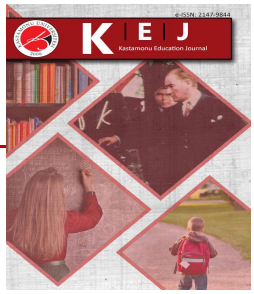
Kastamonu Education Journal, 2023, Vol. 31, No:4, 662-682
doi: 10.24106/KEFDERGI-2023-0032



| Research Article / Araştırma Makalesi |

Middle School Teachers' Views on Mathematical Creativity and Supporting Mathematical Creativity[1]

Ortaokul Öğretmenlerinin Matematiksel Yaratıcılığa ve Matematiksel Yaratıcılığın Desteklenmesine Yönelik Görüşleri

Mine Turan[2] , Şeyma Şengil Akar[3], Elif Saygı[4]

Keywords

1. Creativity
2. Mathematical creativity
3. Teachers who supports creativity
4. Middle school mathematics teachers

Anahtar Kelimeler

1. Yaratıcılık
2. Matematiksel yaratıcılık
3. Yaratıcılığı destekleyen öğretmen
4. Ortaokul matematik öğretmenleri

Received/Başvuru Tarihi
07.04.2023

Accepted / Kabul Tarihi
04.08.2023

Abstract

The aim of this study is to examine middle school mathematics teachers' views on mathematical creativity. Phenomenology, one of the qualitative research designs, was used in the study. Ten middle school mathematics teachers, who are actively working, participated in the research. Purposive sampling method was used to determine the participants. In order to collect the data in the research, first of all, a teacher behavior scale that encourages creativity was applied to ninety-two middle school mathematics teachers. Then, semi-structured interviews were conducted with ten teachers with high scores. In these interviews, teachers were asked questions to support mathematical creativity. The obtained data were analyzed with descriptive analysis. As a result of the research, it was seen that teachers emphasized the concept of creativity with originality, and they emphasized problem solving, originality and high-level thinking for the concept of mathematical creativity. These views are concepts that many researchers have mentioned in the literature. Therefore, many of the opinions of the mathematics teachers interviewed are valid expressions for mathematical creativity.

Öz

Bu çalışmanın amacı, ortaokul matematik öğretmenlerinin matematiksel yaratıcılığa yönelik görüşlerini incelemektir. Araştırmada nitel araştırma desenlerinden biri olan olgu bilim çalışması kullanılmıştır. Araştırmaya, aktif olarak görev yapmakta olan on ortaokul matematik öğretmeni katılmıştır. Katılımcıları belirlemek için amaçlı örnekleme yöntemi kullanılmıştır. Araştırmada verileri toplamak için öncelikle doksan iki ortaokul matematik öğretmenine yaratıcılığa teşvik edici öğretmen davranışları ölçeği uygulanmıştır. Ardından yüksek puan alan on öğretmen ile yarı yapılandırılmış görüşmeler yapılmıştır. Bu görüşmelerde öğretmenlere matematiksel yaratıcılığı desteklemeye yönelik sorular sorulmuştur. Elde edilen veriler betimsel analiz ile analiz edilmiştir. Araştırmanın sonucunda, öğretmenlerin yaratıcılık kavramına orijinallik ile vurgu yaptıkları, matematiksel yaratıcılık kavramı için problem çözmeyi, orijinalliği ve üst düzey düşünmeyi vurguladıkları görülmüştür. Bu görüşler alan yazında da birçok araştırmacının değindiği kavramlardır. Dolayısıyla, görüşme yapılan matematik öğretmenlerinin görüşlerinin birçoğu matematiksel yaratıcılık için geçerli ifadelerdir.

[1] This article is produced from Mine Turan's master's thesis entitled “Investigation of the Processes of Supporting Mathematical Creativity of Middle School Teachers”.

[2] Mine TURAN, Hacettepe University, Department of Mathematics and Science Education , Ankara, Turkiye. https://orcid.org/0009-0002-8683-5537

[3]***Corresponded Author:*** Şeyma ŞENGİL AKAR, Kastamonu University, Department of Primary Education, Kastamonu, Turkiye. https://orcid.org/0000-0002-0032-7439

[4] Elif SAYGI, Hacettepe University, Department of Mathematics and Science Education, Ankara Turkiye. https://orcid.org/0000-0001-8811-4747

INTRODUCTION

In this rapidly changing world, the new generation must have the necessary knowledge, skills and qualifications to keep up with the age. The new generation skills that successful individuals should have are problem solving, metacognitive thinking, critical and creative thinking skills (Yükseltürk and Altıok, 2016). Research on the concept of creativity started in the 1950s and has continued until today (Esi, 2018). Creativity is encountered not only in the field of art or science, but in every part of daily life (Craft, 2003; Pehkonen, 1997). Creativity has an important place in the field of education for the development of countries and the training of people who will make inventions (Esi, 2018). There is no single accepted or used definition of creativity in studies (Haylock, 1997; Pehkonen, 1997). Although the definition of creativity changes over time (Leikin; 2009), Mann (2006) stated that there are more than 100 definitions of creativity. However, there are some features that are common to all definitions. According to Plucker, Beghetto and Dow (2004), when the definitions for creativity in the literature are examined, novelty and usefulness as common concepts in creativity appears. For example, Sternberg and Lubart (2000) defined creativity as the process by which a useful and adaptable product of extraordinary originality is produced. This definition can encompass many features of creativity.

Torrance (1974) mentions four components of divergent thinking which is referee to creativity are fluency, flexibility, originality (authenticity) and elaboration (as cited in Leikin, 2009). While fluency means the continuity of ideas, the flow of reasoning and the use of universal and basic knowledge, flexibility is about being able to change ideas, look at a problem from different perspectives and produce different solutions to a problem (Akgül, 2021; Leikin, 2009). While originality is defined as a unique way of thinking, mentally and artistically creating unique products, elaboration is explained as clarifying, defining and generalizing ideas (Akgül, 2021; Leikin, 2009). The concept of originality, which is one of these four components, is the most mentioned component of creativity because creativity is seen as putting forward original ideas and products (Leikin, 2009).

Although creativity was considered as a general skill in the early days, studies have revealed that creativity is a field-specific concept (Leikin, 2009; Mann, 2005; Sriraman, 2005). Thus, after the general definitions of creativity, mathematical creativity, which is field-specific, appeared as a concept. Just as there is no single accepted, precise definition of creativity in general, there is no single definition of mathematical creativity (Haylock, 1997; Mann, 2006). According to Krutetskii (1976), mathematical creativity is to formulate incomplete mathematical problems, find ways to solve these problems, find theorems and proofs, find original methods and solve non-standard problems. Balka (1974) expressed creative ability in the field of mathematics as using the mathematical structures in our minds to obtain a solution to mathematical situations. Mathematical creativity is the ability to find new solutions to problems and apply mathematical principles in different ways to produce mathematically correct results (Bahar & Maker, 2011). Adapting the components of creativity introduced by Torrence (1974) for problem solving, Silver (1997) defines the fluency component as generating too many ideas and finding many already existing solutions to a problem. While explaining the flexibility component as producing many different solutions, he uses the expression of finding new, extraordinary solutions for originality.

The concept of mathematical creativity is also encountered in research on the support and development of mathematical talent (Shieffield, 1994; Şengil-Akar, 2018) because mathematical creativity is one of the basic elements of the development of mathematical talent (Mann, 2005). Sheffield (1994), examining the development of mathematical talent, stated that the top stage of the development process in her theory is creativity in mathematics. Sheffield (1994) divided talent development into six stages. While individuals who are at the lowest stage, being the stage of ignorance, cannot even understand the logic of simple calculations, creators who are at the highest stage are defined as individuals who construct mathematics. Accordingly, it can be said that the thinking skill that enables the construction of the science of mathematics is creativity. In addition, when answering the question of at which level the creativity should be in children, we encounter the definition of relative creativity (Leikin, 2009). While absolute creativity is defined as being able to make mathematical discoveries at the adult level, relative (sample-based) creativity refers to the creativity that K-12 level students can exhibit in school (Csikszentmihalyi, 1988; as cited in Akgül, 2021). Children are creative while discovering (constructing) different structures at their own level, producing different solutions to problems and trying to produce different problems (Usiskin, 2000). Through mathematical creativity, students improve their problem solving ability by finding original solutions (Sriraman, 2004). In addition, this concept is part of the mathematical thinking skill, because creativity plays a vital role in advanced mathematical thinking (Ervynck, 1991; Mann, 2006).

Mathematical creativity is seen as an important skill to be demonstrated by students in schools, expected to be supported by teachers and to be mastered for the development of mathematical talent (Şengil-Akar, 2017; Şengil-Akar, 2021). In the Middle School Curriculum (2013) of the Ministry of National Education, it was stated that one of the skills that should be imparted to students is creative thinking. The most important factor in supporting mathematical creativity skill is mathematics education in schools (Leikin, 2009). One of the important factors in supporting mathematical creativity is the activities given to students in classes (Sak and Maker, 2006; Sternberg and Davidson, 2005; Şengil-Akar, 2021). Mathematical creativity should be included in classroom activities because creativity is not a static skill; on the contrary, it is a dynamic skill that can be developed with activities (Leikin, 2009). Therefore, teachers have a great influence on creativity because the activities carried out in the classroom are decided and conducted by the teacher (Yıldız and Baltacı, 2018). In order to develop mathematical creativity, teachers need to

bring rich activities and problems to the classroom and create environments that enable students to make decisions and think on their own (Sheffield, 2006). The traditional teaching method, which uses closed-ended questions with predetermined answers, is not sufficient for learning mathematics. In schools that teach in this way, students acquire calculation skills, but they cannot notice the meaningful ways necessary for mathematics (Mann, 2006). According to Sheffield (2006), while learning mathematics, students should not only know the procedures and concepts, but also discover new concepts and solve problems in original ways. Problem solving and problem posing activities can be used as basic tools for the development of mathematical creativity of all students (Sheffield, 2006; Pehkonen, 1997). According to Silver (1997), mathematics teaching enriched with creativity contributes to students making different representations for solutions, being flexible, fluent and original while finding a solution. Open-ended mathematics activities enable students to use divergent thinking skill while doing the activity and improve students' creative thinking skill (Haylock, 1997; Leikin and Lev, 2013; Mann, 2006). In fact, although all the examples given emphasize that mathematical creativity develops through the given activities and in the classroom, it is the teacher who gives, develops these activities, presents them in the classroom and creates this educational environment. In this context, investigation of whether teachers are aware of this fact is one of the purposes of the current study.

The teacher plays an important role in supporting mathematical creativity because it is difficult for students of a teacher who is unwilling to support creativity to display such behaviour (Mann, 2006). According to Sheffield (2006), in order to support mathematical creativity, teachers should listen carefully to students' ideas, ask them questions for them to defend and explain their ideas, follow them and encourage them to participate in the lesson. Moreover, methods and techniques such as critical thinking, questioning and brainstorming used in the classroom contribute to the development of creative thinking skill (Yalçın, 2021). Therefore, the teacher as the implementer of these methods, which are also used in mathematics lessons, is seen to be the main element. Philips and Higginson (1997) stated that creating a classroom and school environment that will allow students to show their creativity in mathematics education will help them develop their creativity (as cited in Yıldız and Baltacı, 2018). Accordingly, in order to ensure the development of mathematical creativity in schools, learning environments should become an environment that puts students into the centre, develops problem-solving skills and does not limit learners (Tezci and Dikici, 2003). However, in order for all these to be done, teachers need to have a conceptually meaningful view of mathematical creativity because conceptual foundations that come from the definition of mathematical creativity such as providing opportunities for different solutions, developing different solutions, posing problems cannot be addressed as independent from teaching. While the teacher factor is so important in developing mathematical creativity and the importance of creative thinking skill has been emphasized in all curricula since 2006, teachers' conceptual views on this subject are worth being researched.

When the relevant literature is reviewed, it is seen that the great majority of the studies conducted on the concept of creativity with the participation of teachers have been carried out on preschool or primary teachers (Pehlivan, 2019; Özel and Bayındır, 2015; Özkan, 2016; Yuvacı, 2017; Yalçın, 2021). These studies have focused on the concept of general creativity and it has been seen that the studies conducted with the participation of mathematics teachers on mathematical creativity, which is a field-specific creativity, different from general creativity, are limited at the middle school level. In particular, studies on mathematical creativity and teacher views on supporting mathematical creativity are seen to be limited in Turkey (Cansız-Aktaş, 2016; Demir and Açıkgül, 2021). In this respect, it has been determined that there is a gap in the literature and it is thought that a gap in the literature will be partially filled with the current study, which is focused on middle school mathematics teachers. When the relevant literature is reviewed, it has been noticed that there are a limited number of studies on mathematical creativity in Turkey (Alkan, 2014; Ayvaz, 2019; Dündar, 2015; Kıymaz, 2009; Şengil Akar, 2017; Yulet Yılmaz, 2016). In these limited number of studies on mathematical creativity, the focus is on gifted students or pre-service teachers' mathematical creative thinking skill (Ayvaz, 2019; Dündar, 2015; Kandemir and Gür, 2009; Kıymaz, 2009; Şengil-Akar, 2017). In addition, the effects of posing or solving problems on mathematical creativity have been examined in these studies (Kavgacı, 2016). However, teachers are the ones who will support the development of mathematical creativity in the classroom. With this study, it is aimed to fill a part of this gap in the literature. In this connection, the purpose of the current study is to examine the opinions of middle school mathematics teachers about creativity, mathematical creativity, supporting mathematical creativity and barriers to supporting mathematical creativity. To this end, answers to the following questions were sought.

1. What are the opinions of middle school mathematics teachers about general creativity?
2. What are the opinions of middle school mathematics teachers about mathematical creativity?

METHOD

Research Model

Due to the detailed examination of the opinions of middle school mathematics teachers about mathematical creativity, the qualitative research method was used in this study. Qualitative research is conducted to explain and interpret a situation in detail (Yıldırım and Şimşek, 2021, p.45). Since the current study was conducted to draw conclusions about teachers' opinions on supporting mathematical creativity, the phenomenological study design was employed. In a phenomenological study, it is aimed to reveal the images in the minds of individuals regarding a phenomenon (Yıldırım- Şimşek, 2021, p.66). Detailed information about the participants of the study is given below.

Participants

The purposive sampling method was used to determine the participants of the study. Purposive sampling enables to carry out the study with the participation of the people who have knowledge about the subject to be researched (Yıldırım and Şimşek, 2021, p.116). In this study, participants were selected with the assumption that people who see themselves as teachers who support mathematical creativity support creativity as well. Therefore, mathematics teachers who were actively working were first selected in the study. In order to collect the research data, approximately nine hundred teachers were sent the Creativity Fostering Teacher Behaviour Index, but only ninety-two of these teachers returned the index. The Creativity Fostering Teacher Behaviour Index was sent to groups of many mathematics teachers on social media (WhatsApp, Telegram, Instagram) via Google forms. In order to determine the participants to be interviewed in the Index, information such as name, surname, mobile phone number were requested. Therefore, it is thought that the participation in the survey is low due to the request for this partly private information.

The participating middle school mathematics teachers, who completed the Creativity Fostering Teacher Behaviour Index, were ranked from the highest to the lowest according to the score obtained from this index. The participants who were thought to not have given correct data were excluded from the sample, and ten volunteer participants who were willing to participate and who could express themselves well were selected from among the participants with total scores higher than the average and semi-structured interviews were conducted with them to make sense of their knowledge about the relevant concept. The purpose of selecting teachers with high scores is to ensure that teachers who define themselves as creativity-fostering teachers participate in the study. The study was structured by collecting data from these teachers. The names of the participants of the study are expressed as T1-T10 in the rest of the study. The table (Table 1) below contains information about the teachers interviewed.

Table 1: Information about Participants

Teachers	Age	Graduated university	Experience	Institution served	Training for math.creativity
T1	25	METU	1-5	State School	No
T2	28	METU	6-10	Private School	Yes
T3	23	Uludağ University	1-5	State School	Yes
T4	39	Hacettepe University	16-20	State School	Yes
T5	25	METU	1-5	Private School	No
T6	27	METU	1-5	Private School	No
T7	31	Hacettepe University	6-10	State School	Yes
T8	31	Hacettepe University	6-10	State School	No
T9	25	METU	1-5	State School	No
T10	26	METU	1-5	State School	No

The table above shows that the most of participants graduated from METU or Hacettepe University. Most teachers have 1-10 years of experience. The reason for choosing these teachers is that there is a possibility of obtaining more data. Four of the teachers stated that they participated in a training for mathematical creativity. Seven of the teachers work in public schools and three of them work in private schools.

Data Collection Process

Ten teachers were selected to be interviewed on a voluntary basis, starting from those with the highest scores from the index. Semi-structured interviews were conducted using Zoom application at different times to collect more detailed data from the selected teachers. An interview was held with each teacher. These interviews lasted at least twenty-five and at most fifty minutes. In the interviews, questions about general creativity, mathematical creativity and fostering mathematical creativity were asked to the teachers. All the interviews were tape-recorded. The dataset was created by analyzing the collected data. The data collection tool used in the data collection process is explained below.

Instrumentations

The Creativity Fostering Teacher Behaviour Index was developed by Soh (2000) to measure how much teachers support students' creativity and creative thinking skill through their classroom behaviours. This index was created based on Cropley's (1997) definition of nine behavioural characteristics to be possessed by teachers in order to develop students' creativity. These nine behavioural characteristics correspond to nine sub-dimensions in the index called "independence, integration, motivation, judgment, flexibility, evaluation, question, opportunities, frustration". The sub-dimension of independence includes behaviours exhibited to encourage students independently, the sub-dimension of integration includes behaviours exhibited to have students use cooperative learning, the sub-dimension of motivation includes behaviours exhibited to motivate students to have basic knowledge and skills, the sub-dimension of judgement includes behaviours exhibited to have students think before receiving feedback for their ideas, the sub-dimension of flexibility includes behaviours exhibited to encourage students to think in different ways, the sub-dimension of evaluation includes behaviours exhibited to encourage students for self-evaluation, the sub-dimension of question includes behaviours showing that the teacher cares for students, the sub-dimension of opportunities include behaviours exhibited to enable students to use their ideas in different conditions and the sub-dimension of frustration includes behaviours exhibited to support students when they fail. Each sub-dimension consists of five items and there are a total of forty-five items in the index. The index was adapted into Turkish by Akar (2014). A total of 192 teachers participated in this adaptation study. Confirmatory factor analysis was performed for the validity and reliability of the scale, and correlation and Cronbach Alpha coefficients were calculated. The Cronbach Alpha reliability coefficient was found to be 0.95. As a result, since the index was seen to have a linguistic equivalence, to be structurally equal, valid and reliable, it was accepted in the current study that teachers who score high in this index see themselves as teachers who foster creativity.

The semi-structured interview form used in this study was prepared by the researchers in order to elicit the opinions of the teachers about mathematical creativity. First, an item pool was created by reviewing the relevant literature and the items were submitted to expert review and some corrections were made in light of the feedbacks given by the experts. Then, the opinions of two academicians having studies in the field of mathematical creativity were sought on the items and then the piloting of the items was performed. In line with the data obtained from the pilot application, some items considered to be directing were removed, and the items that could be related to each other were grouped and the final form of the interview form was obtained. The interview form consists of six items. The items are about general creativity, mathematical creativity and their definitions, creative people and mathematically creative people and their characteristics, methods, classroom environment and problems that support mathematical creativity. First of all, it started with the question of "What is creativity in your opinion?" in order to warm up the participants. Then, the question of "What is mathematical creativity?" was asked. The question of "Who can be mathematically creative?" was used as a probe for the participants to detail their views. Then, the participants were asked "What should be done to support mathematical creativity?". When participants have difficulty expressing their ideas, "Which teaching methods, what kind of problems, what kind of behaviors support creativity?", such questions were used as probes.

Data Analysis

In the study, the interviews were transcribed during the week of the interviews and for the transcription of the interviews, the Voiser application was used. These transcriptions constituted the dataset of the study. The transcribed data were grouped and made suitable for analysis. The data were analyzed using the MAXQDA program. While some of the codes used while analyzing the data were created before the analysis by reviewing the relevant literature (Biçer, 2021; Cropley, 1997; Ervynck, 2002; Haylock, 1987; Leiken, 2009; Luria, Sriraman and Kaufmann, 2017; Sheffield, 2006; Silver, 1997; Soh, 2000; Sriraman, 2005; Torrance, 1974), some codes were created from the data collected from the participants. While creating the codes in accordance with the theoretical framework, the theoretical framework proposed by Torrance (1974) was used for the codes and sub-codes under the theme of general creativity and the theoretical framework proposed by Ervynck (2002), Haylock (1987), Silver (1997) and Sriraman (2005) for the codes and sub-codes under the theme of mathematical creativity. In addition, for the codes and sub-codes under the theme of fostering creativity, the theoretical framework proposed by Biçer (2021), Cropley (1997), Luria, Sriraman and Kaufmann (2017), Sheffield (2006), Silver (1997) and Soh (2000) was used. Since the purpose of the study is to reveal the opinions of teachers on fostering mathematical creativity in depth, descriptive analysis was used for the analysis of the data. In descriptive analysis, all data are analyzed using relevant codes, presented in detail and in depth and interpreted (Patton, 2002).

Validity and Reliability

Some precautions were taken to ensure the validity and reliability of the study. In qualitative research, one method that increases internal validity is expert review (Merriam, 2012; Neuman, 2007). The study was carried out under the supervision of two experts through all the processes from the preparation of the data collection tools to the analysis and interpretation of the data. The triangulation strategy was used to ensure the credibility of the study. For triangulation, interviews were conducted with teachers of different ages, teaching at different levels of schooling, working in different cities and institutions and having graduated from different universities. In order to ensure the transferability of the study, the opinions of the teachers were given as direct quotations and no comments were added. In order to ensure the reliability of the study, the theoretical framework of the interview form was developed by examining the relevant literature and the opinions of two experts working in the field of mathematical creativity were taken during the preparation of the interview items. The necessary corrections were made in light of the feedbacks given by the experts and then a pilot study was conducted and the interview items were given their final form.

Moreover, the conceptual framework was taken into account and the relevant literature was reviewed while determining the themes and codes for data analysis. In addition to these, during the interviews, using the participant consent method, the participants were asked questions such as "Did I understand correctly?" and thus, the reliability of the data was increased. In order to ensure the confirmability of the study, the collected data were reanalyzed by the researcher at different times and the data were re-coded by another expert working in the field of mathematical creativity. The inter-rater reliability was calculated to be 73 % by using the formula "The number of codes agreed upon/The total number of codes X 100". According to Yıldırım and Şimşek (2016), a reliability value above 70% is acceptable. Thus, the level of reliability between the raters in the current study was considered to be acceptable.

FINDINGS

In this section, the findings obtained from the analysis of the interview data are presented under five main headings; creativity, mathematical creativity, mathematically creative people, their characteristics and teacher creativity, fostering mathematical creativity and factors hindering the development of mathematical creativity. Under these headings, similar expressions of the participants come together to form codes and codes emphasizing the same area come together to form themes. An expression of a participant can be included in more than one code and theme. These headings are explained in detail below.

1. Creativity

Under this heading, there are four themes derived from the responses of the participations to questions such as "What is creativity? Who are creative people? What are the characteristics of these people?". These four themes are cognitive characteristics, affective characteristics, creative people and personality characteristics. The participations who mentioned a total of 20 codes and sub-codes under these themes are shown in Table 2.

Table 2. Opinions of the Teachers on the Concept of Creativity

THEME	CODE		PARTICIPANT
Cognitive	Definitional Concepts (Torance,1974)	Originality	T1, T2, T3, T4, T5, T6, T7, T8, T9, T10
		Flexibility	T3, T4, T7
		Fluency (Productivity)	T2, T4, T7, T8
	Cultural Concepts	Thinking Skills	T2, T3, T4, T6, T7, T8, T10
		Imagining	T6, T7
Affective	Motivation		T1, T6
	Need		T1, T6
Creative People	Scientists		T3, T9
	Artists and people related to arts (Art)		T5, T6, T7
	Others	Acquaintances	T1, T2, T4
		Students	T7
		Children	T10, T8
		Leaders	T3, T5
Personality Characteristics	Talented		T1, T6, T10
	Able to change facts		T10
	Open to new ideas		T10
	Solution-oriented		T2
	Having confused minds		T4
	Sensitive		T6
	Having practical intelligence		T8

As seen in Table 2, the themes formed by analyzing the interview data are cognitive, affective, creative people and personality characteristics. From the answers given to the question "what is creativity?", the cognitive and affective themes were derived. The creative people theme was obtained from the answers given to the question "Who are creative people?". The personality characteristics theme was created from the answers given to the question "What are the characteristics of these people?" and moreover, some answers given to this question were also included in the cognitive and affective themes. These themes and codes are explained in detail below.

1.1 Cognitive

This theme consists of codes containing mental processes and codes related to the characteristics of the products and behaviours revealed as a result of these processes. The theme consists of two codes: the code for definitional concepts (Torrance, 1974), which includes the definitions in the literature and the code of cultural concepts, which includes the concepts obtained from the opinions of the teachers that are not explicitly mentioned in the literature. The code of descriptive concepts consists of three sub-codes: originality, flexibility, fluency (productivity) and the code cultural concepts consists of two sub-codes: thinking skills and imagining and all the teachers mentioned this theme. Each of the codes under this theme is explained below in light of the findings.

1.1.1. Definitional Concepts

Under this code, the opinions expressed by the teachers were grouped according to the components of originality, flexibility and fluency proposed within the definition of divergent thinking by Torrance (1974). The sub-codes of originality, flexibility and fluency are explained in detail below.

1.1.1.1. Originality

Originality, as stated in the literature, means extraordinary, unusual, different and is one of the first concepts that come to mind when creativity is concerned (Leikin, 2009). Therefore, the opinions of the teachers who uttered expressions such as creating original ideas, doing unique things, being extraordinary, thinking different things, looking from a different perspective, putting forward something new, doing things that have not been done before were gathered under this code. All the teachers expressed opinions related to originality, and nine out of ten interviewed teachers first emphasized originality when they were asked "What is creativity?". Therefore, it is seen that the code that teachers mostly referred to in relation to the concept of creativity is originality. In addition, the teachers again referred to originality at different times and in different questions throughout the interview. Some of these expressions are given below. In the opinions of the three teachers given below as direct quotations, originality is emphasized on the basis of being unique and having not been done before.

"When I hear the word creativity, I think of something which has not been done before. That is, like doing something unique, something unique that hasn't been done before". (T1)

"Creativity, I think, is to create more original ideas by combining ideas that exist with completely different ideas." (T2)

"I think creativity is to think differently, to come up with something new, to think innovatively." (T4)

The above participants emphasized originality by talking about uniqueness. The teachers refer to originality by emphasizing the idea of something new and different, something that has never been done before. Other teachers, whose opinions are given below, emphasized the concept of originality with the expressions such as "Looking from a different perspective, revealing things that no one has done or thought about before".

"It can be generating something like an idea or a product that no one has done or thought before, on the basis of one's own knowledge or what he/she knows, feels or senses. I mean, to put forward or think about something, to do something that has not been done before … Or to be able to interpret something that someone has thought differently, to add something different, to look at it from a different perspective. This is creativity." (T5)

"I think creativity is to come up with something new, different and useful." (T9)

"Creativity is a different idea, design, thought that no one has put forth and that is unique to this person." (T10)

Given the delineations above, it is clear that the most prominent concept in the minds of the teachers regarding the concept of creativity is the concept of originality.

1.1.1.2. Flexibility

One of the sub-codes under the definitional concepts code is flexibility. One of the sub-codes emerging under the code of definitional concepts is flexibility. Flexibility means that a person has thoughts different from each other and develops approaches different from each other (Yazgan- Sağ, 2019). Accordingly, the opinions of teachers including expressions such as thinking differently and finding different ways were gathered under the sub-code of flexibility. However, only three out of ten teachers expressed opinions that could be related to flexibility. The fact that few teachers mention flexibility, which has an important place in the definition of creativity, shows that teachers have a conceptual weakness in this regard. The opinions of the teachers who mentioned flexibility are given below.

"*Creativity… Finding different ways, benefiting from the unknown, not the known. "(T3)*

"*…producing different ideas, different from each other each time…" (T4)*

The teacher, whose opinion is given as direct quotation below, stated that many different thoughts came to his/her mind while watching cartoons in his/her childhood. Different ideas are included in the definition of flexibility.

"…As a kid, while watching Tom and Jerry, I used to wonder why he is chasing him, whether he doesn't like him, whether he missed him or why they are fighting, etc.… But now I don't think at all, I take what I'm given." (T7)

1.1.1.3. Fluency (Productivity)

Another sub-code mentioned under the definitional concepts code is fluency. Fluency is defined under the concept of creativity as generating too many ideas (Yazgan- Sağ, 2019). None of the teachers used the expression of producing a lot of ideas. But the opinions including the term 'producing' were gathered under the sub-concept of fluency. Therefore, expressions such as producing easy and practical solutions, being productive and productivity were included under the sub-code of fluency. Four out of ten teachers referred to the sub-code of fluency, but three of the teachers who mentioned fluency emphasized productivity. Therefore, there are no teachers who explicitly mentioned the concept of fluency and this may indicate that teachers do not have enough knowledge about fluency, which is one of the components of creativity. The expression of producing practical solutions in the teacher's opinion given as direct quotation below is included under the sub-code of fluency.

" … He/she is solution-oriented and tries to produce easy practical solutions. "(T2)

Three out of ten teachers referred to fluency through the emphasis they put on productivity. The answers given by the participants are given below as direct quotations.

" … I think they are productive…" (T4)

"…here, actually, the child thinks creatively, tries to produce something by himself/herself; that is, without us giving him/her anything. That's what I call creativity…" (T7)

"Creativity is productivity. Generating an idea for what is needed according to your environment is productivity." (T8)

Therefore, from the expressions of the participants, it can be said that fluency and productivity are perceived as similar concepts.

1.1.2. Cultural Concepts

The code of cultural concepts consists of two sub-codes: thinking skills and imagining. Cognitive concepts that are not explicitly mentioned in the literature, but are related to creativity, are gathered under this code. The sub-codes are explained in detail below.

1.1.2.1. Thinking Skills

The sub-code of thinking skills includes expressions such as critical thinking, analyzing, questioning, multidimensional thinking, forward thinking, straight thinking and thinking. Seven out of ten teachers mentioned this sub-code. The teachers especially emphasized that inquiring individuals can be creative, and that children do this very well. The participant, whose opinions are given as direct quotation below, emphasized that the critical thinking of creative people is high.

"The main trait of creative people is that they can think very well. They can analyse events from different perspectives. Their critical thinking is high." (T3)

Participants whose opinions are given as direct quotations below have associated creativity with the skill of questioning. T7 stated that multidimensional and straight thinking positively affects creativity.

"In my opinion, they can think multidimensionally. So let me put it this way, I don't know if it's because of our age or our living conditions. We have children, our spouse, we have a job, business life and so on, so we feel confused but they think more clearly. They think simple and straight. So I think they can think of

new things more easily. I mean, they think creatively, for example, when I was watching cartoons when I was little, I used to design different things with my imagination, but now I watch whatever is given to me in movies, animations, but it is not like that when I was a kid. As a kid, while watching Tom and Jerry, I used to wonder why he is chasing him, whether he doesn't like him, whether he missed him or why they are fighting, etc. … But now I don't think at all, I take what is given to me, but children are not like that, they question and do not have ulterior motives like me, they are pure and clean. That's why I think they are better at creativity because they think simple." (T7)

"Their questioning ability is high and their horizons are open. For example, we say that clouds are blue, we say that all clouds are blue, and people with less creativity say yes, they are blue. But there can be pink clouds and white clouds in age groups with high creativity. In other words, they do not think that the colour of clouds must be blue. You know, they can think that it can be in different colours." (T10)

1.1.2.2 Imagining

Expressions emphasizing imagining were gathered within the sub-code of imagining. Two out of ten teachers mentioned imagining. The participant, whose opinions are given as direct quotation below, stated that it is creativity to imagine things that do not exist now and to come true in the future.

"In other words, to make something that is not possible now true in the future by imagining it. For example, let's think of something impossible. For example, 10 years ago, 10 years ago, or 50 years ago, there was no such thing as a mobile phone, but someone thought of it through imagination and made it possible. In other words, we can even think of something that won't happen right now. This is in our imagination, but we can say that it can be true with the talent of some people in the future." (T6)

One of the participants emphasized his/her imagination by giving an example from his/her childhood. He/she explained that he/she was thinking and dreaming even while watching TV..

"…For example, when I was watching cartoons when I was little, I designed more different things with my imagination, but now I watch whatever is given to me in movies, animations, but it wasn't like that when I was a kid …" (T7)

1.2. Affective

The theme of affective consists of two codes as need and motivation, and only two teachers mentioned this theme. While the sub-code of motivation was created by bringing together expressions such as interest and desire, the expressions indicating that creativity would arise out of a need were included in the sub-code of need. Below, one of the participants mentioned both the sub-code of need and the sub-code of motivation, saying that because his/her friend does not use technology while teaching, he/she needs to produce materials and he/she likes to produce materials. The opinions of this participant are given below as direct quotation.

"I use Geogebra in my lessons, but for example he/she (talking about his/her friend) produces a game with cards, he/she does something, for example he/she uses it. He/she needs to create something because he/she likes to have something like this because he/she thinks more traditionally. Therefore, he/she is more creative than me … He/she always wants to design something. He/she has cardboard in his/her hand constantly designing something." (T1)

While emphasizing motivation with the words of interest and desire, the participant whose opinions are given as direct quotation below, emphasized the sub-code of need with the expressions such as bothering about something and wanting to tell it to other people.

"They like it because of their interest and desire … For example, I am not a person who can create something out of the blue, let me speak for myself, but if I want to tell something to other people, this is because something bothers me. That is, I like or do not like something and I want to tell it to other people." (T6)

1.3. Creative People

Three codes were created on the basis of the opinions expressed by the teachers under the theme of creative people. These are scientists, artists and people related to arts (Art) and others. The code of others consists of four sub-codes: acquaintances, students, children and leaders. While each of the sub-codes of scientists, children and leaders was mentioned by two teachers, each of the sub-codes of acquaintances and artists and people related to arts (Art) was mentioned by three teachers, and one teacher said that students could be creative. In addition, three teachers who gave artists or those who are interested in arts as examples of creative people stated that creativity is related to music, literature, painting and technology-design. The most mentioned branch of arts is painting. The participant, whose opinions are given as direct quotation below, emphasized that leaders like Atatürk and scientists like Edison can be creative people.

"I can say Edison, Atatürk. Scientists." (T3)

The following two participants (T5 and T7) emphasized concepts related to art such as painting, music, design and literature. In addition, artists such as painters and poets or teachers in a branch related to art were given as examples to creative people. The opinions of these participants are presented below as direct quotations.

"For example, painting especially seems very creative to me. Maybe because I don't have the talent, I don't know. In other words, everyone sees it, but he/she interprets it differently, draws differently, and something different comes out of his/her brush. I think painting involves a lot of creativity, writing a novel, that is, things related to art, seem very creative to me. They produce something and no one has produced it before … In other words, everyone sees the rose, but everyone's drawing and interpretation of roses is very different … For example, Atatürk has creative ideas, I find painters and poets creative." (T5)

"When I think of creativity, what always comes to my mind is students and Turkish teachers, or technology design teachers … In other words, Turkish teachers can write compositions and poems in different styles. They can make different comments. This is not something easy. I think this is also true for technology design, visual arts and music; in these fields, different products are designed." (T7)

In addition to the above findings, there were also participants who emphasized that children are creative.

"Children are very creative, especially in the preschool period." (T8)

"I find the world of children more creative." (T10)

1.4. Personality Characteristics

Under the theme of personality characteristics, there are codes that include expressions that contain more specific characteristics of people and that cannot be placed in any other theme. These codes are divided into seven sub-codes; talented, able to change facts, open to new ideas, solution-oriented, having confused minds, sensitive and having practical intelligence. While the sub-code of being talented was mentioned by three teachers and each of the other sub-codes was mentioned by one teacher. The participant, whose opinions are given as direct quotation below, emphasized the sub-code of having confused minds.

"People who are creative have also somewhat confused minds. I think this can be disadvantageous sometimes but it also makes them more productive. I also think that they make better use of the potential of their minds." (T4)

The participant, whose opinions are given as direct quotation below, referred to the code of being talented with the expression of an innate ability, while he/she referred to the code of being sensitive by stating that they are sensitive towards society.

"They have developed imagination and they are sensitive towards society. For example, sometimes we can feel some feelings and thoughts and that is all, but people with high artistic abilities can feel something and then depict is in a picture. That is, they can show what they feel. They can also make other people see what they feel. They are sensitive people … Maybe they have an innate talent, maybe they have developed their talent later by means of training … Sometimes I think it's inborn." (T6)

The participant, whose opinions are given as direct quotation below, referred to the sub-code of having practical intelligence through the expression of not going into much detail.

"I think they think without going into too much detail. In other words, it is more superficial, for example, children can produce very creative ideas; they are more bright-minded because they do not go into too much detail." (T8)

The participant, whose opinions are given as direct quotation below, referred to the sub-code of being talented with the expression of creativity coming from the nature and to the sub-code of being able to change the facts with the expression of not taking the facts as something impossible to change.

"There is a creativity that comes from the disposition of children … That is, they do not take facts as something immutable. They can shape them as they wish." (T10)

2. Mathematical Creativity

Under the heading of mathematical creativity, the opinions expressed by the participants in response to the questions "What is mathematical creativity? And what are the characteristics of creative people?" are grouped into two themes. The two themes, seven codes and eight sub-codes obtained under this heading and the participants who referred to these codes are shown in Table 3.

Table 3. Opinions of the Teachers on the Concept of Creativity

THEME		*CODE*	*PARTICIPANT*
Cognitive	Concepts coming from the general definition of creativity (Silver, 1997;Torrance, 1974)	*Originality*	*T1, T3, T4, T5, T6, T7, T9, T10*
		Flexibility and Fluency	*T2, T6, T8, T9, T10*
		Higher-Order Thinking (Ervynck, 2002)	*T1, T2, T3, T5, T6, T7, T10*

	Concepts coming from the definition of mathematical creativity	*Associating (Ervynck,2002; Haylock,1987)*	*T1, T2, T4, T8, T10*
		Different Representation	*T5, T10*
		Problem Posing (Silver, 1997)	*T1, T2, T9, T10*
		Problem Solving (Silver, 1997; Sriraman, 2005)	*T1, T2, T3, T5, T6, T9, T10*
		Discovering Mathematics (Sriraman, 2005)	*T3,T4, T9*
Affective	*Interest*		*Ö6*
	Self-confidence		*Ö2, Ö4, Ö9*
	Curiosity		*Ö3, Ö7*
	Need		*Ö3, Ö4, Ö6, Ö7*
	Risk Taking		*Ö9*

When Table 3 is examined, it is seen that the themes derived from the analysis of the data are cognitive and affective. From the answers given to the questions ""What is mathematical creativity? And what are the characteristics of creative people?", the themes of cognitive and affective were obtained. These themes and the codes within them are discussed in detail below.

2.1. Cognitive

This theme, which deals with mental processes in a mathematical sense, is divided into two codes: concepts coming from the general definition of creativity and concepts coming from the definition of mathematical creativity. Concepts that come from the general definition of creativity and that are also mentioned in the literature (Silver, 1997; Torrance, 1974) are gathered under two sub-codes called originality and flexibility. Concepts that come from the definition of mathematical creativity are gathered under six sub-codes called higher-order thinking, associating, different representation, problem posing and discovering mathematics. From among these, higher-order thinking (Ervynck, 2002), associating (Ervynck, 2002; Haylock, 1987), problem posing (Silver, 1997), problem solving (Silver, 1997; Sriraman, 2005) and discovering mathematics (Sriraman, 2005) are concepts found in the literature. All the teachers mentioned this theme while explaining their opinions.

2.1.1. Concepts That Come from the Definition of General Creativity

The concepts of originality, flexibility and fluency, which are mentioned in the definition of general creativity, can also be associated with mathematical creativity (Silver, 1997). None of the participants in this study mentioned the concept of fluency for mathematical creativity. Therefore, this code is divided into two as originality and flexibility. These sub-codes are explained in detail below.

2.1.1.1. Originality

Eight of the ten teachers referred to the originality sub-code by means of such expressions as generating a new idea, producing a new solution in a mathematical sense, thinking differently from a mathematical point of view, looking from a different perspective, producing unusual solutions, developing one's own strategy. As in the concept of creativity, it is one of the most mentioned sub-codes in mathematical creativity. The teachers generally focused on producing solutions that are different from others in their opinions. One of the participants whose opinions are quoted directly below wanted to mean original solutions, solutions different from others by means of the expression of creating one's own solution. This is explained with the concept of originality. Some of the teachers' opinions are presented below.

"It can be creating your own solution. I think that producing and developing your own strategy is creativity." (T1)

The participant, whose opinions are given below as direct quotation, emphasized originality by using the expression of unknown methods.

"If considered mathematically, it means solving a problem using unknown methods rather than familiar ways." (T3)

The participant, whose opinions are given as direct quotation below, referred to the concept of originality by using the expression of using one's own style.

"Students, for example, sometimes see things as some certain patterns when they look at any question, but sometimes some students come out and say, "Can we do this in that way?" So yes, I like it very much; he/she sees something different; she thinks very simply. For example, at that moment I have an equation in my mind, I don't know, there is a more classical solution, then he/she offers something very different, very sweet, small. In this sense, students also have mathematical creativity … For example, there might be three different ways of solving an problem and an ordinary student or any student can think of these three different ways to solve the problem, but a student who finds a different method and solves it in a unique way, with a unique pattern, with a unique material, is mathematically creative." (T5)

The teacher, whose opinions are given as direct quotation below, referred to creativity by means of the expressions such as a different solution, one's own method.

"For example, he/she accepts the methods given by the teacher, but he/she also wonders if there is a different method or what his/her method might be, he/she may also look for a different method." (T10)

2.1.1.2. Flexibility and Fluency

This concept was mentioned by five out of the ten teachers. Unlike the originality code, which includes the expression of producing a different solution, the flexibility code means that a student produces solutions different from each other. Some of the opinions are presented below.

All of the participants whose opinions are given as direct quotations below mentioned a student's producing different ways of solution; this expression can be associated with the concept of flexibility.

"In other words, it may be producing different solutions while solving problems." (T2)

"For a child who approaches a question not only through a memorized solution, but through multiple different solutions, I can say that his/her mathematical creativity is high." (T6)

"There is one solution to a mathematical problem, the child learns it, or for example, we explain how the operations of addition and subtraction can be done from the mind to students in the 5th grade; there are different methods of doing this. There is a method of separating into tens, ones. We teach several methods of doing this. The student accepts these but tries to find different alternative methods. This is creativity to me." (T10)

As can be understood from the above-given expressions of the teachers, the concept of fluency and flexibility in mathematical creativity is associated with producing different solutions.

2.1.2. Concepts That Come from the Definition of Mathematical Creativity

There are some concepts that come to the fore in creativity specific to the field of mathematics. These concepts are gathered under six sub-codes called higher-order thinking, associating, different representation, problem posing, problem solving and discovering mathematics. These sub-codes are explained in detail below.

2.1.2.1. Higher-Order Thinking

Expressions that refer to higher-order thinking skills such as critical thinking, questioning, analyzing, making inferences and reasoning are included under this code. Eight out of the ten teachers referred to the sub-code of higher-order thinking. This sub-code is one of the most mentioned sub-codes in the opinions on mathematical creativity, and it is mostly emphasized by means of the expression of questioning. Some opinions of the teachers are presented below.

The participant, whose opinions are given as direct quotation below, referred to higher-order thinking by means of the expressions of critical thinking and examining the reason without memorizing.

"They have high critical thinking … They do not rely on rote-learning in the lesson. For example, instead of memorizing what the teacher has told, he/she examines the reasons and consequences of it." (T3)

The participant, whose opinions are given below emphasized higher-order thinking by means of the expressions of internalizing the information instead of memorizing it.

"Instead of memorizing the given information completely and repeating it like a parrot, it is a bit like constructivism that he/she can absorb the given information and add something to it, constructs it." (T4)

The participant, whose opinions are given as direct quotation below, mentions that a creative child examines differences, asks different questions, all of which are indicators of higher-order thinking.

"Frankly, I think he/she is creative with his/her questions rather than presenting a product. It's not about solving problems rather about asking questions. For example, we are studying the subject of rational numbers. One of my students asks "How is this different from fractions?" After all, both are related to numerator and denominator. To me, this is creativity because one person out of 30-35 people asked this, the other 34 people didn't. Then I say that this student thinks creatively because if both of them were same, their names would also be same. So, they are different. This student analyses this difference. Accordingly, he/she thinks that rational numbers and fractions are different.

This is creativity in my opinion; it is not an absolute necessity to generate a product. He/she does not have the means to do this. The questions he/she asks show that he/she is creative." (T7)

2.1.2.2. Associating

The opinions of the teachers who mentioned associating mathematics with real life, associating mathematical ideas with each other and associating mathematics with different disciplines are gathered under this sub-code. Five out of the ten teachers stated that mathematical creativity is related to the ability to associate and the most frequently mentioned type of association is association with real life. Some opinions of the teachers are given below.

The participant, whose opinions are given as direct quotation below, talks about recognizing that there is mathematics in a real-life situation, in a game, that is, associating mathematics with real life. He/she also stated that establishing associations between mathematics subjects also requires creativity.

"Sometimes students say things and I realize that there is mathematics in them. Like, for me, it's like something that I thought never existed. Here can be mathematical creativity … For example, they have a card and they say something about the numbers on it and say that there is mathematics in here. Yes, it is indeed used, for example, you do not associate the game of taso with mathematics, you know, it has no conceptual relationship but yes there is mathematics there … Or if he/she associates what she finds with other subjects, this is also creativity." (T1)

The participant, whose opinions are given as direct quotation below, referred to the association with daily life by means of the expression of giving examples of rectangular-like objects around him/her and the association between the subjects by means of the expression of the student's being able to think about the pentagon when he/he has learned about the rectangle.

"Or, for example, I think the ones who can give examples of different shapes that look like rectangles or the different objects he/she can see around him/her while he/she is learning the subject of rectangle; this can be an example of creativity. Or the ones who can imagine polygons or hexagons and heptagons while I am teaching the subject of rectangle." (T2)

The participant, whose opinions are given as direct citation below, talked about associating mathematics with different disciplines under the concept of creativity.

" Or, as I said, bringing together different disciplines and mathematics, integration." (T4)

The participant, whose opinions are given as direct quotation below, stated that associating mathematics with daily life requires creativity.

"He/she can transfer mathematics to daily life, that is, if he/she can better understand fractions from the examples he/she sees, for example while he/she is cutting a cake, he/she can see the examples of fractions." (T8)

2.1.2.3. Different Representation

Expressions to explain mathematical concepts with pictures, manipulatives, symbols or verbally are included under this sub-code. Two out of the ten teachers mentioned the sub-code of different representation and these teachers also emphasized the symbolic or visual dimension of different representation.
The participant, whose opinions are given as direct quotation below, mentioned that it requires creativity to be able to show concepts with pictures or mathematical symbols.

"For example, there may be students who can paint them and put them on paper, even though I have not taught them. There may be children who can interpret the question, translate it into mathematical language, or show it in different representations. Or, for example, he/she is not satisfied when I teach something, so he/she needs to visualize it. These students can be considered to be creative." (T5)

2.1.2.4. Problem Posing

One of the most important components of mathematical creativity is problem posing. The expressions of the participants, who mentioned students creating their own questions and problems, are gathered under the sub-code of problem posing. Four out of the ten teachers mentioned this sub-code. Some of the teachers' opinions are given below. The participants, whose opinions are given as direct quotation, stated that writing questions or posing problems requires creativity.

"*…Last week, I went to a course called question writing techniques. For example, I think creativity is needed there as well. You know, they expect us to write different questions. In fact, mathematical creativity can be something like that. Writing different questions. Yes, I think it's very difficult to write a mathematical question, and there is a need for creativity." (T1)*

"For example, when we look at it in terms of problem posing, I think problem posing is a creativity in itself as It requires bringing out something different from the things given." (T9)

2.1.2.5. Problem Solving

Problem solving, which is one of the most frequently mentioned sub-codes by the teachers, has an important place in mathematical creativity. Expressions such as producing solutions to problems are gathered under this sub-code. Seven out of the ten teachers mentioned this sub-code.
The participants whose opinions are given below as direct quotations associated problem solving with creativity.

"That is, it may be producing different solutions while solving problems." (T2)

"When it comes to mathematical creativity, we can look at it from different perspectives. For example, if we look at it from the perspective of problem solving, we can say that mathematical creativity is high if he/she can come up with different solutions to that problem." (T9)

2.1.2.6. Discovering Mathematics

One of the most important findings of this study is that the teachers did not put much emphasis on the concept of discovering mathematics in the context of mathematical creativity. Only three of the ten teachers associated discovering knowledge and finding it by oneself by researching with the concept of mathematical creativity and emphasized discovering knowledge as mathematical creativity.

"He/she is not satisfied with what is said but discovers. The teacher has taught the subject to some extent. The ones who want to further discover the subject are creative." (T3)

"Discovering knowledge, for example, is something that increases creativity." (T9)

"Instead of memorizing the given information completely and repeating it like a parrot, it is a bit like constructivism that it can absorb the given information and add something to it, build it." (T4)

2.2. Affective

The opinions of the teachers who associated mathematical creativity with emotions and feelings are gathered under this theme. Six out of the ten teachers mentioned the theme of affective. The theme consists of five codes: self-confidence, curiosity, need, interest and risk taking. Three teachers mentioned the code of self-confidence, two mentioned the code of curiosity, one mentioned the code of interest, four mentioned the code of need and one teacher mentioned the code of risk taking. Some of the opinions are given below. The participant whose opinions are given below as direct quotations referred to the code of interest.

"For example, he/she can design an activity on his/her own; he/she has a high interest in mathematics. For example, he/she says "Look, I thought about this event, can I do something like that?"; thus, we can say that he/she has a high interest in mathematics." (T6)

The participant whose opinions are given as direct quotation below mentioned the code of self-confidence.

"I think creativity also requires self-confidence. You must be self-confident to come up with a creative idea. In particular, you need to be able to explain clearly what you think." (T2)

The participant whose opinions are given as direct quotation below referred to self-confidence and risk taking.

"… Students who can take risks. Apart from that, self-confident students, self-confident students are different … That is, those who can think differently and take risks." (T9)

3. Mathematically Creative People, Their Characteristics and Teacher Creativity

On the basis of the answers given to the questions "What is mathematical creativity?, Who are mathematically creative people and What are the characteristics of these people?", under the heading of "Mathematically Creative People, Their Characteristics and Teacher Creativity" three themes were obtained. The three themes, eighteen codes and the participants who mentioned these codes for the concepts of mathematically creative people, their characteristics and teacher creativity are shown in Table 4.

Table 4. Opinions of the Teachers about Mathematically Creative People, Their Characteristics and Teacher Creativity

THEME	CODE	PARTICIPANT
	Students	*T1, T4, T5, T6*
	Teachers	*T1, T3, T4, T5, T6, T7, T8*

Mathematically Creative People	*Academicians*	*T4*
	Researchers	*T4*
	Parents	*T6*
	Anyone	*T6, T9*
Their Characteristics	*Mathematically talented students*	*T5, T7, T8, T10*
	Foresighted	*T10*
	Solution-oriented	*T10*
	Extravert	*T10*
	Emotional thinking	*T2*
	Open to new ideas	*T2*
	Developing a method and activity to understand the subject	*T3, T5, T6*
	Thinking three-dimensionally	*T5*
Teacher Creativity	*Teacher's writing different problems*	*T1, T7*
	Teacher's thinking differently	*T4, T5*
	Creativity in teaching method	*T3, T4, T5, T6, T7, T8*
	Material design	*T5, T7*

When Table 4 is examined, it is seen that the themes derived from the analysis of the data are mathematically creative people, their characteristics and teacher creativity. The theme of teacher creativity was derived from the answers given to the question "What is mathematical creativity?". The theme of mathematically creative people was derived from the answers given to the question of "Who are mathematically creative people?" and the theme of their characteristics was derived from the answers given to the question of "What are the characteristics of these people?". These themes and related codes are given below.

3.1. Mathematically Creative People

According to the opinions received from the teachers, six codes were formed under this theme; students, teachers, academicians, parents, researchers and anyone. Each of the codes of academicians, researchers and parents was mentioned by one teacher.

"They can academicians at universities. Then, they can be teachers. Or they can be researchers or people studying mathematics; that is, they can be students." (T4)

The opinions of the participant coded as T4 correctly point to people having mathematical creativity. In order to be mathematically creative, an individual must be studying in the field of mathematics. Seven of the ten teachers stated that the mathematically creative person could be teachers, and four of them stated that they could be students. Therefore, it is seen that the participants associate teachers with mathematical creativity more than students. Two of the ten teachers said that anyone can be mathematically creative. The participant whose opinions are given below as direct quotation stated that parents, teachers, students and anyone could be mathematically creative.

"They can be parents too. That is, the parents who try to support the development of their children can be mathematically creative; therefore, not just teachers and students. In other words, I think that parents should also have strong mathematical creativity because it is not enough just to give birth to the child, but also to support him/her in every sense. This can be education or career in a profession. They need to instil that creativity in them at least until they reach a certain age. Instead of keeping the child in front of the television all the time, they will be able to teach him/her a different way of thinking. At least, they should be able to explain where some things come from and be able to answer the questions of a 3-year-old. That's why I think it should be a feature that belongs to anyone. At least to a certain extent." (T6)

3.2. Their Characteristics

The specific features that are distantly related to mathematical creativity are gathered under the theme of their characteristics. This theme mentioned by seven teachers consists of eight codes: mathematically talented students, foresighted, solution-oriented, extrovert, emotional thinking, open to new ideas, developing a method or activity to understand the subject and thinking three-dimensionally. Four teachers referred to the code of talented students and three teachers referred to the code of a method or activity to understand the subject. Each of the other codes was mentioned by one teacher. Therefore, it is seen that the most emphasized characteristic in this theme is talent. Some opinions of the teachers are presented below. The participant whose opinions are given as direct quotation below mentioned the codes of emotional thinking and open to new ideas.

"I think there may be people who think emotionally, so since mathematics requires a very abstract thinking, one must actually be a little emotional and open to ideas in order for creativity to be involved." (T2)

The participant whose opinions are given as direct quotation below mentioned the code of developing a method or activity to understand the subject.

"Develops a method in order to understand the subject" (T3)

The participant whose opinions are given as direct quotation below referred to the codes of mathematically talented students and three-dimensional thinking.

"First of all, these children are talented on numbers, so I think that their mathematical intelligence is high. When they look at the question, for example, most students think about what I teach, while those children think differently, or while I teach the first way, for example, they say the second way, while I'm about to teach it. Or what else can it be … There might be students thinking three-dimensionally, there may be students who can look from many other different perspectives. Sometimes students think in a much more sophisticated way than their peers, they may be these students. In other words, they can look at the subject from a different point of view." (T5)

The participant whose opinions are given as direct quotation below mentioned the code of mathematically talented students.

"Genetic background is very important in mathematics. I have seen over time that if the child does not have a genetic background, it is difficult to achieve results no matter how hard he/she works. So there may be some genetic background and family support since childhood." (T8)

The participant whose opinions are given as direct quotation below referred to the codes of mathematically talented students, foresighted, solution-oriented and extrovert.

"His/her mathematical intelligence is high; his/her perception is clear. He/she is foresighted. He/she can solve problems in future life, solve them easily, has extravert personality." (T10)

3.3. Teacher Creativity

When the opinions of the teachers are examined, it is seen that most of them associated the concept of mathematical creativity with the teachers' use of creative methods in their lessons. Seven out of the ten teachers mentioned this theme. This theme consists of four codes: creativity in teaching method, material design, teacher's writing different problems and teacher's thinking differently. While six teachers mentioned the code of creativity in teaching method, each of the other codes was mentioned by two teachers. Some of these opinions are presented below.The participant whose opinions are given below as direct quotation referred to the code of creativity in teaching method by means of the expression of creating a participatory method.

"Creating a method suitable for children's thoughts by seeing their thoughts and characteristics, creating methods suitable for them to participate and planning the lesson accordingly." (T3)

"Producing mathematical stories that will solve the misconceptions in mathematics ... While applying differentiated education practices during the lesson, or constructivist education, learning by doing, there might be variation in the practices in the process …" (T4)

The participant whose opinions are given as direct quotation below related mathematical creativity to the creativity of the teacher and mentioned all the codes of creativity in teaching method, material design and teacher's thinking differently.

"Mathematical creativity, in my opinion, is; we are all teachers, we all teach about the same topics but everyone has a different way of teaching. For example, adding something from yourself, creativity, for example using materials. Yes, there are some materials, these are fraction bars, ten blocks, these are the blocks we use in patterns, yes, these are the materials we all use, but if a math teacher can design something himself/herself, for example, if he/she can design materials, or look from different perspectives, I think he/she has creativity on that subject. That's mathematical creativity for me. That is, if he/she can look at the questions from a different point of view, yes, it may be to be able to look at the questions from a different perspective. It can be producing different materials." (T5)

DISCUSSION and RESULTS

This study was conducted to examine the opinions of the teachers who received high scores from the Creativity Fostering Teacher Behaviour Index on creativity, mathematical creativity and fostering mathematical creativity. In this regard, using the findings obtained from the data analysis, discussions and results supported by the literature are presented.

First, the teachers' opinions on creativity were examined, and as a result of the examinations, four themes were obtained: cognitive, affective, creative people and personality characteristics. When the teachers were asked about the concept of creativity, it was seen that the most focused feature was the code of originality (ten teachers) under the theme of cognitive. The teachers emphasized the originality dimension of creativity by using expressions such as thinking and doing unique, original, unusual, different, new things. This finding of the current study concurs with the literature (Akcanca and Cerrah-Özsevgeç, 2016; Aljughaıman and Mowrer-Reynolds, 2005; Ersükmen, 2010; Panaoura and Panaoura, 2014). Panaoura and Panaoura (2014) asked pre-service teachers about the concept of creativity and they concluded that eight out of ten pre-service teachers associated creativity with originality. In the current study, it was seen that while teachers mentioned the flexibility (three teachers) and fluency (four teachers) components of creativity within the concept of general creativity, they did not emphasize these

components as much as originality. The reason why flexibility and fluency were not mentioned as much as originality is Leikin's (2009) claim that the concept of originality has a cultural acceptance. Here, it can be said that teachers focus on original solutions in the concept of creativity, and that they are far from concepts such as productive (fluent) and flexible thinking.

In the findings related to cultural concepts in the theme of cognitive, it was seen that teachers (seven teachers) associated creativity with other thinking skills. Thinking skills that the teachers associated creativity with are critical thinking, questioning, analyzing and multidimensional thinking. This finding is consistent with the results of Demir and Açıkgül (2021). In the study conducted by Biber (2006), the teachers stated that one of the characteristics of creative students is questioning, which is similar to the current study. Sheffield (1994) expressed creativity as the ability to observe events quickly, to grasp the cause-effect relationship and to question. Similar to Sheffield (1994), Altın and Saracaloğlu (2018) stated that there is a similarity between creativity and critical thinking in terms of being multi-dimensional. Accordingly, the opinions expressed by the teachers in this study concur with the literature. In addition, some teachers (two teachers) described creativity as imagining. In addition, as can be seen from the findings, there emerged no conceptual consensus on creative people and the personality characteristics of creative people and it was revealed that teachers had different subjective opinions.

Two headings were derived from the opinions expressed by the teachers on mathematical creativity: mathematical creativity and mathematically creative people, their characteristics and teacher creativity. Under these headings, the themes of cognitive, affective, mathematically creative people, teacher creativity and personality characteristics were formed. In the theme of cognitive, as in the theme of general creativity, the most emphasized code was originality (eight teachers). The teachers mentioned the originality dimension of creativity by using expressions such as producing an unusual, different, new solution, and developing one's own strategy. In previous studies that conducted interviews on mathematical creativity, participants expressed opinions similar to the ones expressed in the current study (Demir and Açıkgül, 2021; Dündar, 2015; Leikin, Subotnik, Pitta-Pantazi, Singer and Pelczer, 2013). In the current study, some teachers (five teachers) emphasized the flexibility and fluency component of mathematical creativity by using expressions such as producing different solutions, thinking about different things. However, considering the fact that these teachers are teachers with higher scores from the Creativity Fostering Teacher Behaviour Index, it can be said that the rate of 50% is below the expected value. However, the fluency and flexibility component means generating a lot of ideas, productivity and has a place in mathematical creativity (Silver, 1997). It can be considered as an important finding that the teachers mentioned the idea of producing too many and too few ideas because although the teachers' emphasis on originality is important for the concept of creativity, mathematical creativity requires mental capacity, flexibility and competence to produce many solutions as much as it requires producing original solutions. In this respect, the fact that teachers are conceptually far from these important sub-components of creativity suggests that supporting these sub-skills may be overlooked.

The other code that many (seven) of the teachers referred to is higher-order thinking, which includes expressions such as questioning, reasoning and analysis. In this regard, the opinions elicited in the current study concur with opinions and definitions encountered in the literature (Cansız-Aktaş, 2016; Demir and Açıkgül, 2021; Dündar, 2015; Ervynck, 1991; Mann, 2006). Moreover, some of the teachers (five teachers) associated mathematical creativity with establishing connections among the subjects of mathematics and with different disciplines. Similarly, it is seen in the literature that mathematical creativity is defined as being able to establish connections with other disciplines, create mathematical relationships and connect ideas (Haylock, 1997). The fact that only half of the teachers referred to this concept may enable us to conclude that teachers do not put much emphasis on the ability to associate as an important component.

Other concepts that the teachers associated with mathematical creativity are problem solving (seven teachers), problem posing (four teachers) and they especially emphasized that the solutions to problems should be unique and different. Mathematical creativity has been associated with problem solving (Leikin et al., 2013) and problem posing (Shriki, 2010) in many studies, as in the current study. Problem posing skill is as important as problem solving skill and supporting the development of these skills is very important for mathematical creativity. However, while most of the teachers (seven) emphasized problem solving skill, only a few (four teachers) mentioned problem posing skill. It is a remarkable finding that the majority of the teachers did not mention problem posing skill while talking about the concept of creativity.

In addition, mathematics is a science of discovery. Mathematicians enable science to progress by discovering different problems and theories in the mathematical space. At the same time, students learn mathematics by combining and discovering the links between different pieces of mathematical knowledge at the K-12 level. However, in the current study, only three teachers emphasized the conceptual link between mathematical creativity and discovering mathematics. It is a remarkable finding that the teachers of the Ministry of National Education, where the constructivist approach has been applied within the framework of the curriculum, did not emphasize this concept. This finding gives rise to the idea that there is a gap in the opinions of teachers on the concept of mathematical creativity.

Another remarkable finding of the current study is related to teacher creativity. When the participants were asked what mathematical creativity is, it was seen that most of them (seven teachers) associated this concept with a creative teacher. Teachers' using creative teaching methods (six teachers), designing materials (two teachers), writing questions (two teachers) and thinking differently (two teachers) were perceived as mathematical creativity. Similar opinions have been seen in the literature but not under the concept of creativity rather under the concept of creative teacher. Seen from this perspective, it can be argued that the teachers in other studies in the literature think of their own creativity as mathematical creativity; thus, they have partially distanced themselves from the concept and attributed a different meaning to the concept.

As a result, in the interviews conducted with the teachers who scored above the average in the Creativity Fostering Teacher Behaviour Index, it was seen that even if the teachers did not take a course on mathematical creativity, they had some opinions on creativity and mathematical

creativity and these opinions concur with the relevant literature. In particular, originality emphasized for creativity, problem solving emphasized for mathematical creativity and originality and higher-order thinking are the concepts that have been widely mentioned by many researchers in the literature. Therefore, the opinions of the interviewed mathematics teachers are valid expressions for mathematical creativity. However, the fact that many of the teachers did not mention concepts such as discovering mathematics, making connections within mathematics itself and posing mathematical problems which are indispensible part of the concept of mathematical creativity shows that teachers have conceptual gaps. It is one of the remarkable findings of this study that the teachers who scored well above the average in a scale measuring teachers' ability to foster creativity in the classroom did not mention these important concepts. Future research on how teachers can foster mathematical creativity can answer the questions raised by the findings of the current study. Research to be conducted on how and to what extent the teachers who can express mathematical creativity well can foster mathematical creativity in the classroom can help fill the void in the literature.

The current study was conducted to draw conclusions about teachers' opinions on mathematical creativity and supporting mathematical creativity via interviews. In order to collect more detailed data for future research, it may be suggested to make classroom observations on how teachers support mathematical creativity in the classroom. In addition, the main purpose of this research is to examine teachers' views on supporting mathematical creativity. However, in the research, it was understood from the teachers' views that there are barriers to supporting mathematical creativity. Therefore, it may be recommended to conduct more detailed interviews in order to examine the barriers to mathematical creativity for future research. Finally, in this study, it was noticed that teachers had gaps in mathematical creativity. For this reason, it is recommended to organize in-service trainings in order to eliminate these deficiencies.

REFERENCES

Akar, İ. (2014). Yaratıcılığa Teşvik Edici Öğretmen Davranışları İndeksi 'nin (YÖDİndeksi) Türkçeye uyarlanması. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi, 14*(1), 304-328.

Akcanca, N. & Cerrah- Özsevgeç, L. (2016). Fen bilimleri öğretmen adaylarının yaratıcılığa ilişkin düşüncelerinin belirlenmesi. *Bayburt Eğitim Fakültesi Dergisi*, *11*(2).

Akgül, S. (2021). Matematiksel yaratıcılık ve geliştirilmesi. Ş. Şengil Akar ve G. Batdal Karaduman (editörler), *Özel yeteneklilerde matematik öğretimi ve matematiksel yaratıcılığın desteklenmesi,* Ankara; PegemA Yayıncılık.

Aktas, M. C. (2016). Turkish high school teachers' conceptions of creativity in mathematics. *Journal of Education and Training Studies, 4*(2), 42-52.

Aljughaiman, A. & Mowrer-Reynolds, E. (2005). Teachers' conceptions of creativity and creative students. *The Journal of Creative Behavior, 39*(1), 17–34.

Alkan, R. (2014). *Genel yaratıcılık, matematiksel yaratıcılık ve akademik başarı arasındaki ilişkilerin incelenmesi,* Yayınlanmamış doktora tezi, Gazi Üniversitesi, Ankara.

Altın, M., & Saracaloğlu, A. S. (2018). Yaratıcı, eleştirel ve yansıtıcı düşünme: Benzerlikler-farklılıklar. *Uluslararası Güncel Eğitim Araştırmaları Dergisi, 4*(1), 1-9.

Arıkan, E.E. (2017). Is There a Relationship between Creativity and Mathematical Creativity. *Journal of Education and Learning, 6*(4), 239- 253.

Ayvaz, Ü. (2019). *Problem kurma temelli etkinliklerle özel yetenekli öğrencilerin matematiksel yaratıcılıklarının geliştirilmesi üzerine bir eylem araştırması*, Yayınlanmamış doktora tezi, Abant İzzet Baysal Üniversitesi, Bolu.

Aziza, M. (2018). An analysis of a teacher's questioning related to students' responses and mathematical creativity in an elementary school in the UK. *International Electronic Journal of Elementary Education, 10*(4), 475–487.

Bahar, A. K., & Maker, C. J. (2011). Exploring the relationship between mathematical creativity and mathematical achievement. *Asia-Pacific Journal of Gifted and Talented Education, 3(*1), 33-48.

Bakanlığı, M. E. (2013). *İlköğretim Matematik Dersi (5-8. Sınıflar) Öğretim Programı*. Ankara: MEB.

Balka, D. S. (1974). Creative ability in mathematics. *Arithmetic Teacher, 21*(7), 633-636.

Biber, M. (2006). *Keşfederek öğrenme yönteminin ilköğretim II kademe matematik dersi öğrencilerinin yaratıcılıkları üzerindeki etkisi*, Yayınlanmamış doktora tezi, Dokuz Eylül Üniversitesi, İzmir.

Bicer, A., Lee, Y., Perihan, C., Capraro, M. M., & Capraro, R. M. (2020). Considering mathematical creative self-efficacy with problem posing as a measure of mathematical creativity. *Educational Studies in Mathematics, 105*(3), 457-485.

Craft, A. (2003). The Limits to Creativity in Education: Dilemmas for the Educator. *British Journal of Educational Studies, 51*(1), 113-126.

Cropley, A. J. (1997). Fostering creativity in the classroom: General principles. *The creativity research handbook*, *1*(84.114), 1-46.

Demir, M., & Açıkgül, K. (2021). Matematik Öğretmenlerinin Matematiksel Yaratıcılığa İlişkin Görüşlerinin ve Yaratıcı Problem Çözme Becerilerinin İncelenmesi. *International Journal of Educational Studies in Mathematics*, *8*(3), 175-194.

Dündar, S. (2015). Matematiksel yaratıcılığa yönelik matematik öğretmen adaylarının görüşlerinin incelenmesi. *Ondokuz Mayis University Journal of Education Faculty*, *34*(1), 18-34.

Ersükmen, E. (2010). *İlköğretim fen ve teknoloji ders öğretmenlerinin yaratıcılık kavramına ilişkin görüşleri*, Yayınlanmamış doktora tezi, Dokuz Eylül Üniversitesi, İzmir.

Ervynck, G. (1991). *Mathematical creativity. In D. Tall* (Ed.), In Advanced mathematical thinking (pp. 42-53). Dordrecht: Kluwer.

Esi, A. (2018). Matematikte Yaratıcılık. *Journal of Awareness, 3*(5), 309-314.

Haylock, D. (1997). Recognising mathematical creativity in schoolchildren. *ZDM, 29*(3), 68-74.

Kandemir, M. A., & Gür, H. (2009). The use of creative problem solving scenarios in mathematics education: views of some prospective teachers. *Procedia-Social and Behavioral Sciences*, *1*(1), 1628-1635.

Kattou, M., Kontoyianni, K., & Christou, C. (2009). Mathematical creativity through teachers' perceptions. In *Proceedings of the 33rd Conference of the International Group for the Psychology of Mathematics Education*, 3(1), 297-304. Thessaloniki, Greece: PME.

Katz, S., & Stupel, M. (2015). Promoting Creativity and Self-Efficacy of Elementary Students through a Collaborative Research Task in Mathematics: A Case Study. *Journal of Curriculum and Teaching, 4*(1), 68-82.

Kavgacı, Y. (2016). *Matematik Problemi Özme Stratejileri Öğretiminin Dokuzuncu Sınıf Öğrencilerinin Yaratıcılık Düzeylerinin Gelişimine Etkisi*, Yayınlanmamış doktora tezi, Necmettin Erbakan Üniversitesi, Konya.

Kıymaz, Y. (2009). *Ortaöğretim matematik öğretmen adaylarının problem çözme durumlarındaki matematiksel yaratıcılıkları üzerine nitel bir araştırma*, Gazi Üniversitesi, Ankara.

Kıymaz, Y., Sriraman, B., & Lee, K. H. (2011). *Prospective Secondary Mathematics Teachers' Mathematical Creativity in Problem Solving.* In The Elements of Creativity and Giftedness in Mathematics. Leiden, The Netherlands: Brill.

Krutetskii, V. A. (1976). The psychology of mathematical abilities in school children. Chicago: University of Chicago Press.

Kwon, O. N., Park, J. H., & Park, J. S. (2006). Cultivating divergent thinking in mathematics through an open-ended approach. *Asia Pacific Education Review, 7*(1), 51-61.

Leikin, R. (2009). Exploring mathematical creativity using multiple solution tasks. In R. Leikin, A. Berman and B. Koichu (Eds.), *Creativity in mathematics and the education of gifted students.* (Pp. 129-145). Rotterdam, Netherlands: Sense Publishers.

Leikin, R., & Lev, M. (2013). Mathematical creativity in generally gifted and mathematically excelling adolescents: What makes the difference. *ZDM, 45*(2), 183-197.

Leikin, R., Subotnik, R., Pitta-Pantazi, D., Singer, F. M., & Pelczer, I. (2013). Teachers' views on creativity in mathematics education: An international survey. *ZDM, 45*(2), 309-324.

Levenson, E. S. (2011). Exploring Collective Mathematical Creativity in Elementary School. *Journal of Creative Behavior, 45(*3), 215-234.

Levenson, E. (2013). Tasks that may occasion mathematical creativity: Teachers' choices. *Journal of Mathematics Teacher Education, 16*(4), 269-291.

Lev-Zamir, H. & Leikin, R. (2011). Creative Mathematics teaching in the eye of the be holder: Focusing on teachers' conceptions. *Research in Mathematics Education, 13*(1), 17-32.

Luria, S. R., Sriraman, B., & Kaufman, J. C. (2017). Enhancing equity in the classroom by teaching for mathematical creativity. *ZDM, 49*(7), 1033-1039.

Mann, E. L. (2005). *Mathematical creativity and school mathematics: Indicators of mathematical creativity in middle school students*, Doktora tezi, University of Connecticut.

Mann, E. L. (2006). Creativity: The essence of mathematics. *Journal for the Education of the Gifted, 30*(2), 236-260.

Merriam, S. B. (2012). *Nitel Araştırma Yöntemleri: Tasarım ve Uygulama İçin Bir Rehber.* Nobel Yayım Dağıtım. Ankara.

Molad, O., Levenson, E. S., & Levy, S. (2020). Individual and Group Mathematical Creativity among Post-High School Students. *Educational Studies in Mathematics, 104*(2), 201–220.

Neuman, W. L. (2007). *Toplumsal araştırma yöntemlerinde nitel ve nicel yaklaşımlar.* (Ö. Sedef, Çev.). İstanbul: Yayın Odası.

Özel, A., & Bayındır, N. (2015). Sınıf öğretmenlerinin öğrencilerde yaratıcılığı geliştirmeye yönelik öğretimsel davranışları. *Uluslararası Türk Eğitim Bilimleri Dergisi*, *2015*(5), 348-358.

Özerbaş, M. A. (2011). Yaratıcı Düşünme Öğrenme Ortamının Akademik Başarı ve Bilgilerin Kalıcılığa Etkisi. *Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi, 31*(3), 675-705.

Özkan, H. (2016). *Okul öncesi eğitim kurumlarındaki öğrencilerin yaratıcılık düzeyleri ile öğretmenlerin yaratıcılık gelişimine ve okul öncesi eğitim programına yönelik görüşleri ve uygulamaları*, Yayınlanmamış Yüksek Lisans Tezi, Erciyes Üniversitesi, Kayseri.

Panaoura, A., & Panaoura, G. (2014). Teachers' awareness of creativity in mathematical teaching and their practice. *Issues in the Undergraduate Mathematics Preparation of School Teachers, 4*(1), 1-11.

Patton, M. Q. (2002). Two decades of developments in qualitative inquiry: A personal, experiential perspective. *Qualitative social work, 1(*3), 261-283.

Pehkonen, E. (1997). The state-of-art in mathematical creativity. *ZDM Mathematics Education, 29*(3), 63-67.

Pehlivan, N. (2019). *Sınıf öğretmenlerinin yaratıcılık düzeyleri ile yaratıcılığı destekleme düzeyleri arasındaki ilişkinin incelenmesi*, Yayınlanmamış Yüksek Lisans Tezi, Sakarya Üniversitesi, Sakarya.

Philips, E., Higginson, W. (1997). *Creative mathematics: Exploring children's understanding.* London: Routledge.

Plucker, J. A., Beghetto, R. A., & Dow, G. T. (2004). Why isn't creativity more important to educational psychologists? Potentials, pitfalls, and future directions in creativity research. *Educational psychologist, 39*(2), 83-96.

Sak, U., & Maker, C. J. (2006). Developmental variation in children's creative mathematical thinking as a function of schooling, age, and knowledge. *Creativity research journal, 18(*3), 279-291.

Sheffield, L. J. (1994). *The development of gifted and talented mathematics students and the National Council of Teachers of Mathematics Standards* (Report No. RBDM 9404). Storrs: National Research Center on the Gifted and Talented, University of Connecticut.

Sheffield, L. J. (2006). Developing mathematical promise and creativity. *Research in Mathematical Education, 10*(1), 1-11.

Shriki, A. (2010). Working like real mathematicians: Developing prospective teachers' awareness of mathematical creativity through generating new concepts. *Educational Studies in Mathematics, 73*(2), 159-179.

Silver, E. A. (1997). Fostering creativity through instruction rich in mathematical problem solving and problem posing. *ZDM, 29*(3), 75-80.

Soh, K. C. (2000). Indexing creativity fostering teacher behavior: A preliminary validation study. *Journal of Creative Behavior, 34*(2), 118- 134.

Sriraman, B. (2004). The Characteristics of Mathematical Creativity. *Mathematics Educator, 14*(1), 19-34.

Sriraman, B. (2005). Are mathematical giftedness and mathematical creativity synonyms? An analysis of constructs within the professional and school realms. *The Journal of Secondary Gifted Education, 17*(1), 20–36.

Sternberg, R. J., & Davidson, J. E. (2005). *Conceptions of giftedness.* Cambridge University Press.

Şengil-Akar, Ş., & Yetkin-Ozdemir, I. E. (2021). Investigation of mathematical collective creativity of gifted middle school students during model-eliciting activities: the case of the quilt problem. *International Journal of Mathematical Education in Science and Technology*, *53*(2), 337-363.

Şengil-Akar, Ş. (2017). *Üstün yetenekli öğrencilerin matematiksel yaratıcılıklarının matematiksel modelleme etkinlikleri sürecinde incelenmesi.* Yayınlanmamış doktora tezi, Hacettepe Üniversitesi, Ankara.

Tezci, E., & Dikici, A. (2003). Yaratıcı düşünceyi geliştirme ve oluşturmacı öğretim tasarımı. *Fırat Üniversitesi Sosyal Bilgiler Dergisi, 1*(13).

Torrance, E. P. (1995). Insights about creativity: Questioned, rejected, ridiculed, ignored. *Educational Psychology Review, 7*(1), 313.

Torrance, E.P. (1974). Torrance tests of creative thinking. Bensenville, IL: Scholastic Testing Service.

Yalçın, M. M. (2021*). Öğretimde yaratıcılık ölçeği'nin geçerlik-güvenirlik çalışması ve okul öncesi öğretmenlerinin 48-72 aylar arasındaki çocukların yaratıcılıklarını destekleme durumlarının farklı değişkenler açısından incelenmesi*, Yayınlanmamış doktora tezi, Necmettin Erbakan Üniversitesi, Konya.

Yazgan-Sağ, G. (2019). *Matematikte Üstün Yetenekliliğe Teorik Bir Bakış. Milli Eğitim Dergisi, 48*(221), 159-174.

Yazgan-Sağ, G., & Emre-Akdoğan, E. (2016). Creativity from two perspectives: Prospective mathematics teachers and mathematician. *Australian Journal of Teacher Education, 41*(12), 25-40.

Yıldırım, A., & Şimşek, H. (2016). Sosyal bilimlerde nitel araştırma yöntemleri. Ankara: Seçkin Yayıncılık.

Yıldırım, A., & Şimşek, H. (2021). Sosyal bilimlerde nitel araştırma yöntemleri. Ankara: Seçkin Yayıncılık.

Yıldırım, B. (2006). *Öğretmenlerin yaratıcılığa bakış açısı ve anasınıfı çocuklarının yaratıcılık düzeylerinin öğretmenin yaratıcılık düzeyine göre incelenmesi*, Yayımlanmamış yüksek lisans tezi, Hacettepe Üniversitesi, Ankara.

Yıldız, A. & Baltacı, S. (2018). İki Farklı Kurumda Çalışan Ortaokul Matematik Öğretmenlerinin Yaratıcılığı Destekleme Durumlarının İncelenmesi. *Van Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi, 15(*1), 1392-1418.

Yılmaz, T. Y. (2016). *Öğrencilerin çok çözümlü problemlerde kullandıkları stratejilerinin belirlenmesi ve matematiksel yaratıcılıklarının değerlendirilmesi*, Yayımlanmamış Doktora Tezi, Anadolu Üniversitesi, Eskişehir

Yuvacı, Z. (2017). *Okul öncesi eğitim alan 6 yaş çocuklarının yaratıcılık düzeylerinin öğretmenlerinin ve sınıf ortamlarının yaratıcılıklarına göre incelenmesi*, Gazi Üniversitesi, Ankara.

Yükseltürk, E., & Altıok, S. (2016). Bilişim teknolojileri öğretmen adaylarının programlama öğretiminde scratch aracının kullanımına ilişkin algıları. *Mersin Üniversitesi Eğitim Fakültesi Dergisi, 12*(1), 39-52.