Art. #2538, 16 pages, https://doi.org/10.15700/saje.v44n4a2538

# The mediating role of cognitive flexibility in the relationship between creative thinking tendencies and problem-solving skills

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In the study reported on here we aimed to investigate the mediating effect of pre-school teacher candidates' cognitive flexibility between creative thinking tendencies and problem-solving skills. The relational model was used to examine the direct and mediation relationship between the variables. The sample consisted of 516 pre-school teacher candidates, 445 of whom were female and 71 male, studying at 16 universities in Türkiye. Three Likert-type scales were used in the research: the Marmara creative thinking tendencies scale, the problem-solving inventory and the cognitive flexibility scale. To analyse data, the Pearson moment correlation coefficient and Hayes process macro for the Statistical Package for the Social Sciences (SPSS) were used through the SPSS-22 program to examine the relationship between the variables and to conduct the mediation analysis. The results show a moderate relationships between the creative thinking tendencies, problem-solving skills, and cognitive flexibility of pre-school teacher candidates. Cognitive flexibility also played a mediating role between creative thinking tendencies and problem-solving skills. According to these results, creative thinking tendencies and cognitive flexibility variables together explain 35% of the change in problem-solving skills. Based on the results, some suggestions are made.

**Keywords:** cognitive flexibility; creative thinking tendencies; pre-school teacher candidates; problem-solving skills

## Introduction

Problem-solving is a high-level cognitive capacity and has some consequences for daily functioning. Science and technology are rapidly advancing in the 21st century. In this rapid progress, instability increases with the growth of knowledge. As a result, problems become more complex (Hacıoğlu, 1990; Kalia, Fuesting & Cody, 2019). Since the pace of social change never slows down, citizens of the 21st century should become master problem-solvers, be able to deal with ill-defined problems, and become successful (Martinez, 1998). The future may bring new and more complex problems.

It is important to provide students with skills that enable them to find their way in an increasingly uncertain and unstable world and to provide them with high-level thinking skills that are vital for the 21st century to prepare them for a future full of unknowns. To cope with problems, economically develop, and achieve sustainable development, individuals should not only acquire knowledge but also be able to innovatively and flexibly use this knowledge in new situations. In the 21st century, individuals can exist not with what they already know, but with their actions – they can use what they know. The Organization for Economic Co-operation and Development (OECD) attaches importance to problem-solving skills as many other 21st-century skills. For this reason, the OECD provides evidence-based data by associating the education systems of countries with many variables to contribute to the world economy through international student evaluation programmes such as the Programme for International Student Assessment (PISA). In this way, the OECD provides information to education stakeholders about the current status and improvability of problem-solving skills (Csapó & Funke, 2017; OECD, 2021). These evaluations show that in the education systems of high-performing countries the importance of problem-solving skills, which are acquired at an early age through pre-school education are acknowledged and teachers have the necessary competencies to support these skills (Bausela Herreras, 2017; Pholphirul, 2017; Tonga, Eryiğit, Yalçın & Erden, 2022).

Individuals with developed problem-solving skills are open to innovation, aware of their choices and decisions, responsible, flexible, courageous, able to develop new ideas, are intelligent, careful, self-confident, objective, logical, pay attention to procedures and methods, are active, energetic, creative, productive, and have the ability to critically look at events (Nezu & Nezu, 2001). Individuals with better problem-solving skills are more likely to make faster decisions and find functional solutions in their lives (Snyder & Snyder, 2008).

Hamza and Griffith (2006) emphasise that individuals should acquire creative thinking skills as well as problem-solving skills to be contributing members of society and to survive in the real world. For a qualified education process, it is more important for teachers to have these skills. However, research conducted in recent years shows that teachers do not have sufficient 21st-century skills such as creative thinking and problem-solving (Mullet, Willerson, Lamb & Kettler, 2016). Problem-solving is a skill that can be learned (Bingham, 2004) and improved through education (Webster-Stratton, 2005). For this reason, raising individuals who can overcome problems has always been one of the primary goals of education (Charles & Lester, 1982:15). The ability of students to live effectively and sustainably depends on their awareness of the problems that naturally arise in rapid progress and their ability to develop effective solutions to these problems during their learning processes. Paine,

Blömeke and Aydarova (2016) state that discussions about teaching are no longer local issues and emphasise that teacher qualifications and teacher training processes should be defined with a global vision. As such, many organisations such as the OECD, Assessment and Teaching of 21st Century Skills Framework (ATSC21), Partnership for 21st Century Skills ([P21], 2009), and the National Research Council (NRC) strongly argue for the essential skills that individuals should acquire in school and life today and in the future. The conclusion from these discussions is that problem-solving and creativity are among the fundamental skills that students need to develop in the 21st century (Beers, 2011; Lemke, 2002; OECD, 2018; P21, 2009; Wagner, 2008). The development of these skills is of particular importance for children who are the active individuals of the future. At this point, teachers should have and be able to use these skills.

### Problem-solving

Researchers define the concept, "problem", in various ways. Evans (1997) states that the problem is a complex and troublesome situation. Nezu, Nezu and D'Zurilla (2007) describe a problem as emerging when there's a discrepancy between what is and what one wishes it to be. Bingham (2004) defines a problem as the obstacles that individuals encounter while trying to achieve their goals. However, what most researchers agree on is that problems have two basic features: a goal and an obstacle (Jackson, 1975).

While a problem is any situation for which individuals do not have ready and instant solution reactions, a solution is the act of choosing between different ideas or possible solutions (Ramsey, 1989).

The solution process to a problem consists of the interaction of many cognitive processes such as research, decision-making, analysis, and synthesis (Wang & Chiew, 2010). Many researchers report that problem-solving includes various processes (D'Zurilla & Goldfried, 1971; Gunawan, Suranti, Nisrina & Herayanti, 2018; Wang & Chiew, 2010). For example, D'Zurilla and Goldfried (1971) describe the problem-solving process in which they define five steps: (1) recognising the problem, (2) diagnosing and formulating the problem, (3) producing alternative solutions, (4) making a decision and (5) applying the solutions to the problem. However, the process involves recognising the existence of a problem, thinking about what needs to be done, and doing what has been decided (Gilhooly, 1989). The multi-stage and complex structure of the problem-solving process causes many factors to affect the solution process. Researchers state that problem-solving, like the problem itself, is a process with different underlying factors (Bingham, 2004; Heppner, 1978; Mayer & Wittrock, 2006; Weiss, 1993). The solution to problems encountered in daily life varies depending on the type of problem, existing situation, resources, and even the individual (Heppner, Witty & Dixon, 2004; Khademi, 2016). While Mayer and Wittrock (2006) state that cognitive, metacognitive, and motivational factors are effective in problem-solving, Jonassen (2011) draws attention to the internal and external factors influencing the problem-solving process. Internal factors are related to the affective and mental processes of the persons who solve the problem (Heppner & Krauskopf, 1987; Jonassen, 2011). External factors, on the other hand, are mostly related to the characteristics of the problem encountered (e.g., structure, difficulty, scope, and quality) (Jonassen, 2011; Weiss, 1993).

Researchers state that problem-solving is influenced by the individual's personality traits (D'Zurilla & Goldfried, 1971), sense of responsibility, anxiety, shyness (Bingham, 2004), self-confidence, and belief in solving the problem (D'Zurilla, Nezu & Maydeu-Olivares, 2004). Chi and Glaser (1985) highlight that problem-solving represents a sophisticated cognitive ability, marking it as one of the highest forms of human intelligence. Problem-solving has been associated with many cognitive skills such as perception (Bingham, 2004, D'Zurilla, 1988), attention (Nezu & D'Zurilla, 2005), reasoning skills, and cognitive style (Cormier & Nurius, 2003; D'Zurilla & Nezu, 2006, 2007; Gorski, 2003; Jonassen, 2011). Additionally, problem-solving has been so closely associated with intelligence that it has become part of the definition of intelligence (Sternberg, 1981). Similar to intelligence, many researchers directly explain problem-solving skills through creative processes (Bingham, 2004; Torrance, 1962).

### Problem-solving and Creative Thinking

For many years the relationship between problem-solving and creativity has been and is being discussed by various researchers (Guilford, 1977; Hilgard, 1959; Isaksen, 1995; Kaufmann, 1988; MacKinnon, DW 1978; Maltzman, 1960; Newell, Shaw & Simon, 1962; Rugg, 1963; Russell, 1956; Smith, 1966; Torrance & Torrance, 1973; Wu & Koutstaal, 2020). Although creative thinking and problem-solving are two distinguishable types of activities, there appears to be a significant overlap between abilities, skills, and outcomes (Isaksen, 1995). The conceptual connection between problem-solving and creativity is clearly seen in Torrance's definition of creativity. According to Torrance (2003), creativity is a natural problem-solving process that requires perceiving difficulties, problems, knowledge deficiencies, and flaws, making predictions developing hypotheses to solve the problems, and presenting the results after testing these hypotheses. This definition supports the idea that creativity is a problem-solving action (Butcher & Niec, 2005; Monahan, 2002; Vidal,

2003). Problem-based tasks generally require creative thinking (Ubah & Ogbonnaya, 2021).

Problem-solving processes precede knowledge. Bare facts, no matter how they are stored in memory, do not solve problems (Simon, 1980:85). Halpern (2013) states that producing satisfactory solutions to problems often requires creativity. It is emphasised that creativity is required, particularly in solving problems that are ill-structured or require productive thinking (Frederiksen, 1983). Recognition, definition, and the problem-solving procedure constitute the basis of the creativity process (Starko, 2013). Creativity assists individuals in solving problems, presenting new ideas, and making decisions regarding various situations (Sarwinda, 2013). The first stage of problem-solving is considered as recognising the problem. DW MacKinnon (1978) states that the creative process always begins with seeing, that is, perceiving the problem. Creative individuals generally see problems that others cannot. Torrance and Torrance (1973) state that creative thinking begins with being sensitive to problems and becoming aware of gaps in knowledge, missing elements, and incompatibilities. Recognition and definition of the problem require more creativity than solving the problem (Starko, 2013). The person who notices the problem is expected to produce alternative solutions. At this point, creativity enables the fluent production of new ideas (Benedek, Franz, Heene & Neubauer, 2012; Mednick, 1962).

The productivity of creative thinking facilitates the generation of alternatives for solving a problem (Guilford, 1977; Siburian, Corebima & Saptasari, 2019; Wechsler, Saiz, Rivas, Vendramini, Almeida, Mundim & Franco, 2018). After this stage, the creative person should choose the most useful one among the alternative solutions. Merely being original is inadequate for the solution. The creative process occurs not only by creating and producing new uses but also by finding a useful solution to the problem (Clément, 2022). In other words, a creative idea should also be useful (James, Brodersen & Eisenberg, 2021; Sternberg & Lubart, 1999; Takala, 1993; Torrance, 1968). This information shows that creativity has an important role in creating and formulating solution techniques and producing alternative solutions, acting as a bridge between problem-posing and problem-solving.

### Cognitive Flexibility as a Mediating Variable

Creativity is vital in solving many types of complex problems (Wu & Koutstaal, 2020). While Russell (1956) recognises the relationship between creative thinking and problem-solving, he thinks that problem-solving is more objective and external, and emphasises that creativity is more personal and related to innovation rather than predetermined conditions. According to Farcaş (2013), not all problem-solving methods are creative. While simple problem situations are solved with existing solutions and tried-and-tested solutions, creativity is required in productive problem-solving methods.

The diverse viewpoints in the literature regarding the relationship between creativity and problem-solving prompt inquiries into the extent of creativity used by individuals who are adept at navigating challenges. Or do individuals who develop effective solution strategies for problems always use their creativity at the first stage? Does the characteristic definition of creativity (e.g., making meaningful and new connections to think about many possibilities, thinking in different ways and from different perspectives, thinking of new and unusual possibilities, and producing alternatives) (Meintjes & Grosser, 2010) tell us that creative people are always good problem-solvers across a variety of issues? Cañas, Quesada, Antolí and Fajardo (2003) emphasise that this is not always the case and reveal that individuals who perform well in problem-solving tasks are sometimes affected by this change when they encounter new conditions and their problem-solving performance decreases. This interesting result shows that developing effective solution strategies in the face of unexpected situations cannot be explained primarily by creativity. This situation requires finding an answer to the question of what other skills should be employed along with creativity to develop effective solution strategies in the face of problems. Different views exist regarding whether creative individuals engage in more automatic processing due to unfocused attention or looser associations when working on a creative task, or, conversely, more controlled processing due to a greater ability to focus (Zabelina & Robinson, 2010). According to Miller and Cohen (2001), more creative human cognition uses the brain's cognitive control circuits to overcome over-learned ordinary associations. Diminished cognitive control might enhance associative mechanisms, which have historically been deemed crucial for inventive thought. Conversely, persons inclined towards automatic processing tend to exhibit persistence in their cognitive patterns, leading to reduced creativity (Zabelina & Robinson, 2010). Generally, individuals who perceive themselves as competent are less inclined to alter their strategies upon recognising changes and may initially struggle to detect these changes. Consequently, when they depend on established automated routines for performance, they might be less prone to assess the potential for system failures (Edland, Svenson & Hollnagel, 2000).

Clerc and Josseron (2022) analysed the challenges that an individual faces in problem resolution as a misinterpretation of the situation's characteristics. The knowledge and experiential background of a person undeniably contribute significantly to their ability to solve problems

(Bassok & Olseth, 1995). Familiar information is useful for problems that require the same solution strategy. However, an incorrectly coded problem and an incorrectly coded solution strategy for this problem make the solution to the problem difficult. When solvers recognise problems as similar because they follow the same solution principle, the transfer of solutions is beneficial. Conversely, when problems with distinct abstract structures are mistakenly perceived as similar, the transfer of solutions is detrimental. Likewise, there is an absence of solution transfer when problems that adhere to the same solution principle are perceived as dissimilar (Clément, 2022).

Achieving accurate problem transfer necessitates an individual's departure from automatic processing modes. Exiting such modes embodies representational flexibility, enabling the person to formulate a novel representation of the issue at hand and to amalgamate diverse viewpoints that facilitate the derivation of a solution (Clément, 2001, 2008). Researchers concur that recognising a change in circumstances is crucial for an individual to transition from automatic to controlled processing modes, especially when confronted with unforeseen alterations (Hollnagel, 1998; Norman, 1981; Norman & Shallice, 1980; Rasmussen, 1983; Reason, 1990). At this point, cognitive flexibility is understood as the capacity to modify one's cognitive framework, abilities, thoughts, or focus in order to perceive, interpret, or react to various situations in alternative manners (Eslinger & Grattan, 1993). Cognitive flexibility is essential for recognising that a situation has altered and requires a response that deviates from routine practices (Cañas, Fajardo & Salmerón, 2006).

For cognitive flexibility to be exhibited, an individual must be aware of environmental factors that could potentially disrupt the execution of the current task (Cañas et al., 2006). Flexibility refers to the ability to modify one's cognitive representations and processes in alignment with the objective sought, as a reaction to shifts in environmental signals (Blaye, 2022). Individuals adapt to unexpected environmental changes through cognitive flexibility (Payne, Bettman & Johnson, 1993). Due to cognitive flexibility, individuals can modify their cognitive processing strategies to tackle new and unforeseen situations (Cañas et al., 2003), thereby generating an alternative mental representation that more accurately reflects the traits of the encountered scenario (Gamo, Sander & Richard, 2010; Richard & Zamani, 2003). Thus, instead of using frequently used solutions based on faulty representations, they create new representations that enable them to solve the problems (Clement & Richard, 1997).

Cognitive flexibility manages individuals' knowledge about a problem and the possible solution strategies they develop with this information. This knowledge is acquired through the experience gained from previous analogous situations. However, when the situation evolves, this information must be updated to reassess potential new task demands. When a person is cognitively inflexible, this person behaves dysfunctionally in coping with situational demands and, thus often performs incorrectly (Cañas et al., 2006). Problem-solving is inherently domain-specific and contextual, meaning that problems emerge within specific contexts or situations. Solutions effective in one context might not be applicable in another. As such, problem-solving necessitates an awareness of the unique constraints of the problem's context. This demands the creation of novel problem-solving approaches, embodying an ethos of flexibility, open-mindedness, and creativity (Kitchener, 2011).

Creativity is a multifaceted concept consisting of dimensions such as fluency, originality, and flexibility (Mumford & Gustafson, 1988; Simonton, 2003). Flexibility, as an aspect of creativity, fosters the processes of ideation and the ability to transform. It enables individuals to reinterpret and reorganise existing knowledge to innovate and generate new concepts. Although the components of creativity seem to be inseparable parts of each other, the issue becomes not a matter of creating and producing new uses, but also a matter of finding a solution in the problem-solving process. Cognitive flexibility is closer to daily life situations and is the more analytical dimension of creativity (Clément, 2022). Cognitive flexibility is characterised by individuals' ability to think and select choices and responses in a deliberate and measured manner, rather than resorting to impulsive alterations (Schommer-Aikins, 2011). This may facilitate the problem-solving process by playing a regulatory role in the unfocused attention and loose association process claimed for creative individuals (Zabelina & Robinson, 2010). Cognitive flexibility is crucial for adapting behaviour to the fluctuating conditions of daily life. Especially in problem-solving, uncovering a solution frequently necessitates a shift in perspective, namely, altering the representation of the situation, thus demonstrating representational or conceptual flexibility (Clément, 2022). Cognitive flexibility, which emphasises the change of the problem solver's existing beliefs and strategies (Krems, 2014), facilitates the use of imagination and creativity to solve the problem (Georgsdottir & Lubart, 2003). Creative insights and original ideas are the final products of creative processes. These outcomes can be realised through the application of cognitive flexibility (Dreu, Nijstad & Baas, 2011). To create the new, it is necessary to reinterpret and rearrange the known. This can happen, as mentioned, through cognitive flexibility (Clément, 2022).

Although this information shows that creativity is a necessary skill for problem-solving, it

strengthens the idea that to develop effective strategies for solving the problem, it is necessary to first realise that the problem representation has changed and use cognitive flexibility to create new problem representations. In this sense, it can be said that cognitive flexibility acts as a catalyst when using creativity in the process of solving a problem. It is clear from recent studies that, as the cognitive flexibility of teacher candidates increases, positive changes take place in their problem-solving skills (Idawati, Setyosari, Kuswandi & Ulfa, 2020). However, other studies also prove the existence of a positive relationship between the creativity of teacher candidates (Ubah & Ogbonnaya, 2021), cognitive flexibility (Çağlar Özhan, Tekeli & Altun 2024; Yaşar Ekici & Balcı, 2019) and problem-solving skills.

It is very important for pre-school teachers, who are the most significant legacy guiding our rapidly changing and developing world, to be individuals equipped with the necessary knowledge and skills. Various studies have shown that pre-school teachers who work with children with different individual characteristics, having cognitive flexibility and creative problem-solving skills – both of which are metacognitive functions – have positive effects on children (Kömbeci, 2021; Yılmaz, İnce & Kırımoğlu, 2020). The cognitive flexibility skills that begin to develop rapidly during the pre-school period continue to evolve until adolescence, alongside the growth of neural networks (Buttelmann & Karbach, 2017). While cognitive flexibility creates a variety of strengths and creative abilities in children, it also enhances their problem-solving skills (Diamond, 2013). Teachers' ability to serve as role models for children in terms of the skills they possess is an important step for supporting the development of the same skills in children. Therefore, teachers play a critical role in fostering metacognitive gains such as cognitive flexibility during early childhood. On the other hand, unexpected situations are quite likely to arise in educational settings with children. Pre-school teachers need to apply their cognitive flexibility and creativity skills to develop alternative solutions to the different situations they encounter during the educational process. At this point, the role of cognitive flexibility, defined as the ability to adapt to new situations and provide different solutions, is significant for teachers (Çağlar Özhan et al., 2024; Camcı Erdoğan, 2018). In this context, examining the cognitive flexibility, creativity, and problem-solving skills of pre-school teacher candidates is important for the training they will receive throughout the teaching process.

### Purpose of the Research

With this research we aimed to examine the mediating role of cognitive flexibility in the relationship between creative thinking tendencies and problem-solving skills.

In this context, we sought to answer questions regarding whether creative thinking tendencies have an impact on problem-solving skills and whether cognitive flexibility plays a mediating role in the relationship between creative thinking tendencies and problem-solving skills. The model to be tested is shown in Figure 1.

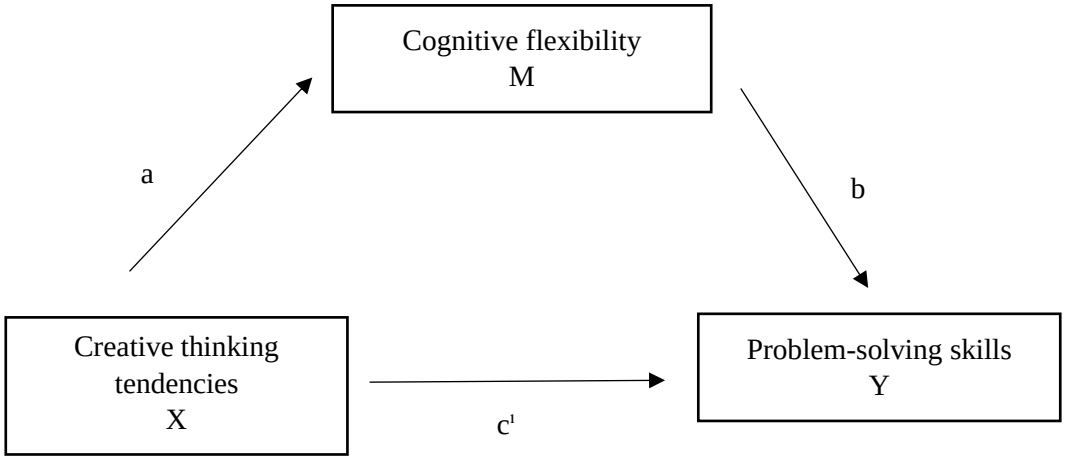


**Figure 1** Research model

### Hypotheses of the Research

The hypotheses in the research are shown below:

$H_1$: There is a positive and significant relationship between creative thinking tendencies and problem-solving skills.

$H_2$: Cognitive flexibility mediates the relationship between creative thinking tendencies and problem-solving skills.

## Method

### Research Model

In this study, the relational survey model, one of the quantitative research methods, was used to examine the mediating role of cognitive flexibility in the effect of creative thinking tendencies on problem-solving skills. The main purpose of the relational screening model is to reveal whether two or more variables change together (Creswell, 2011). In the study, the Hayes model (Gürbüz, 2019), one of the contemporary approaches, was used to statistically calculate the mediation effect.

### Population and Sample

The population of the research consisted of pre-school teacher candidates studying at universities in Türkiye. The sample, which consisted of 516 pre-school teacher candidates (445 female and 71 male) studying at 16 universities in Türkiye, was determined through the convenience sampling method, which is one of the non-random sampling methods. Data were collected via online forms. The required ethical permission to conduct the research was obtained from the Scientific Research and Publication Ethics Board of the University of Social and Human Sciences. The research team ensured that all participants knew and agreed on the principles of informed consent, voluntary participation, and confidentiality of their responses.

### Data Collection Tools

The Marmara creative thinking tendencies scale, the problem-solving inventory and the cognitive flexibility scales were used in the study. Detailed information about the scales is given below.

#### *Marmara creative thinking tendencies scale*

The Marmara creative thinking tendencies scale was developed by Özgenel and Çetin (2017). The scale is a 5-point Likert-type measurement tool consisting of 25 items and six factors. The dimensions of the scale are defined as seeking innovation, courage, self-discipline, curiosity, doubting and flexibility. The total score can be calculated on the scale. In this research, the Cronbach alpha coefficient was calculated as .90 for the entire scale.

#### *Problem-solving inventory*

The problem-solving inventory, developed by Heppner and Petersen in 1982, was adapted into Turkish by Taylan (1990), and its validation was also conducted. The scale is a 6-point Likert-type tool consisting of a three-factor and 35-item structure: confidence in problem-solving ability, approach-avoidance and personal control, including positive and negative items. The total score can be calculated on the scale. In this study, the Cronbach alpha coefficient was calculated as .86 for the entire scale.

#### *Cognitive flexibility inventory*

The Turkish adaptation of the cognitive flexibility inventory developed by Dennis and Vander Wal (2010) and its validation was carried out by Sapmaz and Doğan (2013). The scale is a 5-point Likert-type measurement tool consisting of 20 items and two factors: alternatives and control. The total score can be calculated from the scale consisting of positive and negative items. In this study, the Cronbach alpha coefficient was calculated as .93 for the entire scale.

### Data Analysis

The data obtained in the research were analysed through the SPSS 22.0 program. Central tendency measures, kurtosis, and skewness coefficients were used to determine whether the data showed normal distribution. From the analyses it was seen that the central tendency measures of the score distributions obtained from the scales were close to each other. When the analysis results regarding kurtosis and skewness are examined, creative thinking tendencies (kurtosis = .385, skewness = -.334), problem-solving skills (kurtosis = .094, skewness = -.445), and cognitive flexibility (kurtosis = .256, skewness = -.599) scales showed a normal distribution (Tabachnick & Fidell, 2007). Before moving on to the analysis of the variable "role of the mediator" in the study, correlation analysis was conducted to reveal whether multicollinearity existed between the variables. The results of the analyses show that the relationships between the variables ($r$ = .487–.599) were not above .90 (Çokluk, Şekercioğlu & Büyüköztürk, 2014), tolerance values (Tolerance = .613–.673) were greater than .20, and the variance inflation factor were (VIF = 1.485–1.632) below 10 (Büyüköztürk, 2019). These scores show that there was no multicollinearity problem between the variables and mediation analysis could be performed for the proposed model. Model 4 put forward by Hayes (2018) was used through SPSS Process Macro v4.3 to reveal the mediating role of cognitive flexibility in the relationship between creative thinking tendencies and problem-solving skills. When examining Figure 1, it can be seen that the effect of creative thinking tendencies on cognitive flexibility is represented as path a, the effect of cognitive flexibility on problem-solving skills is represented as path b, the direct effect of creative thinking tendencies on problem-solving is represented as path $c^{\prime}$, and the total effect is symbolised by c. The mentioned symbolic paths represent unstandardised regression coefficients. It is anticipated that the established model demonstrates the effect of creative thinking tendencies on problem-solving skills through the mediating role of cognitive flexibility. Thus, it aims to reveal whether cognitive flexibility transfers the influence of creative thinking tendencies to problem-solving skills.

The effect of the mediator variable was tested with the bootstrap method using 5,000 repeated samples at a 95% confidence interval, and it was taken into account that the confidence intervals did not include zero (Preacher & Hayes, 2004).

## Results

### Results Regarding the Examination of the Mediating Role of Cognitive Flexibility in the Relationship Between Creative Thinking Tendencies and Problem-solving

Regression analysis based on the bootstrap method was used to test whether cognitive flexibility played a mediating role in the effect of pre-school teacher candidates' creative thinking tendencies on their problem-solving skills. It is claimed that the bootstrap method provides more reliable results than Baron and Kenny's traditional method and the Sobel test (Gürbüz, 2019; Hayes, 2018). Analyses were done using the process macro developed by Hayes (2018). In the analysis, 5,000 resampling options were used with the bootstrap technique. In mediation effect analyses conducted with the bootstrap technique, to support the research hypothesis, the 95% confidence interval (CI) values obtained as a result of the analysis should not include the zero value (MacKinnon, DP, Lockwood & Williams, 2004). The results of the regression analysis conducted for this purpose are given in Table 1.

**Table 1** Regression analysis results for mediation test

| | Result variables | | | | | |
|---|---|---|---|---|---|---|
| | M (Cognitive flexibility) | | | Y (Problem-solving skill) | | |
| Forecast variables | | *b* | *SE* | | *b* | *SE* |
| X (Creative thinking tendencies) | a | 0.6534* | .551 | c' | .4746* | .0617 |
| M (Cognitive flexibility) | - | - | - | b | .3970* | .0437 |
| Still | $İ_M$ | 15.88* | 4.814 | $İ_Y$ | 67.70 | 4.826 |
| | | $R^2$ = .21 | | | $R^2$ = .35 | |
| | | $F(1, 533) = 140.61$; $p < .005$ | | | $F(2, 532) = 131{,}34$; $p < .005$ | |

*Note*. *$p$ < .05, Standard error (*SE*) and unstandardised beta coefficients (*b*) are reported.

Table 1 shows that creative thinking tendencies positively and significantly affect cognitive flexibility, which is the mediator variable ($b$ = 0.653, $SE$ = .551, $p$ < .05). Creative thinking tendencies explain 21% of the change in cognitive flexibility and 23% of the change in problem-solving skills. Table 1 shows that the cognitive flexibility variable has a positive and significant effect on problem-solving ($b$ = .397, $SE$ = 0.437, $p$ < 05) and that creative thinking tendencies have a positive and significant effect on problem-solving skills ($b$ = .475, $SE$ = 0.617, $p$ < 05). Creative thinking tendencies and cognitive flexibility explain 35% of the change in problem-solving skills. The results of the bootstrapping test conducted to reveal the indirect, direct, and total effects of creative thinking tendencies on problem-solving skills are given in Table 2.

**Table 2** Indirect, direct, and total effects of creative thinking tendencies on problem-solving skills

| Effect | Bootstrapping | | 95% CI | |
|---|---|---|---|---|
| Direct effect | *b* | *SE* | LLCI | ULCI |
| YDE ___ PCB | .4746 | .0617 | .3534 | .5957 |
| YDE____ BE | .6534 | .0551 | .5452 | .7617 |
| Indirect effect | | | | |
| YDE _ BE _ PCB | .2594 | .0437 | .1811 | .3538 |
| Total impact | .7340 | .0588 | .6184 | .8495 |

Table 2 shows that the total effect of creative thinking tendencies on problem-solving skills ($b$ = .7340, $SE$ = .0588, $p$ <. 05) is positive and significant. The effect of creative thinking tendencies on problem-solving ($b$ = .4746, $SE$ = .0617, $p$ < .05) and the effect of creative thinking tendencies on cognitive flexibility, which is the mediator variable ($b$ = .6534, $SE$ = .0551, $p$ < .05) is seen to be positive and significant. It is also revealed that the indirect effect of creative thinking tendencies on problem-solving skills ($b$ = .2594, $SE$ = .0437, $p$ < .05) is positive and significant. When the full standardised effect size of the mediation effect is examined, it can be said that it is in the 95% CI (β = .1704, CI = .1193, .2315) and this value is between medium and high mediation effect values. An effect size value close to .01 is interpreted as a low effect, close to .09 as a medium effect, and close to .25 as a high effect (Preacher & Kelley, 2011). From the findings we see that cognitive flexibility plays a mediating role in the relationship between creative thinking tendencies and problem-solving skills. The mediating role of cognitive flexibility in the relationship between creative thinking tendencies and problem-solving skills is shown in Figure 2.

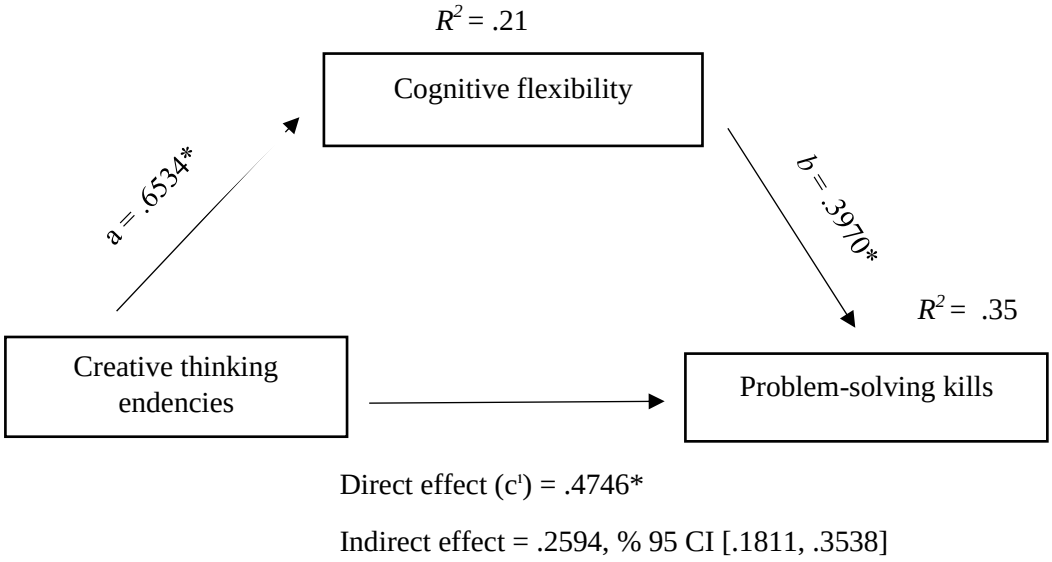


**Figure 2** Model on the mediating role of cognitive flexibility

## Discussion

In this study, the mediating role of cognitive flexibility in the relationship between pre-school teacher candidates' creative thinking tendencies and problem-solving skills was examined. In this section, the results regarding the relationship between creative thinking tendencies and problem-solving skills and ultimately the mediating role of cognitive flexibility are presented in line with the stated hypotheses.

We found a positive and significant correlation between the creative thinking tendencies of pre-school teacher candidates and their problem-solving abilities. These findings align with previous research, which also indicate a link between creative thinking and problem-solving skills (Güven & Karasulu Kavuncuoğlu, 2020; Khalid, Saad, Hamid, Abdullah, Ibrahim & Shahrill, 2020; Köse, Çelik Ercoşkun & Balcı, 2016; Simanjuntak, Hutahaean, Marpaung & Ramadhani, 2021; Sonmaz, 2002).

Hamza and Griffith (2006) concluded in their study that a learning environment based on creative thinking improves students' problem-solving skills. The results of our and other studies show that creative thinking tendencies support the development and use of problem-solving skills, which is an important skill for pre-school teachers. Indeed, mirroring the outcomes of the research, Treffinger, Selby and Isaksen (2008) provide a theoretical explanation for the link between creative thinking capabilities and problem-solving skills. Vidal (2009) states that successful and effective use of problem-solving skills in real life depends on a high level of creative thinking and the ability to innovate. According to Martz, Hughes and Braun (2017), since innovation and entrepreneurship are seen as a driving force for career life, it is the mutual relationship between the two skills that makes creative thinking and problem-solving skills important and necessary for 21st-century education programmes. Newell, Shaw and Simon (1958) state that problem-solving and creativity are different concepts and suggest that if certain conditions are met, the presence of creative thinking skills can be mentioned in the use of problem-solving skills. These conditions are as follows: (1) the product of thinking is original and valuable, (2) the existence of an unconventional thought in the sense that it requires changing or rejecting previously accepted ideas, (3) high motivation and concentration for a solution process that can take a long time, (4) being able to formulate the problem if the problem is not clear and well-defined. Ismayılov and Khudiyeva (2023), similar to the results obtained in the research, state that with creative thinking, a way out of difficult situations can be found to achieve goals, new ideas can be created for problems, and non-standard solutions can be found to problems. Based on the research they conducted in South Africa, which focused on the need for teachers to develop creative thinking, solve problems, apply solutions, and thus provide an effective learning environment, they concluded that there was a need to develop teachers' creative thinking and problem-solving skills through pre-service teacher training programmes (Ubah & Ogbonnaya, 2021). Similarly, studies emphasise that in South Africa, which has a cultural mix, creative thinking and problem-solving skills are important global skills for both education stakeholders and educational programmes (Gcabashe, 2024; Meintjes & Grosser, 2010). As a result, it can be said that problem-solving skills are supported and gained value by creative thinking skills at the point of coming up with new and original solutions through

the transfer of previously acquired knowledge in case of encountering new problems.

A significant finding from our study is that cognitive flexibility serves as a mediator in the relationship between creative thinking tendencies and problem-solving skills. This outcome validates the model designed to explore the connection between creative thinking tendencies and problem-solving abilities. Thus, it is seen that the effect of creative thinking tendencies on problem-solving skills decreases as cognitive flexibility plays a mediating role. Consistent with this finding, it has been demonstrated that cognitive flexibility also contributes to the influence of creative thinking tendencies on problem-solving abilities.

This result also shows that cognitive flexibility plays a facilitating role in the effect of creative thinking tendencies on problem-solving skills. Researchers acknowledge that cognitive flexibility is necessary for higher-level cognition, similar to higher-level skills such as creative thinking skills and problem-solving (Arán Filippetti & Krumm, 2020; Rende, 2000; Wang & Chiew, 2010).

Wu and Koutstaal (2020) state that creative thinking is vital in solving various complex problems, but how cognitive flexibility dynamically supports creative thinking processes is largely unexplored. Additionally, Wu and Koutstaal (2020) argue that cognitive flexibility has significant effects on creative thinking.

Based on the research findings, it has been concluded that creative thinking tendencies and cognitive flexibility are related. Q Chen, Yang, Li, Wei, Li, Lei, Zhang and Qiu (2014) uncovered that a correlation between creative thinking skills and cognitive flexibility exists and they emphasise that the cognitive flexibility skills of individuals with creative thinking are critical for real life. Li (2023) revealed that cognitive flexibility contributes to academic success with the power to produce alternative thoughts in new and difficult situations.

DeHaan (2017) argues that creative thinking skills are explained by cognitive flexibility and creative problem-solving skills – a synthesis of creative thinking and problem-solving skills – can be improved with cognitive flexibility. Similarly, research shows that creative thinking tendencies and cognitive flexibility are related (Arán Filippetti & Krumm, 2020; Chen, X, He & Fan, 2022; Çuhadaroğlu, 2013; Erkin & Göl, 2021; Kim & Runco, 2022; Shao, Nijstad & Täuber, 2018; Tayhan, Çetinkaya, Özmen, Şahin Büyük & Uyar, 2023; Zabelina & Robinson, 2010; Zhao, Zhang & Heng, 2024). Our study shows that cognitive flexibility has an impact on problem-solving skills by playing a mediating role. The research results are similarly compatible with many research results revealing the relationship between cognitive flexibility and problem-solving skills (Bahadır Yılmaz & Yüksel, 2023; Buğa, Özkamalı, Wise & Çekiç, 2018; Esen-Aygun, 2018; Taş & Deniz, 2018; Türe & Sarıçam, 2016). Stevens (2009) asserts that a connection exists between the cognitive flexibility and problem-solving skills of children, who are the primary focus of pre-school educators. Furthermore, within the same study, it was observed that children exhibiting high levels of cognitive flexibility displayed enhanced social skills, attributed to their improved problem-solving abilities. The results obtained are also confirmed by the theoretical infrastructure regarding cognitive flexibility and problem-solving skills.

Cognitive flexibility helps individuals to look for alternative and flexible solutions when thinking about their problems and deciding on a solution. For this reason, cognitive flexibility plays an important role in that individuals can recognise problems and take initiative for solutions when alternative ideas and new and original ways are tried (Kim & Runco, 2022). Keeping up with changing situations requires an information processing system that can adapt to new tasks and situations. This depends on cognitive flexibility. Solving a problem requires more than merely using previously acquired knowledge as opposed to simply performing a task. As individuals' cognitive flexibility increases, their likelihood of developing and using problem-solving skills increases. Cognitive flexibility increases the problem-solving performance of individuals by enabling the modification and development of existing problem-solving strategies (Krems, 2014).

## Conclusion and Recommendations

In this research, as in other fields, the starting point was the relationship between the theoretical structures of creative thinking dispositions, problem-solving skills and cognitive flexibility, which are important global skills for education systems. Since the aforementioned skills are important for children in the pre-school period, it is necessity for pre-school teachers to have these skills.

Problem-solving is a natural process found in human functioning and is a cognitive passport that opens doors to the future. The 21st century, where rapid social changes are experienced, has made problem-solving skills more important than before. In the current time period, it is more important for individuals to be skilled problem-solvers in order to keep up with change and find effective solutions to unusual problems (Martinez, 1998). In order to achieve goals and solve unexpected problems in the most effective way, the role of creative thinking skills, which is effective in offering alternative perspectives and solutions to problems, is very important (Awang & Ramly, 2008; Ramalingam, Anderson, Duckworth, Scoular & Heard, 2020). Problem-solving skills are high-level cognitive skills that require the use of creative thinking skills (Wanya, 2016). Creative thinking skills, on the other

hand, are complex cognitive processes that include new and useful ideas or solutions to problems. Creative thinking and problem-solving skills, which are related to each other, require cognitive flexibility skills that include higher-level cognitive functions along with many skills for more efficient processing of information (Tardner, 2024).

The aim with this study was to reveal the mediating role of cognitive flexibility in the relationship between creative thinking tendencies and problem-solving skills, based on the theoretical structures of creative thinking, problem-solving and cognitive flexibility skills that are important for individuals to acquire from an early age, and the relationships between these structures. The research results reveal that the aforementioned skills are interrelated and that cognitive flexibility plays a mediating and, therefore, facilitating role in the relationship between creative thinking tendencies and problem-solving skills. We consider this result important in terms of proving that creativity predicts problem-solving through increased cognitive flexibility.

In line with the research results, it is recommended that pre-school teacher training programmes be structured in a way that supports the skills in question and the relationships between these skills. We also believe that the programme in question should focus on practices and lessons that will develop students' cognitive flexibility as well as problem-solving and creativity. In addition, it is important for the pre-school education programme to take on a function that will support teachers so that teachers can apply the skills in question and reflect them to children.

### Limitations

Our study had some limitations. The research was conducted with pre-school teaching students only. Research can also be conducted with other disciplines for future studies. Another limitation of this study was that we only worked with university students. Due to these limitations, caution should be exercised when generalising the findings. Future studies should also examine how cognitive flexibility and creativity may contribute to problem-solving.

## Authors' Contribution

The authors equally contributed to the article and all authors reviewed the latest version of the manuscript.

## Notes

i. This research was presented as an oral presentation at the 12th World Conference on Psychology and Sociology on 4 November 2023.

iii. DATES: Received: 8 February 2024; Revised: 18 August 2024; Accepted: 23 September 2024; Published: 30 November 2024.

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