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Creative Cognition, Autonomous Learning, and Problem-Solving: A Mediation Model*

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ABSTRACT

The study tested a model of the mediating role of autonomous learning, creative cognition and problem-solving. The autonomous learning scale, the creative cognition scale, and the problem-solving scale were administrated to a sample of 443 gifted-talented students. The present study showed that autonomous learning and creative cognition were positively related to problem-solving. The result of the mediation analysis showed that autonomous learning significantly predicts both problem-solving and creative cognition. Problem-solving significantly predicted creative cognition, and autonomous learning decreased the effect of problem-solving on creative cognition. Finally, the relationship between problem-solving and creative cognition was partially mediated by autonomous learning. These findings suggested that problem-solving had both direct and indirect effects on Creative Cognition.

Keywords: Creative cognition, autonomous learning, problem-solving

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1. INTRODUCTION

In the 21st Century, there is a growing interest toward the new and the different one in the whole world that is globalizing day by day with the help of technology. Creativity does not have a simple definition. However, in the past, various emphasis was made, which shed light on several aspects of the creative effort both concerning its process and its product (Welling, 2007). Creativity has various definitions, with the most traditional perspectives consisting of "a proclivity toward offering original solutions or novel products" (Gardner, 1988) and "the building of something that did not exist before" (Roskos-Ewoldsen, 1993). Presumably, novelty is the most illustrative characteristic of creativity. The meaning of being creative is generating or considering something new. In addition, scientific or artistic creativity means producing something original or at least adding something that hasn't been planned or performed before. To illustrate, if a scientific discovery has been published elsewhere before, it will not be perceived as a scientific discovery (Welling, 2007).

Creative cognition is based on the principle that creativity is not a characteristic only of the gifted individuals, but it is an ordinary process that any individual may have (Berman, 2010). Complementary aims of the creative cognition approach are to utilize experimental developments from cognitive science to help comprehending creativity and to utilize creative performance to find out more about basic cognitive processes (Csikszentmihalyi, 1999; Sternberg & Lubart; 1995; Simonton, 1999; Ward, 2001). However, it focuses on the cognitive processes in which new and useful ideas are produced, which form the basis of creative developments in practical terms. In other words, the other factors mentioned should clearly affect the likelihood and frequency of individuals engaging in cognitive functions, the information provided to the creative individual, and the probability that a newly produced idea will be accepted. Guilford (1950) offers a model of intellectual processes that diverge in divergent and convergent thinking. In this model, Guilford (1950) defends the importance of divergent thinking in creativity. Also, Guilford (1950) defines convergent thinking as a process that results in reaching a single truth through deductive reasoning. Although researchers generally agree that convergent thinking is necessary for the creative process (Armstrong, 2004; Okuda, Runco, & Berger, 1991; Runco, 1991; Runco & Chand, 1994), there is a debate about the creative critical thinking process (Halpem, 2003;

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Runco, 2003). Convergent thinking tests are tests that measure cognitive processes such as recognizing which ideas are more useful or which ideas are the most qualified in order to reach a single correct solution (Brophy, 2000; Lee, 2012).

Autonomy as a word includes both the ideas of independence and freedom and it also has a particular meaning when it is applied to learning. The first researcher who applied autonomy to the field of language learning is Henri Holec. Holec's definition of autonomy is taking responsibility for your own learning. According to Holec, a learner who has autonomy would take responsibility for his decisions on learning like deciding learning goals, selecting content and progress through content, choosing approaches and even practices, checking progress and assessing acquisition. However, according to the practitioners, Holec's definition ignores cognitive processes underlying autonomy. As a result, new definitions of autonomy have arisen (McCrocklin, 2014). After Holec's first definition, Leni Dam (Sinclair, 2000) contributed to the field with a definition called the Bergen. According to this definition, learner autonomy means being ready to take the responsibity for your own learning according to your needs and aims. This requires a capacity to behave independently and in unity with other people as a socially responsible individual (Haseborg, 2012). According to Dam (1990), autonomy may be defined in regard to the learner's wistfulness and capability to monitor or supervise his own learning process. To Dam, an autonomous learner is someone who freely selects aims and sets goals; selects tasks, materials and methods; practices choice and aims in arranging and performing the chosen tasks; and selects criteria for assessment (Phillips, 2004). When Holec and Dam's definitions are analyzed, it is clearly seen that both of them are mostly interested in organizing the learning process. Little (1991), another researcher who defines learner autonomy, mostly focuses on cognitive processes underlying autonomous learning (Hsieh,2010). According to Little (1991), autonomy is in relation with the learner's psychological attitude to the process and subject matter, a capability to be objective, critical thinking, deciding and acting independently. Moreover, little suggests that the capability of autonomy will be shown both in the way of the learner's learning and in the way he or she transfers the things that he/she has learned to broader contexts (Phillips, 2004).

In the process of autonomous learning, the learner makes a purposeful decision to undertake the liability to set goals, plan and act in a learning situation. That means the learner controls his own learning. Knowles (1980) emphasizes that the learner has the responsibility for his own learning process. This idea forms the basics of autonomous learning (Derrick,2000). Levels of learner autonomy are evaluable (Confessore & Park, 2004; Derrick & Carr, 2003; Sass, 2016). Individuals who have learner autonomy at high levels are commonly more likely to show autonomous learning behavior (Confessore,1991; Confessore& Park,2004; Ng & Confessore, 2010; Ponton, 1999; Sass, 2016). While autonomous learning reflects a group of learning behaviors, learner autonomy is the psychological indications that form the basis for such behaviors (Confessore, 2009; Sass, 2016). The problem may be defined as a gap between the current and desired situation (Gagne, 1985). In order to divide the problem into steps and solve it, it is necessary to know the sentence through which the problem has been expressed. This problem statement or cognitive model includes an explanation of a range of goals or procedures related to the solution of a problem (Johnson-Laird, 1983). Problem-solving is defined as a behavioral process that means increasing the likelihood of generating the most effective responses related to the problem and choosing the most efficient one among the various choices (D'Zurilla, Nezu & Maydeu-Olivares, 2004).

Bloom and Broder (1950) state that an individual who can understand a problem through the ability to define a problem is more successful in solving the problem. Instead, individuals focus on the gap between the current situation and the desired situation. Nevertheless, individuals must be trained in a way that leads them to consider alternative solutions to some simple questions such as "What can I do?" while solving the problems. Problem-solving is the process of understanding, synthesizing and adapting what he has learned to a new or different situation by using previously acquired knowledge and abilities (Krulik & Rudnick, 1980). Problem-solving can be expressed as a cognitive process to reach a goal when the solution does not appear immediately for the person who solves the problem (Mayer, 1998). According to Woods (1987), problem-solving is a mental process that a person uses to arrive at the best answer to an unknown or a set of constraints. The problem solver should define the problem, realize its requirements, choose the special and general skills that he has learned before in the solution of this new problem and follow this application in the solution phase (Mayer & Wittrock, 1996). Effective problem solvers generally have a greater degree of private knowledge and can record larger units of knowledge (Mayer, 1998). The problem-solving process usually takes place in the natural environment and includes the steps of a) recognizing the problem, b) identifying the solution, and c) evaluating the solution. The purpose of this process is to act independently against multiple environments (D'Zurilla et al., 2004).

1.1. Statement of the Problem

The hypotheses of the research are listed below:

1) Hypothesis 1: Creative cognition is positively associated with problem-solving.
2) Hypothesis 2: Creative cognition is positively associated with autonomous learning.
3) Hypothesis 3 Problem solving is positively associated with autonomous learning.

2. METHODOLOGY

2.1. Participants

Descriptive research design was used in the research. The descriptive research design is a model that aims to determine the relationship between two or more variables. It is commonly known as the correlational survey model. The descriptions in the relational survey model are made to reveal the relationships and differences between the determined variables instead of determining the existing measures that comply with the determined standards. Relationships found with the model used in the research are not expressed with cause-effect relationships as in experimental models. The research sample consisted of 443 gifted and talented students, ranging in age from 8 to 17 years (M = 12.1, SD =1.8). 218 (49%) of the participants were female, and 225 (51%) of them were male. The scales were applied in the classroom environment. Permission was obtained from the school administrators and teachers to apply the scales. The contents of the scales were explained to the students. The application process took 20 minutes.

2.2. Measures

2.2.1. Autonomous learning scale

Macaskill and Taylor (2010) completed the scale with a pilot study with university freshman psychology students (N=214). The Autonomous Learning Scale measurement tool is a kind of self-evaluation scale in which the participants describe their own situation. The participants who completed the scale responded to the statements in the scale by indicating their level of agreement or disagreement using a 5-point Likert scale, ranging from 1 to 5. The scale consists of 12 items, which are divided into two sub-dimensions. Additionally, the scale provides an overall score for general autonomous learning. The Independent Learning subscale consists of 7 items (example item: I enjoy new learning experiences); The Study Habits subscale consists of 5 items (example item: I plan my time for study effectively). Internal consistency coefficients were found to be .83 for gifted students for the overall scale and it was seen that the scale had sufficient reliability (Arslan & Yurdakul, 2015).

2.2.2. Creative cognition scale

In the scale development study (Moneta & Rogaten, 2015), items were removed from two of the six subscales of the 21-item scale applied to 517 students due to conceptual and psychometric problems. Explanatory factor analysis revealed that the 21-item scale was unidimensional. Five items were selected to create the new uni-dimensional scale. In Study 2, confirmatory factor analysis measuring 696 students and related constructs confirmed the uni-dimensional nature of the scale (example item: I find effective solutions by combining multiple ideas). The results of the Turkish version of the creative cognition scale indicated that the internal consistency coefficients were. 71 for gifted students for the overall scale and it was found to have sufficient reliability (Arslan & Ünal, 2016).

2.2.3. *Problem-solving scale*

The results of the Problem-Solving Style Questionnaire were developed by Romereo, Tepper and Tetrault (PSSQ; Romereo, Tepper & Tetrault, 1992). The scale, which consists of 14 items in total, has two sub-dimensions. While the first sub-dimension is expressed as concreteness; The second sub-dimension is expressed as reflection. Various fit indices were examined for the model fit of the scale, and a decision was made about the fit of the model. The degree of freedom is an important criterion in the chi-square test (χ^2/df=2.3), and the ratio of the degree of freedom to the chi-square is less than 5, which is considered a good fit indicator. An IFI value above 0.95 indicates a good fit, while values above 0.90 are considered acceptable. While 0.95 and above show good agreement for TLI value; Values above 0.90 are considered acceptable (Arslan, Akdeniz & Ünal, 2016).

2.3. Data Analysis

In the present study, the relationship between variables was examined with Pearson correlational coefficient. Sobel test was used to test the statistical significance of mediation effects. In other words, in order not to face the problem of multicollinearity in regression analysis, new variables were obtained via subtracting predictor variables' scores from their own mean values and interaction effect was obtained from the multiplication of these new variables. Before the regression analysis, data was examined in terms of assumptions needed for regression analysis. As a result of these examinations, Stepwise regression analysis was decided to be conducted in order to determine whether creative cognition and problem-solving predict autonomous learning.

3. FINDINGS

The variables included in the study are listed in Table 1.

Table 1.
Descriptive Statistics and Correlations

Variables	1	2	3
Creative cognition	1		
Problem-solving	.56**	1	
Autonomous learning	.57**	.59**	1
Mean	20.3	67.0	47.5
SD	3.51	9.09	7.90

**p< 0.01

Creative cognition related positively to problem-solving (r=.56) and to autonomous learning (r=.57). Problem-solving was found to be positive (r=.59) to autonomous learning.

3.1. Mediating Role of Autonomous Learning

Problem-solving significantly predicted creative cognition (Coeff. = .21, p< .001) as a result of regression analysis in Table 2.

Table 2.
Regression Analysis Results

Predictor	Coeff.	*SE*	*P*	*F*	R^2
Constant	5.79	1.02	<.000		
Problem-solving	.21	.01	<.000	203.53	.31

As shown in Table 3 and Figure 1, the result of the mediation analysis showed that autonomous learning significantly predicts both problem-solving (Coeff. = .52, p< .001) and creative cognition (Coeff. = .16, p< .001). Problem-solving significantly predicted creative cognition (Coeff. = .21; p< .001), and also autonomous learning decreased the effect of problem-solving on creative cognition (from .21 to .13). Finally, the relationship between problem-solving and creative cognition was partially mediated by autonomous learning.

Table 3
Mediational Model Coefficients

Predictors		Consequent: Problem-Solving				Consequent: Creative Cognition		
		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*
Autonomous Learning	*A*	.52	.03	<.001	c'	.16	*.02*	*<.001*
Problem-Solving		------	------	------	*b*	.13	.01	<.001
Constant	i_1	12.66	2.23	<.001	i_2	3.76	.99	<.001
		R^2=.35				R^2=.39		
		$F(1, 443) = 248.1$, p=.000				$F(2, 442) = 146.1$, p = .000		
						Z= 6,99, p= .000		

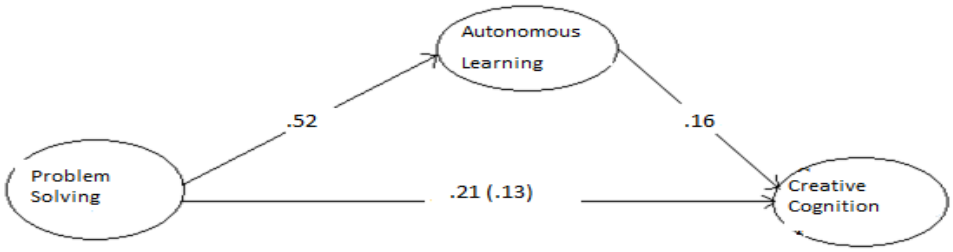

Figure 1. Model of the Mediational Role of *Autonomous Learning*

4. RESULTS, DISCUSSION AND RECOMMENDATIONS

The objective of this research was to examine the mediating role of Autonomous Learning in the connection between Creative Cognition and Problem Solving. This study shows the significance of autonomous learning as a determiner of the relationship between autonomous learning and problem-solving. Nowadays, people live in an advanced technological time where having improved reading, writing or numeric skills is not enough. Individuals are expected to have both quantitative skills and reading comprehension skills in order to be able to understand complex material. They need to consolidate and update on learned skills progressively in a lifelong learning process (Darmer,1995; Lowe, 1993). Therefore, it's important to teach higher-order skills to all students (Darmer, 1995; Resnick, 1987).

Autonomous learning, problem-solving and creative cognition are some of the concepts that have a significant influence on improving individuals' higher-order thinking skills. Gifted individuals represent the qualified members of the society who have higher-order thinking skills. As teaching higher-order skills gain importance, especially in secondary school where students meet some complicated contextual elements, the age group that belongs to the aforementioned level was selected in this study. The creative cognition approach aims to supply extra power to basic cognitive examinations of creativity (Csikszentmihalyi, 1999; Guilford, 1950; Simonton, 1999; Sternberg & Lubart, 1995; Ward, 2001). The creative cognition process can be expressed as "the tendency to propose original solutions and new products" (Gardner, 1988) and "the construction of something that did not exist before" (Roskos-Ewoldsen, 1993). At the core of creativity, there is the idea of "innovation". In other words, being creative requires producing or thinking about something new (Welling, 2007). The concept of creativity, which has developed over time, has led to the formation of the creative cognition approach. According to this approach to creativity, cognition is a universal feature unique to all people, not just a certain group, and is a multidimensional structure based on multiple cognitive processes (Finke, Ward, & Smith, 1992).

According to learner-centered self-access perspective, taking one's own responsibility means that the learner is the representative of his/her own learning (Benson, 2007) and autonomy can be proved by independent and active participation during the process (Dickinson, 1995; Hsieh, 2010; Little, 1995). Also, autonomous learners can transfer the information they have learned in a teacher-centered educational context into broader contexts (Hsieh, 2010; Little, 1991). Derrick (2001) defined autonomous learning as "the process in which the learner deliberately makes decisions in setting goals, making plans, and taking responsibility for action in a learning situation". In other words, it can be called "learning control that the student takes". These factors can be understood as effortful or intentional factors because each of them is based on the psychological characteristic of an individual's effort to engage in autonomous learning (Derrick, 2001). According to Ponton, learner autonomy is defined as the psychological undergirding related to information and interest. However, autonomous learning forms the behavior-related part (Flannagan, 2007; Meyer, 2001). Ponton and Carr (1999) defined learner autonomy as the psychological undergirding essential for the exhibition of the conative factors related to autonomous learning, desire (Meyer, 2001), resourcefulness (Carr, 1999), initiative (Ponton, 1999), and persistence (Derrick, 2001). Student autonomy has many personal qualities (willingness, self-efficacy, curiosity) that affect autonomous learning (Derrick et al., 2007). Jonassen (2000) defines problem-solving as finding the unknown in a situation in which there is a difference between the current situation and the aimed one. Woods (1987) suggests that in order to improve students' problem-solving skills, problem-solving must be taught as a separate skill and it must be thought of as a separate discipline that has its own hidden context. A lot of academicians have the common idea that problem-solving is one of the most meaningful and important learning and thinking styles (Jonassen, 1997). To solve a problem efficiently it is necessary for individuals to have a strong basic intellectual ability in terms of higher-order thinking skills. In addition, it is also important for individuals to remember and apply this knowledge when it is needed.

The current study has some valuable data that contributes to the literature, but it also has some limitations. One of the most important limitations of this study is the small study group. The study group only consists of secondary and high school students. Moreover, the data was collected via some assessment tools with which students evaluate themselves. Therefore, collecting the data with a study group that includes participants with a larger age range and from different cultural backgrounds may contribute to the development of this study. As the present study aims to establish a model instead of testing a preexisting one, the results have an explanatory feature. Thus, reporting the results as certain data might be objectionable in case the study is not repeated in another sample group. Although the results intended to show causality, it is highly difficult to show the causality between the variables in this study as the correlational data was utilized in the present study. Studies involving experimental setups are very important for future studies. In addition, it is very important for future studies to support quantitative findings with qualitative findings.

Research and Publication Ethics Statement

The study was approved by the research team's university ethics committee of the Necmettin Erbakan University (Approval Number/ID: 02/2021/75. Hereby, we as the authors consciously assure that for the manuscript "*Mediating Role of Autonomous Learning in The Relationship between Creative Cognition and Problem-Solving: Gifted Talented Students*" the following is fulfilled:

- This material is the authors' own original work, which has not been previously published elsewhere.
- The paper reflects the authors' own research and analysis in a truthful and complete manner.
- The results are appropriately placed in the context of prior and existing research.
- All sources used are properly disclosed.

Contribution Rates of Authors to the Article

The authors provide equal contribution to this work.

Statement of Interest

There is no conflict of interest.

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