There is a book by Van de Walle. It is a great guide for me. I read it when I am confused or forget mathematical concepts”. (T14)*

*“We have games called mind games. We spend the last ten minutes of related classes learning how to play these games. For example, students play tic-tac-toe; they play a corridor game”. (T16)*

T7 stated that he enjoyed reading the book “Mathematics Without Numbers”, while T14 said he read Van de Walle’s book whenever he needed it. T16 stated that he included mind games, such as tic-tac-toe and the corridor game, in his lessons.

The professional development activities performed by the teachers are shown in Table 5:

**Table 5.** *Professional Development Activities Performed by the Teachers*

Category	Codes	<i>f</i>
<b>Professional Development Activities</b>	1. Participating in mathematics-related training (in-service seminars, courses)	27
	2. Pursuing a master’s degree	13
	3. Relating mathematics to other disciplines	4
	4. Receiving online mathematics-related training	3
	5. Participating in mathematics-related workshops	3
	6. Exploring the relationship between mathematics and daily life	2
	7. Conducting studies on mathematical modeling	2

According to Table 5, it is understood that attending mathematics-related training is the most frequently performed professional development activity, mentioned 27 times. The other most frequently performed professional development activity is pursuing a master's degree ( $f:13$ ). This is followed by relating mathematics to other disciplines ( $f:4$ ), taking online mathematics training, and attending mathematics workshops ( $f:3$ ). Exploring the relationship between mathematics and daily life ( $f:2$ ) and conducting studies on mathematical modeling ( $f:2$ ) are the least frequently undertaken professional development activities.

In the interviews, some teachers expressed their opinions about their performed professional development activities as follows:

*“There was training provided by the Measurement and Evaluation Center to help prepare math questions more easily for exams and measure their students' success. I attended both of them”. (T12)*

*“When I was first appointed, I took a course on adding and subtracting with my fingers. We also started working with students. I also attended a training on mental addition and subtraction”. (T10)*

*“I attend as many math-related seminars as possible to improve myself. I participate in courses such as Mind Games and Chess. I have already received the certificate. For example, I attended seminars and courses on mathematical literacy”. (T13)*

*“One of the biggest reasons to pursue for my master's degree was to be able to learn and teach how to write school projects.”. (T18)*

T12 emphasized that he participated in exam preparation training provided by the Measurement and Evaluation Center. T10 stated that he took a course on adding and subtracting with fingers to improve mental addition and subtraction skills. T13 stated that he participated in mind games and chess courses, as well as seminars and courses on mathematical literacy. T18 stated that he started his master's degree so that he could learn and teach how to write school projects.

The social activities performed by the teachers are presented in Table 6:

**Table 6.** *Social Activities Performed by the Teachers*

Category	Codes	<i>f</i>
<b>Social Activities</b>	1. Attending math-related exhibitions	3
	2. Visiting math museums	2
	3. Following people working on math-related topics on social media	2
	4. Creating math-related blogs	2
	5. Conducting math-related research on social media	1
	6. Communicating with math teachers on social media	1
	7. Organizing math-related activities at non-governmental organizations	1
	8. Starting math-related clubs	1

According to Table 6, it is understood that attending mathematics-related exhibitions is the most frequently performed social activity, mentioned 3 times. Visiting mathematics museums (*f*:2), following people working on mathematics on social media (*f*:2), and creating mathematics-related blogs (*f*:2) were less frequently engaged activities. Conducting mathematics-related research on social media, communicating with mathematics teachers on social media, organizing mathematics-related events at non-governmental organizations, and setting up mathematics-related clubs were the least frequently engaged social activities.

In the interviews, some teachers expressed their views on social activities with the following statements:

*“Some schools hold TÜBİTAK exhibitions. We are invited to them. We go there as a class”. (T13)*

*“I myself participated in a mathematics museum trip. I had the opportunity to visit the mathematics museum in Sincan”. (T2)*

*“I follow people on YouTube or Instagram who are working on mathematics education. I try to apply, do, or understand their work”. (T14)*

*“I have a page on Instagram called “1000 Tane Matematik (Thousands of Mathematics)”. I share my work there”. (T16)*

*“I have my own Instagram blog page. On this page, I share the work I do with my fellow teachers. I think this is effective”. (T20)*

T13 stated that schools invited him to TÜBİTAK exhibitions and attended these exhibitions with his students. T2 said he visited the Sincan Mathematics Museum. T14 stated that he follows individuals working on mathematics education on social media platforms such as YouTube and Instagram. He also stated that he tries to implement the work of those he follows. T16 explained that he has a mathematics-related Instagram blog page where he shares his work. T20 emphasized that he has a mathematics-related Instagram blog page, where he shares his work to benefit his colleagues.

## 5. RESULTS AND DISCUSSION

In this study, it was determined that teachers prepared numerous teaching materials for learning and teaching mathematics, conducted computer-aided teaching and professional development activities, and engaged in scientific, intellectual, and social activities.

In the research, it was found that teachers conducted numerous preparation activities for teaching materials during the learning and teaching processes. Of these, the activities in which teachers most frequently participated were preparing concrete materials, organizing mathematics competitions, and preparing mathematics-related games. The prominence of these types of activities demonstrates that teachers are striving to both increase students' interest in mathematics and to concretize abstract mathematical concepts. Kwakman (2003) similarly found that teachers' most frequent professional learning activities were preparing course materials. A study by Garay-Abad and Hattie (2025) also concluded that teachers found concrete materials beneficial for teaching and professional development. In Gündüz's (2011) study, it was emphasized that teachers included activities such as concept mapping, mind mapping, and preparing visual materials outside the classroom. Uygun (2023) also noted that preservice classroom teachers preferred to develop both concrete and digital materials within the context of their mathematics teaching course.

This study revealed that teachers employed various computer-assisted teaching activities during the learning and teaching of mathematics. It was seen that teachers were particularly found to engage in computer-assisted instructional activities such as attending online meetings, conducting research on websites, and having students watch videos about the biographies of famous mathematicians. It can be argued that teachers use technological tools in this digital age to both access information and increase student motivation. In Eroglu's (2015) study, it was revealed that teachers tend to surf the internet and engage in online chatting. Similarly, Kul (2019) determined that a large majority of preservice teachers use the internet in their free time. Additionally, the study by Yıldız and Mollaahmet (2023) found that all pre-service mathematics teachers used the Educational Informatics Network (EBA), educational websites, and social media groups as instructional portals in teaching the topic of polygons. İnam's (2014) study revealed that web-assisted instruction in a mathematics applications course increased students' interest, attention, and motivation, and also improved their ability to understand and implement activities.

It was concluded that teachers engage in many scientific activities during the learning and teaching of mathematics. Findings indicate that teachers are most likely to participate in TÜBİTAK projects and to read articles and theses related to mathematics. Activities such as TÜBİTAK projects can provide mathematics teachers with opportunities to develop materials that concretize abstract concepts. Teachers can transfer the knowledge and experience they gain from such projects to their learning and teaching processes. The fact that the study group consisted of teachers with master's degrees and those currently pursuing master's degrees may be a reason why teachers follow scientific publications, such as articles and theses. Similarly, in Eroğlu and Özbek's (2020) study, teachers identified project work and competitions as

processes that contribute to their professional learning. Aytaç's (2018) study also supports these findings, showing that a significant portion of teachers follow scientific publications or media programs related to their fields of expertise. On the other hand, Dağ's (2016) research, conducted with science teachers, revealed that teachers prefer to use the Internet, read articles, and watch television programs to obtain information in the fields of science, teaching, technology, and education. In Dağ's (2016) research, it was stated that reading articles was the second most frequently performed activity by teachers, indicating that teachers were interested in scientific sources. However, factors such as access, time, and language negatively affected these preferences.

It has been revealed that mathematics teachers also engage in intellectual activities during the teaching and learning process. Findings indicate that teachers are most likely to read books about mathematics and play games that stimulate mental and intellectual development. It can be argued that teachers engage in reading activities to maintain their current content knowledge and to support their teaching processes. Furthermore, the fact that mind and intelligence games develop mathematical thinking, problem-solving, and logical reasoning skills may have led mathematics teachers to prefer these activities (Applebaum, 2025). In Kul's (2019) study, the majority of teachers reported engaging in reading activities in their free time, indicating that reading is an everyday intellectual activity among teachers. Similarly, Kwakman (2003) found that reading activities are the professional learning activity that teachers most frequently engage in. Eroğlu and Özbek (2020) stated that teachers most frequently participate in activities to update professional knowledge and skills, and that reading activities are the most frequently included among these activities.

It was also observed that teachers participate in various professional development activities during the teaching and learning of mathematics. The most common professional development activities teachers participate in are attending mathematics-related training and pursuing a master's degree. The mandatory in-service training programs run by the MoNE may be effective in encouraging teachers to participate in mathematics-related training. Furthermore, the fact that the majority of the teachers participating in the study had a master's degree may be a contributing factor. In Yirci's (2017) study, it was also noted that teachers strive to stay current in their fields by adhering to legislation and attending training seminars, conferences, and other professional development opportunities.

Research findings have revealed that teachers also incorporate social activities into the learning and teaching of mathematics. Among the most common social activities teachers engage in are attending mathematics-related exhibitions, visiting mathematics museums, following people conducting mathematics-related research on social networks, and creating mathematics-related blogs. The widespread use of social media today can be considered an important factor supporting teachers' orientation to social media environments, both in their own learning processes and in their teaching practices. At the same time, museums are effective learning environments for mathematics teaching (Casi & Sabena, 2024; Yıldız, 2013; Yıldız & Göl, 2014). It has been revealed that teachers reinterpret mathematics within a cultural context

through the activities they organize in museums. However, Dağ (2016) revealed that teachers face limitations in participating in social and cultural activities, such as theater plays, concerts, congresses, and symposia, due to financial difficulties, a lack of time, and transportation problems. On the other hand, in Yaylak's (2017) study, it was emphasized that social studies teachers prefer to use social media due to its contribution to education and communication. Doğan and colleagues (2023) stated that teachers learn about other teachers' real-life practices by utilizing social interaction platforms, such as blogs and forums, where colleagues share their experiences and insights. Similarly, Anderson and Williams (2023) found that mathematics teachers participated in online groups but served as secret observers, not actively engaging and instead transferring the knowledge they acquired from virtual environments to others. On the other hand, Nelimarkka and colleagues' (2021) study demonstrates that social media communities contribute superficially to teachers' professional development and are insufficient to provide pedagogical depth.

## 6. RECOMMENDATIONS

Considering the results of the study, the following implications are presented:

1. Within the scope of the research, it was observed that teachers participated in various scientific activities (participating in TÜBİTAK projects, reading articles and dissertations about mathematics etc.) during the mathematics teaching process. In this context, mentoring programs can be developed to increase teacher participation in projects such as TÜBİTAK.
2. It was determined that teachers develop in various intellectual activities (reading books about mathematics, playing mind and intelligence games etc.) during the mathematics learning and teaching process. It was determined that teachers read mathematics-related books as part of these intellectual activities. In this context, school libraries and mathematics libraries can be enriched.
3. Digital and face-to-face professional development communities can be formed to increase teacher participation in activities related to mathematics learning and teaching.
4. It was determined that teachers engage in social activities that support the teaching-learning process. Social media platforms can be developed by the Ministry of National Education, considering the active use of social media platforms by teachers.
5. This study, conducted with middle school mathematics teachers, can also be conducted with secondary school mathematics teachers or prospective mathematics teachers.

## 7. ABOUT THE AUTHORS

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