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Examination the Opinions of Pre-Service Teachers on the Concept of Creativity

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Abstract

This study aims to examine the opinions of the pre-service teachers, who are studying in the department of mathematics, on creativity and the concept of mathematical creativity. The study group of the study consisted of 32 pre-service teachers studying in the 4th grade in the department of mathematics teaching in a province located in the southern region of Turkey in the 2022-2023 academic year. In this study, qualitative research method was used. In the study, semi-structured interview technique, one of the qualitative data collection techniques, was used. Content analysis technique was employed to analyze the data obtained from the interviews. As a result of the analysis of the data obtained in the research, pre-service teachers stated that creativity is a different and original way of thinking, it is a case of adding a new one on top of the existing situation, and mathematical creativity is the ability to produce different and new solutions. In addition, the opinions of pre-service teachers about the characteristics that should be in a creative teacher are gathered in two themes as professional and personal characteristics. In addition, it was concluded that the majority of the opinions of the pre-service teachers about their self-sufficient and inadequate situations in terms of creativity considered themselves at a sufficient level in this regard.

Introduction

The concept of creativity etymologically consists of the English word “create” and the Latin word “*creare*,” and it is used in the sense of creating, exploring, producing, and finding (Memduhoğlu, Uçar and Uçar, 2017). Sawyer (2006) defined creativity as a process that is perceived as the source of innovation. Benedek, Jauk, Sommer, Arendasy and Neubauer (2014) have defined creativity as innovation and usefulness. The first of the studies on creativity in the modern sense was the work “Creativity” published by Guilford (1950). Mathematical creativity, on the other hand, is a sub-dimension of creativity and is the part specific to the field of mathematics. Chamberlin and Moon (2005) defined mathematical creativity as solving problems in non-standard ways and expressed it as the domain-specific thinking process that mathematicians use when they engage in non-routine problem solving. They also defined creativity as the unusual ability to produce useful and original solutions to problems. Sriraman (2004) expressed mathematical creativity as the process of bringing solutions to a problem with an unusually clear and deep insight, regardless of the level of complexity of a problem.

Creative individuals are people who think, question and produce. The training of creative individuals can be possible with a creative education. In addition, the skills expected from individuals are generally called 21st Century Skills and include skills such as creativity, critical thinking, innovation, communication, problem solving, collaboration, and learning to learn. One of the most important qualities sought in individuals today is creative thinking skills. Creativity increases the chances of the individual and society to succeed, the ability to constantly renew oneself and make changes. To encourage and manage creativity, managers need to have knowledge and ideas about how the creative process works and know how to create an environment where creativity can be nurtured and developed (Şimşek, Akgemici & Çelik, 2001). The administrators of the teaching environment within the classroom are the teachers. Therefore, teachers need to know and apply creativity. It has been emphasized in the field literature that the early discovery of creativity is important for the development of this feature (Aktamış & Ergin, 2007; Öncü, 2003; Yıldırım, 2006). Davis (2004) stated that when the necessary methods and techniques are used in appropriate environments, the potential of individuals in terms of creativity will emerge and develop. Many researchers have also indicated that a creative student can only be trained by a creative teacher (Gorshunova, Medvedev & Razdorskaya, 2014; Gürgen & Bilen, 2005; Töremen, 2002).

According to Polya (1962), teachers should develop their students' reasoning skills, recognize and encourage creative thinking. Polya points out that teachers who have no experience in any creative work will not be able to help their students. It is important to include this skill in the mathematics curriculum to provide environments in which students can fully use their creative potential and to enable them to use their potential (Balka, 1974; Mann, 2005) and that the teachers who are the practitioners of this program have competence in this subject.

Examining the studies on the concept of creativity at national and international levels, it is observed that there are studies discussing the conceptualization of the creative thinking skills of prospective teachers (Aksoy, 2017), and the creativity skills of teachers from different branches (Aktamış & Ergin 2007; Arslan, 2000; Çetingöz, 2002; Demirtaş, 2018; Kurnaz, 2011). In addition, there are also studies in which the relationship of the concept of creativity with different skills such as mathematical attitude, belief, mathematical thinking, computer-aided collaborative environments, leadership, critical thinking, creative problem solving is addressed (Aydoğdu & Yüksel, 2013; Ayllón, Gómez & Ballesta-Claver 2016; Bağçeci & Kinay, 2013; Birişçi & Karal, 2015; Çoban, 1999; Gök & Erdoğan, 2011; Kashefi, Ismail & Yusof, 2017; Leung & Silver, 1997; Mullet, Willerson, Lamb & Kettler 2016; Shermukhammadov, 2022). There are also studies in which the views of prospective mathematics teachers for mathematical creativity were examined, and the metaphorical perceptions of prospective teachers about the concept of creative teacher were discussed (Dündar, 2015; Schreglmann & Kazanci, 2016).

Compared to the studies conducted with mathematics teachers or prospective mathematics teachers, there are also studies available in the field literature in which the correlated situations between creative thinking, critical thinking, anxiety, leadership, intelligence, empathy, excellence levels and academic achievements were examined comparatively in relation to students with special abilities and normal development (Bıçakçı & Baloğlu, 2010; Mercan, 2022; Özdemir, 2010; Sontay, 2013; Uyaroğlu, 2011; Ürek, 2012). It is thought that the examination of the views of prospective mathematics teachers, who will be responsible for developing creative thinking in students, on the concepts of creativity and mathematical creativity will contribute to the field literature. In this

context, the following research questions were formed in this research.

What are the views of pre-service teachers about

- the concept of creativity?
- the concept of mathematical creativity?
- the qualities that a creative teacher should have?
- feeling adequate or inadequate in terms of creativity?

Method

Design of the Study

Qualitative research method was used in this study which aims to determine the opinions of pre-service teachers about the concept of creativity. Qualitative research is a form of research in which qualitative data collection methods such as observation, interview and document analysis are used and a qualitative process is followed to reveal perceptions and events in a realistic and holistic way in the natural environment (Yıldırım & Şimşek, 2011).

In the study, semi-structured interview technique was used after the literature review to solve the questions sought to be answered. “In the semi-structured interview technique, the researcher prepares the interview questions in advance; however, it provides partial flexibility to the people investigated during the interview, allowing the questions created to be rearranged and discussed. In this type of interview, the people interviewed also have control over the research” (Ekiz, 2009).

Study Group

The study group of this research consisted of 32 pre-service teachers attending their education in the 4th grade in the department of mathematics teaching in a province located in the southern region of Turkey in the 2022-2023 academic year. In the determination of the study group of the study, criterion sampling method, was used. Criterion sampling can be formed from events, people, objects or situations with certain characteristics (Büyüköztürk, Çakmak, Akgün, Karadeniz & Demirel, 2009). Criteria for this pre-service mathematics teachers selected through purposeful sampling were determined as being in the 4th grade of mathematics teaching department and their voluntary participation in this research.

Data Collection Tool

While developing the data collection tool, first of all, the resource scan was carried out on the subject. To ensure the validity of the data collection tool, this tool was presented to the examination of 3 faculty members including 2 experts in the field of Mathematics education and 1 language expert. The data collection tool was reorganized in line with the opinions and suggestions of the faculty members and applied to five mathematics teachers for pre-application. The opinions of the pre-service teachers who participated in the pre-application were excluded from the evaluation in the research.

As a result of these interviews, it was concluded that the interview questions were sufficiently clear and understandable. Pre-service teachers were asked a total of 5 questions:

1. What are your opinions about creativity?
2. How do you evaluate yourself in terms of creativity?
3. What qualities should be present in a creative teacher?
4. What are your opinion about mathematical creativity?
5. Do you think you are creative when solving mathematical problems?

The data and analyses should be presented to the people being interviewed and checked whether the researcher's understanding and interpretations are correct. If there are misinterpretations and understandings, the researcher should correct this in line with what the participants of the study report (Ekiz, 2009). Due to this feature of the qualitative research, the opinions of some of the pre-service teachers who participated in the interview were arranged and presented.

Data Analysis

In the study, content analysis was used from qualitative data analysis techniques in the analysis of the data. Content analysis is the thematic analysis of data in terms of certain categories by scanning it in a systematic way. With the data obtained in content analysis, there is identification, counting and interpretation of recurring topics, problems and concepts (Denzin & Lincoln, 2008; Miles & Huberman, 1994; Silverman, 2000). In other words, the data obtained by content analysis are classified between each other and certain themes, thus revealing the relationships between the data (Yıldırım & Şimşek, 2011). In the research, first the themes and sub-themes were determined, and some of the opinions of participants were conveyed through the quotations. In order not to reveal the identities of the participants in the studies, participants are given codes such as PMT1, PMT2... .

The answers of the participants to the interview questions were coded by two researchers. The codes determined were examined separately, and the codes with "consensus" and "difference of opinion" were determined. Later, the necessary arrangements were made. In the reliability calculation of the codings, the reliability formula proposed by Miles and Huberman (1994) was used: $\text{Credibility} = \text{Consensus} / (\text{Consensus} + \text{Disagreement})$. As a result of the calculations, the reliability was calculated as a total of 0.92.

Findings

In this section, the results of the analysis made in line with the research findings are included.

Opinions of Pre-service Mathematics Teachers on the Concept of Creativity

Pre-service mathematics teachers were asked about their opinions about the concept of creativity, and the findings obtained from the analysis of the data were presented in Table 1.

Table 1. Views on the Concept of Creativity

Themes	Code	f
To add a new one on top of the existing situation	Ö1, Ö3, Ö9, Ö10, Ö13, Ö14, Ö20	7
A necessary skill that provides convenience	Ö2, Ö16, Ö31	3
To require unlimited dreaming and producing	Ö4	1
Different and original way of thinking	Ö5, Ö6, Ö7, Ö11, Ö16, Ö17, Ö18, Ö21, Ö22, Ö23, Ö24, Ö25, Ö27, Ö28, Ö29, Ö31, Ö32	17
Exploratory solution, curiosity and interest	Ö8	1
To push boundaries, abandoning the comfort zone	Ö12, Ö32	2
To require talent	Ö19, Ö32	2
A skill that can be developed	Ö23, Ö32	2
Not getting stuck in function	Ö26	1
To produce what works, what is useful	Ö28	1
To enable changing perspective	Ö30	1

According to Table 1, the views of participants on the concept of creativity are collected in 11 different themes. The majority of participants (f:17) expressed the opinion that creativity is a different and original way of thinking. In addition, there are different opinions about the concept of creativity in the direction of adding a new one to the existing situation (f: 7), that it is a necessary skill that provides convenience (f: 3), that it is a skill that can be developed (f: 2), that it is useful (f: 1), and that it requires talent (f: 2).

In addition, there are also opinions about fact that the concept of creativity is associated with exploratory solutions, curiosity and interest; that it allows to change the point of view; that it is a skill that can be developed that requires talent; that it requires pushing the boundaries and leaving the comfort zone. Some examples of the opinions of participants are given below.

PMT1: Creativity is the idea of coming up with newer, interesting and different ideas about a topic or problem other than the existing ones.

PMT9: I think creativity is about making logical and new inferences based on known data, reasoning.

PMT11: Creativity is a prominent feature of the person. It is usually an individualized individual and a characteristic of original thinking.

PMT26: It is not getting stuck in function.

PMT28: To create the product that will work with the materials in hand.

PMT32: Creativity is an ability used in many areas such as generating new and original ideas, problem solving, innovation and art. Creativity can be an innate ability or a skill that can be developed.

Opinions of Pre-service Mathematics Teachers on the Concept of Mathematical Creativity

Pre-service mathematics teachers were asked about their opinions about the concept of mathematical creativity, and the findings obtained from the analysis of the data were presented in Table 2.

Table 2. Opinions on the Concept of Mathematical Creativity

Themes	Code	f
Ability to produce different and new solutions	Ö1, Ö2, Ö5, Ö6, Ö9, Ö15, Ö17, Ö19, Ö21, Ö27, Ö29, Ö32	12
Ability to present a different point of view	Ö2, Ö9, Ö21, Ö25, Ö26	5
To add a new one on top of the existing situation	Ö3, Ö28	2
Necessary and important	Ö4, Ö11, Ö31	3
Ability to present different methods, techniques or materials	Ö7, Ö14, Ö15, Ö16, Ö22, Ö24	6
To be able to offer practical solutions	Ö8, Ö23, Ö27, Ö29, Ö30	5
About intelligence and education	Ö10	1
To develop with reasoning activities	Ö10	1
To require the prerequisite of liking mathematics	Ö12	1
To see the unseen	Ö18	1
To break the mold	Ö18	1
To require skill	Ö20	1

According to Table 2, the views of participants on the concept of mathematical creativity are collected under 12 different themes. The majority of participants (f:12) expressed the opinion that mathematical creativity is the ability to produce different and new solutions. In addition, there are different opinions that the concept of mathematical creativity requires the ability to present different methods, techniques or materials (f: 6), to propose practical solutions (f: 5), to offer a different perspective (f: 5), to add a new one to the existing situation (f: 2), and that it is a necessary and important skill (f: 3). In addition, there are also opinions on the fact that the concept of mathematical creativity is related to intelligence and the education received; that it can develop with reasoning activities; that it requires the prerequisite of loving mathematics; that it requires breaking the mold; that it requires talent. Some examples of the opinions of participants are given below.

PMT5: In mathematics, problems and operations need to be shown not only one way but also other solutions, and we should even involve the student in this process and ensure that he produces different solutions.

PMT9: It is not only to solve a problem with the known formulas and in one way, but also to be able to solve it in other ways by thinking differently.

PMT10: Mathematical creativity is directly proportional to education as much as it is to intelligence. Activities aimed at improving reasoning skills can develop students' creativity.

PMT23: I think that the science of mathematics is founded on the strategy of "problem solving". Therefore, I predict that people with high creative skills will be able to succeed in this science.

PMT25: To be able to look at the same question from different angles. To find solutions by using the topics within mathematics itself.

PMT29: Creativity has an important place to be able to produce solutions to daily life problems to mathematics problems, to understand new generation questions and to produce solutions, the student should be able to produce different ways in his mind and transfer to the problem.

Opinions of Pre-service Mathematics Teachers on the Characteristics that should be in a Creative Teacher

Pre-service mathematics teachers were asked what characteristics should be in a creative teacher, and the findings obtained from the analysis of the data were presented in Table 3.

Table 3. Opinions on the Characteristics that should be in a Creative Teacher

Themes	Sub-Themes	Code	f	
Professional qualifications	Mastery of the subject	Ö1	1	
	To be able to make interesting and different narratives	Ö1, Ö2, Ö18, Ö24, Ö26, Ö27, Ö29, Ö30, Ö31	9	
	To take care of student needs	Ö1, Ö15, Ö18	3	
	To be a developer and useful	Ö3, Ö27	2	
	To possess effective communication skills	Ö4	1	
	To engage students to think creatively	Ö4, Ö12	2	
	A good field education	Ö7, Ö10, Ö16, Ö25, Ö26, Ö28, Ö29	7	
	To emphasize on teaching through invention	Ö8	1	
	Ability to use technology actively	Ö8, Ö9	2	
	To be innovative, to follow professional developments	Ö8, Ö9, Ö10, Ö12, Ö15, Ö17	6	
	Personality traits	Rapid adaptation to new situations and quick and solution to problems	Ö2, Ö5, Ö11, Ö12, Ö17, Ö23, Ö25	7
		To have a broad perspective	Ö2, Ö4, Ö10	3
		To become a researcher	Ö3, Ö9, Ö13	3
To be authentic		Ö3, Ö14, Ö15	3	
To be a leader		Ö6	1	
Not to like to take responsibility		Ö6	1	
Not to be friendly		Ö6	1	
To have agile intelligence		Ö7	1	
To be energetic		Ö7, Ö20, Ö22	3	
Ability to make self-criticism		Ö9	1	
A lot of reading		Ö9	1	
To be farsighted		Ö15	1	
To be able to take risks		Ö17, Ö31	2	
To be productive	Ö19	1		
To have high level of imagination	Ö20	1		
To be curious	Ö20	1		
To be patient	Ö21, Ö28	2		
Not to be afraid to make mistakes	Ö31	1		

According to Table 3, the opinions of participants about the characteristics that should be in a creative teacher are

collected under 2 themes and 28 sub-themes. Participants expressed their opinions about the professional competencies that a creative teacher should have as follows: to be able to make interesting and different expressions (f: 9), to have a good field education (f: 7), to be innovative, to follow professional developments (f: 6), to observe student needs (f:3), to use technology actively (f: 2). In addition, participant stated that creative teachers should be familiar with the subject and have effective communication skills. Participants expressed their opinions about the personal characteristics that should be in a creative teacher as follows: to quickly adapt to new situations, to produce quick solutions to problems (f: 7), to have a broad perspective (f: 3), to be inquisitive (f: 3), to be original (f: 3), to be patient (f: 2), and to be energetic (f: 3). In addition, participants have expressed the opinion that a creative teacher should be patient, curious, productive, not afraid to make mistakes and able to make self-criticism. Some examples of the opinions of participants are given below.

PMT3: Creative teachers should be original and inquisitive; they should be developer and utilitarian.

PMT6: Creative teachers must have leadership qualities, love to take responsibility and be friendly.

PMT8: Creative teachers should give importance to teaching through invention, however, there should be a teacher who follows up-to-date and technological teaching tools.

PMT15: A creative teacher should always be able to offer different examples to students, adapt to different students, be forward-thinking, always open to innovations.

PMT18: Creative teachers should be able to translate what is in the book not as it is and give examples from current life into a format that students can understand.

PMT21: Creative teachers should be patient people who respect different points of view and thinking styles, listen, try to understand. They should be open to innovations.

PMT29: They must be able to think in a way that can answer questions from students, use different strategies, and spend hours with active participation.

Opinions of Pre-service Mathematics Teachers on Their Feelings of Being Inadequate and Inadequate in Creativity

Pre-service mathematics teachers were asked to evaluate themselves in terms of creativity, and the findings obtained from the analysis of the data are presented in Table 4.

Table 4. Opinions on Feeling Sufficient-Insufficient for Creativity

Themes	Code	f
Feeling sufficient	Ö2, Ö3, Ö7, Ö8, Ö10, Ö12, Ö14, Ö15, Ö16, Ö17, Ö18, Ö23, Ö26, Ö27, Ö28, Ö29, Ö30, Ö31	18
Feeling moderately sufficient	Ö4, Ö5, Ö9, Ö19, Ö22, Ö24, Ö32	7
Feeling insufficient	Ö1, Ö6, Ö13, Ö20, Ö21, Ö25	6
Feeling indecisive	Ö11	1

According to Table 4, the opinions of participants about their feelings of being sufficient-insufficient about creativity are collected under 4 different themes. The majority of participants(f:18) stated that they were sufficient in this regard. In addition, there are participants who feel moderately sufficient (f: 7), feeling insufficient (f: 6),

and indecisive (f: 1) regarding their competence in creativity. Some examples of the opinions of participants are given below.

PMT1: No. I usually solve problems through the classical solutions that exist.

PMT11: To be honest, I can say that I am undecided about the answer to this question. Instead of just using formulas to solve questions, I always solve problems according to daily life.

PMT16: I think I am creative because I am trying to find different solutions

PMT20: I think no. Because I have a hard time solving problems for myself and I always resort to the pattern I was taught. When I want to put something new out there, I can't. Because, as I said above, creativity in math requires talent, and I don't have that ability

PMT21: I don't think I am very creative. When I think about my school life, the teachers' approach to problems and learn-by-rote understanding can have an impact on this.

PMT23 :I definitely think I am creative. In most geometry questions, I had a hard time solving the rule because I could not memorize it. But as I embraced and thought about the question, I realized that I could reach that rule and solve the question easily.

PMT25: No. Because the questions posed to me did not require it too much. Lately, I've been trying to step outside the box to understand and solve questions with the new generation of questions.

Discussion and Conclusion

This research, which aims to examine the views of participants studying in the department of primary mathematics on creativity and the concept of mathematical creativity, is based on the data obtained from 32 pre-service teachers. In line with the first research question, the views of participants on the concept of creativity were collected under 11 themes. Participants expressed different opinions such as creativity is a different and original way of thinking; that it is a case of adding a new one on top of the existing situation; that it is a necessary skill that can be developed that provides convenience. In addition, participants stated that creativity is related to curiosity and interest; that it allows to change the point of view; that it is a skill that requires pushing the boundaries and leaving the comfort zone. In line with the second research question, the opinions of participants about the concept of mathematical creativity were collected under 12 different themes. The majority of Participants expressed the opinion that mathematical creativity is the ability to produce different and new solutions.

In addition, there are different opinions that the concept of mathematical creativity requires the ability to present different methods, techniques or materials, to propose practical solutions, to offer a different perspective, to add a new one to the existing situation and that it is a necessary and important skill In addition, participants stated that the concept of mathematical creativity is related to intelligence and the education received, that it can develop with reasoning activities, that it requires the prerequisite of liking mathematics, that it requires going out of memory and that it requires ability. In his study, Dündar (2015) examined the views of mathematics pre-service teachers on the concepts of mathematical creativity and creative teachers. At the end of this research, it was found that the views of the pre-service teachers about mathematical creativity were mostly in the form of solving problems in different ways, related to an original perspective, abstract thinking, critical thinking, and reasoning. Chamberlin and Moon (2005) stated in their study that mathematical creativity arises in the process of solving a

problem that cannot be solved by an individual's standard method to solve a problem that cannot be solved by a standard method. It can be said that the findings obtained from this research are similar to the findings in the field literature.

In line with the third research question, the opinions of participants about the characteristics that should be in a creative teacher are collected under 2 themes: professional and personal characteristics. Participants expressed their opinions about the professional competencies that a creative teacher should have as follows: to be able to make interesting and different expressions, to have a good field education, to be innovative, to follow professional developments, to observe student needs, and to use technology actively. Participants expressed their opinions about the personal characteristics that should be in a creative teacher as follows: to quickly adapt to new situations, to produce quick solutions to problems, to have a broad perspective, to be inquisitive, to be original, to be patient, and to be energetic. In the field literature, it has been indicated (Büyükkaragöz et al., 1998; Kosar et al., 2003; Çelikten & Can, 2003) that a well-trained teacher should communicate well, follow the innovations in the field regularly, update himself/herself constantly and guide the student every step of the way with a deep knowledge. Pre-service mathematics teachers who participated in the research also presented opinions that were in line with the findings of the literature that the creative teacher should have these skills. Schreglmann and Kazancı (2016) examined the metaphorical perceptions of pre-service teachers about the concept of creative teacher, and stated that pre-service teachers presented opinions that the "creative teacher" was reborn like a sun with all its vitality and energy every morning in the classroom environment, enlightened the minds of students with his knowledge, warmed the hearts of students with his friendliness and energized with his friendliness. In this research, pre-service teachers offered views about the characteristics that should be in a creative teacher (Çelikten, Şanal & Yeni, 2005; Schreglmann & Kazancı, 2016) similar to the findings in the field literature. Consequently, it can be said that the creative teacher is the teacher who is smiling, patient, original and energetic, who has knowledge of the field and profession, and who organizes the teaching environment in the best way.

In line with the fourth research question, the opinions of the participants about their feelings sufficient-insufficient about creativity were collected under 4 different themes as sufficient, moderately sufficient, insufficient and indecisive. The majority of participants have stated that they are sufficient in this regard. Although the majority of teachers feel competent in terms of creativity and mathematical creativity, it was seen that 14 out of 32 teachers felt insufficient or moderately sufficient in this regard. In a study by Yıldırım (2006), "Teachers' Perspective on Creativity and Examining the Creativity Levels of Kindergarten Children according to the Creativity Level of the Teacher," the researcher indicated that 57% of the participants answered Yes to the question, "Do you find yourself creative?" addressed to the teachers. In a study by Şahin (2010), "Creativity, Professional Burnout and Life Satisfaction in Primary School Teachers", in which 434 teachers participated, it was revealed that 80.6% of the teachers who participated in the study were not creative. Similarly, Polat (2017) stated in his study titled "Examining the Critical Thinking Tendencies and Creativity Levels of Classroom Teachers according to Some Variables" in which 189 classroom teachers participated that 99.4% of the classroom teachers who participated in the study had a low level of creativity.

In summary, as a result of this research, pre-service teachers stated that creativity is a different and original way

of thinking, that it is a case of adding a new one on top of the existing situation, and that mathematical creativity is the ability to produce a different and new solution. In addition, the opinions of participants about the characteristics that should be in a creative teacher are gathered in two themes as professional and personal characteristics. In addition, it was concluded that the majority of the opinions of the participants about their self-sufficient and inadequate situations in terms of creativity considered themselves at a sufficient level in this regard.

Recommendations

In the faculties of education, courses can be created that address creativity, the subject of mathematical creativity and what needs to be done to ensure the development of these skills in students. Within the Ministry of National Education, in-service training activities can be organized for teachers to acquire and acquire these skills. In terms of the generalizability of the research, different studies can be done to expand the sample and compare the results in different cities and different countries.

Limitations

This research, which aims to examine the views of pre-service mathematics teachers on creativity and the concept of mathematical creativity, is limited to the data obtained from 32 teacher candidates.

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