Turkish Journal of Giftedness and Education
2019, Vol 9, Issue 1, 16-31

Özyaprak, M., & Leana-Taşcılar, M, Z. (2019). The effectiveness of self-regulated learning on teaching SCAMPER technique of creativity. *Turkish Journal of Giftedness and Education, 9*(1), 16-31.
Received: 21 Now 2018; Accepted: 08 March 2019

The Effectiveness of Self-Regulated Learning on Teaching SCAMPER Technique of Creativity

SCAMPER Yaratıcılık Tekniğinin Öğretiminde Öz Düzenleyici Öğrenmenin Etkililiği

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Abstract

Researchers of current study hypothesized that self-regulated learning is a convenient tool to enhance creativity since both serve to autonomous learning and self-actualization. In this respect, the aim of the study was to investigate the effect of self-regulated learning on enhancing creative thinking skills. An experimental design with a control group was used in this study. A total of 14 participants were assigned to receive the experimental training. The same number of participants was assigned to the control group. A unique program developed by the researchers combined SCAMPER and self-regulated learning technique was used in the experimental group. Only SCAMPER was used in the control group. The findings of the study revealed that self-regulated learning was effective to teach SCAMPER.

Key Words: self-regulated learning, SCAMPER, creative thinking, teaching creativity

Öz

Mevcut araştırmada öz düzenleyici öğrenmenin, otonom bir düşünür olup kendini gerçekleştirmeye hizmet etmesinden dolayı, yaratıcılığın arttırılması için uygun bir araç olduğu varsayılmaktadır. Bu bağlamda çalışmanın amacı, öz düzenleyici öğrenmenin yaratıcı düşünme becerilerini geliştirmedeki etkisini araştırmaktır ve temel araştırma sorusu şu şekildedir: Öz düzenleyici öğrenme, üniversite 2. Sınıf öğrencilerinin SCAMPER etkinliğindeki puanlarının arttırılmasında etkili midir? Bu çalışmada kontrol gruplu deneysel model kullanılmıştır. Deney ve kontrol grupları on dört öğrenciden oluşmuştur. Mevcut çalışma kapsamında araştırmacılar tarafından geliştirilen ve SCAMPER ve öz düzenleyici öğrenme teknikleri birleştiren bir program deney grubuna uygulanmıştır. Kontrol grubunda sadece SCAMPER tekniği çalışılmıştır. Çalışmanın bulguları, öz düzenleyici öğrenmenin, SCAMPER tekniğinin öğretilmesi için etkili olduğunu ortaya koymuştur.

Anahtar Sözcükler: öz-düzenleyici öğrenme, SCAMPER, yaratıcı düşünme, yaratıcılık

Introduction

Creativity is a complex concept. It has various elements within. The most famous and accepted elements which aim to explain creativity are creative person, process, product, and place (Rhodes, 1961). The creative person emphasizes creative potential (Reis & Renzulli, 2009) and characteristics which affect creativity in a good or bad manner (Dacey, 1989). On the contrary, the creative process considers creativity as a cognitive concept. It examines how creation process happens. Creative process encloses some cognitive thinking skills like divergent and convergent thinking, finding problems, problem solving, associative and analogical thinking (Davis, Rimm, & Siegle, 2011). Especially, divergent thinking is considered as a basic thinking skill of creativity because it is believed that divergent thinking mostly leads to originality (Sak, 2014). Creative process is also related with some techniques which are believed to enhance creativity such as brain storming, analogy use (Sak, 2014), attribute listing, morphological synthesis and SCAMPER (Özyaprak, 2012).

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Creative product focuses on outcomes obtained at the end of the creation process. This perspective searches for some criteria which a product has to meet to be considered as creative. Those criteria are originality, fluency, flexibility (Runco, 2007; Linke, 2010) and convenience (Feldhusen, & Eng Gogh, 1995). Creative product underlines that creativity process has a goal and it emphasizes the need for meaningful, aesthetic, novel and concrete solutions, ideas or outcomes. Creative place, as the last element, represents influences and restraints that affect creative person or process. It expresses the relationship between the person and the environment. The place addresses two aspects of the environment: the stimuli, which encourage or prevent creative thinking and social and disciplinal context, which evaluates the creative product (Sternberg, O'Hara, & Lubart, 1997).

The studies show that creative potential can be nurtured (Baer, 1993; Feldman & Benjamin, 2006; Freiman, 2009; Huang, 2009; Kolloff & Feldhusen, 1984; Meissner, 1999; Smith & Smith, 2010). According to researchers, nurturing creative potential is mostly related to creative process and product. Creativity training is important in terms of teaching the criteria of a creative product and practicing creative thinking skills. Creative thinking strategies and techniques are useful to practice creative thinking skills. It is the general opinion that creative thinking strategies enable to use creative thinking skills and increase the possibility of having a creative product or idea (Baer, 1993; De Bono, 1992; MacKinnon, 1978). Besides, these kinds of techniques enable the person to develop their creative potential by themselves. They allow autonomy and life-long learning. Another advantage of those techniques is sharing the eminent creators' habits of mind with students, which is expected to be a model for them. Most of eminent scientists and artists have used creative thinking strategies consciously or unconsciously like Einstein, Da Vinci and George Lucas (Davis & Rimm, 2004). It is vital to show children that it is possible to make progress with creativity consciously via these examples.

A Creative Thinking Technique: SCAMPER

Creativity literature has so many studies about creative thinking strategies (Baer, 1993; De Bono, 1992; Feldman & Benjamin, 2006; MacKinnon, 1978; Smith & Smith, 2010). SCAMPER is a commonly used creative thinking technique in both studies and practices. SCAMPER basically aims to create numerous ideas (De Bono, 2000). At the same time students are encouraged to gain new and various perspectives (Kerr, 2009). SCAMPER was developed by De Bono (2000) and is an acronym. SCAMPER stands for: substitute (thinking out alternative ideas/objects instead of the existing idea/object); combine (forming novel ideas by combining various and connected-disconnected ideas); adapt (modifying existing object for the purpose of adapting to a situation or environment); modify (changing the present object by magnifying, minifying, modifying it); put to other uses (using an object in a different concept/situation/place); eliminate (improving the existing material by eliminating a part of it or figuring out the consequences of elimination of something); rearrange/reverse (rearranging or reversing present status/situations/orders/patterns with the aim of considering alternative ends, practices, ideas).

SCAMPER provides an enjoyable environment for practicing creative thinking for children. Also the leading questions in the technique present a concrete system to think in a flexible and fluent manner. The systematic thinking in SCAMPER helps children to overcome their mental blocks.

Thinking alternative uses of an object or various strategies instead of one single and ordinary strategy help children to go beyond the generalizations and axioms.

Self-Regulated Learning and Seven-Step Cycle of Self-Regulated Learning Model

Self-regulation is a learning process and consists of some developmental behaviors. This process can be organized and adapted according to the learning environment. Thus, learning is regulated by the person individually and becomes permanent.

As Bandura (1986) pointed out, learning becomes more effective when the learning material is meaningful for the person. Therefore, being aware of what and how to learn, without the guidance of a teacher or a guide, makes the individual more independent and it has positive influence on lifelong learning (Winne & Perry, 2000). Self-regulation is one of the most important skills, so it should be well understood how it works, how it can be supported and developed (Zimmerman, 2000). When individuals are active in cognitive, motivational and behavioral ways in their learning process, then it can be proclaimed that they are self-regulated (Zimmerman, 1986).

According to Zimmerman (2000), there are three control mechanisms underlying in self-regulated learning: personal, behavioral and environmental. Advanced self-regulated learners are flexible in their strategies, they have environmental support and they have positive self-concepts. These features are available in creative individuals too (Jackson & Sinclair, 2006). Likewise, creative individuals are also familiar with the three phases that affect the learning process and beliefs: preliminary consideration (thinking about tasks, problems and context), controlling the performance (implementation of ideas and strategies) and self-reflection (reviewing performance and to stimulate in mind) (Zimmerman, 2000).

Many researchers including Zimmerman (1986), suggested different steps or phases about self-regulated learning (Pintrich, 2000; Winne & Perry, 2000). The good news are as Ziegler (2014) emphasized that no matter which model or approach we use, self-regulated learning itself leads to excellence. In addition, Stoeger (2013) indicated that students from the age of nine can develop their own self-regulated learning process.

Stoeger and Ziegler (2005) suggested the seven-step cycle of self-regulated learning:

1st Step - Ability to assess state of one's own learning. This step stands for being aware of the obstacles that can occur during the learning process, of the personal skills, and the characteristics of the material that will be learned.

2nd Step - Ability to set suitable learning goals. Having a realistic perspective about themselves and set the appropriate learning targets. Setting your own goals rather than being focused on external factors such as teacher or parents is more important and beneficial.

3rd Step - Choice of effective learning strategy. As Weinstein, Husman, and Dierking (2000) noted there are several cognitive learning strategies such as repeating, rearranging, summarizing, and underlying. There are also several studies that investigate the effectiveness of these strategies (Weinstein,

1978; Ziegler, Stoeger, & Vialle, 2013; Zimmerman, Bonner, & Kovach, 1996). In this step, it is important to introduce these strategies and help the student to select the appropriate ones.

4th Step - Consistency of learning strategy application. In this step, the individual is more active than the other steps. It is not enough just to know and to choose the appropriate learning strategy; it must also be able to apply it properly.

5th Step - Ability to monitor one's own learning progress. Here the individuals self-monitor themselves about the usage of the strategy and get more general about the entire learning process.

6th Step - Ability to adjust one's own learning strategy. The individual must be flexible in changing and adapting the learning strategies when there is a gap between the learning strategies and the learning process. Sometimes students are required to find and select a more appropriate strategy in order to study the material.

7th Step - Checking and assessing the learning outcome. This evaluation is also a tool to assess oneself when the cycle gets started again. It is important to be able to evaluate the success of the entire learning process.

Creativity and Self-regulated Learning

Jackson and Sinclair (2006) discussed that the above mentioned phases of self-regulated learning are related to creativity. According to this view in the first phase, creative individuals are good at using their imagination, generating new projects and motivating themselves. Thus, they set goals and make a plan themselves. They are concerned not only with the process but also with the product, and they have original ideas in determining strategies. In the second phase, the self-monitoring of their performance and the surrounding factors will help them to have information about how they are affected by themselves and the environment. In the last phase, individuals examine critically what they have produced and what should be done about the evaluation. Hence, the last two phases help individuals to use their imagination and to take advantage of both environment and personal traits for achieving their goals (Jackson & Sinclair, 2006).

In addition to Jackson and Sinclair's (2006) perspective, there are other points about self-regulated learning which can be related to creativity. These points, listed and explained below, helped the authors to create a reason and a pathway for using self-regulated learning as an instructional method for studying SCAMPER:

1. Even though it is important to teach creative thinking techniques, training should not only focus on learning a fixed set of strategies. Creativity training should help individuals to realize and develop their unique strengths and talents and to inspire them to create something new in their own ways (Kerr, 2009). Self-regulated learning may be considered as an appropriate instructional method to achieve that fruitful environment which will lead individuals to apply creative thinking skills in real-life problems.

2. Self-regulated learning is considered to be related with a creative person's element of creativity, since autonomy is one of the characteristics of creative people (Sak, 2014).

3. The features to diminish creativity in the environment may be listed as time restriction, competition, too much expectation, destructive feedback, manipulation, over-controlling the people and not letting them monitor and control their processes (Amabile, 1988). Self-regulated learning helps individuals to deal with all those features and enables creative training to produce long-term and transferable effects, because it is not possible to help all students throughout all their creative processes. So, students must retain the control of this process. As Sternberg and Williams (1996) pointed out, after teaching specific techniques and waking the joy of creativity in students, self-regulated learning should be given. It should be noted here that both the creativity and the strategies that they are using must be self-driven. During the process students will improve themselves in organizing their creative learning processes. The crucial point here is that at the beginning teacher must be the guide and teach the students about self-regulation.

Although there is a great deal of research about teaching creativity and different tasks that serve for creativity (Feldhusen & Treffinger, 1977; Rose & Lin, 1984; Sak & Oz, 2010; Torrance, 1972), teaching creativity tasks through self-regulation is a brand new research area. Accordingly, the hypothesis of the study is that *the self-regulated learning training is an effective tool for enhancing creativity. In this respect, the study aimed to investigate the effects of self-regulated learning on teaching SCAMPER technique of creativity*.

Method

Sample

The study was conducted with 28 undergraduate students (female =20; male = 8) who are sophomores. All of the participants are enrolled in Gifted Teacher Training Program at Istanbul University. 28 of the 68 students who had enrolled in the Teaching Creativity course volunteered to participate in this study. Once 28 volunteers had completed the pre-test on creativity they were assigned as experimental (female=9; male 5) and control (female=11; male = 3) groups. Control group's mean age was calculated as 22.43 with standard deviation 1.54 while experimental group's mean age was 21.14 and standard deviation 0.86. Gifted Teacher Training Program is the first undergraduate program of teacher training for gifted elementary students, which was established in 2002 at Istanbul University. The curriculum of the undergraduate program specifically includes teaching of higher level thinking skills to be able to meet the gifted students' intellectual and academic needs. Therefore, Teaching Creativity class is in the core curriculum of the program.

General Procedures

A pre-test-post-test design with a control group was used in this study. The study took four weeks of training (three and a half hours per week) and two weeks of testing. One design task and one story writing task developed by the authors were used as pre and post-test. Both tasks were presented together and there was no time restriction. Pre-tests were administered a week before the training, and post-tests were administered a week just after the training.

The authors developed and carried out the training program, which combined SCAMPER and self-regulated learning techniques. The training did not include any topics on designing or story writing tasks, and put its focus solely on creative thinking via SCAMPER and the steps of self-regulated learning.

Instruments

The aim of the training was to develop the use of SCAMPER via self-regulated learning. Therefore, the tasks to be used as pre and post-test were expected to evaluate the expertise on using SCAMPER. The researchers expected to observe two aspects of the expertise in SCAMPER: theoretical and practical. The correct and appropriate usage of SCAMPER letters was examined by the theoretical aspect. For that reason, students were asked to explain which SCAMPER letter and which question were preferred to create the new idea in the theoretical setting of the task. Whilst practicing the task, students were expected to produce novel ideas by using the SCAMPER questions they wrote in the theoretical part of the task. However, any specific tests or tasks for this purpose could not be found out in the literature review. Thus, authors developed two tasks, design and story writing tasks, including the aforementioned aspects. The reason for developing two different kinds of tasks (one verbal and one figural) was to prevent the possible bias based on field of expression. Individuals' level of creativity potentials may show differences according to the field of expression, so it was considered important to give 2 options for expression. (Lubart, Besançon, & Barbot, 2012).

Design task. While designing the task, students were given the following instruction: '*Design a novel chair to launch by using SCAMPER letters. Explain and illustrate your chair on blank papers (practical aspect). Fulfill the table based on your usage of SCAMPER letters (theoretical aspect). Don't worry about the time. Be creative as you can!'* The students were given empty A4 papers to draw and explain their chairs. A table was also given to explain which letters of SCAMPER were used as an explanation of the theoretical aspect. Then SCAMPER letters with brief explanations were presented in sheet of A4 paper since students would encounter such a technique for the first time.

The students' designs were scored by two specialists in Gifted Education and Creativity field using a 4-point rating scale developed by the authors (Figure 1). The judges appraised the task according to the following criteria: (a) fluency - the number of the ideas, (b) originality within group - the frequency of the ideas, (c) originality within the world of design - novel, surprising solutions, (d) flexibility - thinking out of the box, (e) flexibility - the number of categories, (f) elaboration - the details of the product, (g) workability - the possibility of carrying out the idea/product. First four criteria were built on the main aspects of creative thinking which were suggested in Torrance's (1974) definition of creativity. The last criterion was based on the definition of creativity in the Triarchic Theory of Intelligence (Sternberg, 1997; Sternberg & Lubart, 2000).

Inter-rater reliability analysis showed a high agreement between the judges' ratings, yielding a 0.92 reliability coefficient for the theoretical part of the pre-test and 0.95 for the post-test; and 0.80 for the practical part of the pre-test, 0.86 for the post-test.

	(0)	(1)	(2)	(3)
FLUENCY (The number of ideas)	**0 idea**	**1-5 ideas**	**6-10 ideas**	**11 ideas and more**
ORIGINALITY 1 (Frequency of the ideas within the group)				
ORIGINALITY 2	The constructed idea is same as existing ideas in terms of design, purpose of use and comfort.	The constructed idea is similar to existing ideas in terms of design, purpose of use and comfort.	The constructed idea indicates difference from the existing ideas with regard to at least one dimensions among design, purpose of use and comfort.	The constructed idea is completely different from the existing ideas in terms of design, purpose of use and comfort.
FEASIBILITY	The constructed idea cannot be put into practise.	The constructed idea can be put into practise partly.	The constructed idea can be put into practise mostly.	The constructed idea can be totally put into practise.
FLEXIBILITY (Thinking out of the box)	The constructed idea does not indicate any difference from the existing ideas	The constructed idea indicates difference from the existing ideas with regard to one category.	The constructed idea indicates difference from the existing ideas with regard to two categories.	The constructed idea indicates difference from the existing ideas with regard to at least 3 categories.
FLEXIBILITY 2 (The number of categories of constructed ideas)	The constructed ideas indicate one category.	The constructed ideas indicate 2 categories.	The constructed ideas indicate 3 categories.	The constructed ideas indicate 4 and more categories.
ELABORATION	There is no elaboration, just idea.	There is some elaboration.	There is moderate elaboration with some details.	There is efficient elaboration including important verbal and/or figural details.

Figure 1. Sample rubric of the design task

Story task. For the story task students were given the following instruction: *'Rewrite the story called 'Rapunzel' which is attached by using SCAMPER letters. Use the blank papers to write your new story (practical aspect). Fulfill the table based on your usage of SCAMPER letters (theoretical aspect). Don't worry about the time. Be creative as you can!'* The students were given empty A4 papers to write their stories. A table was also given to explain which letters of SCAMPER were used as an explanation of the theoretical aspect.

The students' stories were scored by two specialists in Gifted Education and Creativity field using a 4-point rating scale developed by the authors. The judges appraised the task according to the following criteria: (a) originality within group - the frequency of the ideas, (b) flexibility - thinking out of the box, and (c) elaboration - the details of the story. Again, creative thinking aspects were taken into consideration. Interrater reliability analysis showed a high agreement between the judge's ratings, yielding a 0.89 reliability coefficient for the theoretical part of the pre-test and 0.94 for the post-test; and 0.79 for the practical part of the pre-test, 0.65 for the post-test.

Training

The participants both in the control and experimental groups worked together through a training program with the intention to learn the use of SCAMPER. The training of SCAMPER letters spread out into four weeks. Every week the training started with a presentation of the letter/s. Then it continued by giving examples and running a discussion on why that example was suitable for this letter. The given examples were chosen from advertisements, science and technology, art, engineering, cartoons and nutrition. Later on, the most creative examples were selected. The participants were asked to explain how the creators of the examples might have achieved the creativity thinking and which SCAMPER letter might have directed them to this product. For example; the picture of a snowman made by balloons was showed to the participants as an example of 'S -Substitute' letter. This sort of tasks aimed to develop the theoretical aspect of SCAMPER. To develop the practical aspect, another activity was introduced. This time the participants were asked to create at least three novel ideas/products by using the ideas studied during the week. In every lesson the main questions of the current letter were underlined and the participants were encouraged to ask those questions properly. Every week the students were required to do their homework about the current letter/s.

Although both groups took the basic SCAMPER training together (2 hours per week), only the experimental group participants participated to the 'SCAMPER through Self-Regulation (S-SRL)' training (1 and a half hours per week). The aim of the S-SRL was first to teach self-regulated learning and then to develop the expertise in SCAMPER and creativity. In the beginning of every lecture, self-regulated learning step/s was/were introduced. As the next step, the SCAMPER letter/s of the week was/were combined with self-regulated learning step/s of the week. The instructional program consisted of the following steps, which lasted four weeks:

1. Before the experimental group's first lesson the participants were asked to choose various creative SCAMPER examples taken from advertisements, science and technology, art, engineering, cartoons and nutrition fields based on their knowledge about SCAMPER letters that they had already been introduced.

2. During the lecture the instructors discussed their examples. SCAMPER letters usage was checked. After the students recognized their mistakes, as self-regulated learning requires, they were asked to determine and share their *strong and weak parts (1st step of self-regulated learning)*. Therefore, they were able increase their awareness about their creative thinking potential and to learn the SCAMPER letters in more depth.

3. The participants were expected to bring some regular stuff/idea to the class like a white t-shirt. Participants via using the current SCAMPER letters differentiated the regular idea. The purpose of this activity was to give a chance to the participants to create novel ideas while they *set their daily and general goals (2nd step of self-regulated learning)* about being creative and SCAMPER learning process.

4. In the next step the learning strategies were introduced and the students completed a table about their most used strategies. After that the most *effective* (testing yourself and practice)

two *strategies (3rd and 4th step of self-regulated learning)* according to Dunlosky, Rawson, Marsh, Nathan and Willingham (2013) were presented. As homework, the students were asked to study the current SCAMPER letters by using the strategies they had learned.

5. While students were making presentations about their social responsibility project prepared by SCAMPER technique, they had been *monitoring (5th step of self-regulated learning)* themselves especially for their learning strategies. In addition, they were asked to write down their observations about issues such as their attention, focus ability, the use of SCAMPER letters, creativity processes, physical and mental reactions. Afterwards students discussed their observations. The instructors gave them feedback and guided them about how to deal with distractions.

6. Following, students were asked to *adapt their learning strategies (6th step of self-regulated learning)* according to their experiences gained from the self-monitoring process. For instance; if a student had a problem with testing strategy when s/he was studying SCAMPER letters, s/he might decide to change the frequency of their study testing interval.

7. In the last step, the participants *reviewed their learning processes (7th step of self-regulated learning)* about SCAMPER, creative thinking and self-regulation. The goal of this evaluation was to emphasize our learning process was in our control. The participants could control it by identifying the failing and successful aspects of the whole process, realizing their strengths and weaknesses, developing new strategies or adjusting existing ones to deal with those challenges.

Results

Test of Normality and Pre-test Results of the Groups

Since the normality Kolmogorov-Smirnov test was KS $_{(28)}$= .200, p>.05, paired samples t-test was used to test the significance of differences between student's pre-test and post-test scores on design (theoretical and practical) and story (theoretical and practical) tasks. After the normality test bivariate correlations were calculated among the tasks as they were assumed to have some common roots for being areas of creativity. The analysis showed significant correlations among the tasks except the theoretical part of the story task (Table 1.)

Table 1. Zero Order Correlations Between the Tasks

Tasks	1	2	3	4
Participants (n = 28)				
1. Design-Practical	-	.448*	.648*	.334
2. Design-Theoretical		-	.386*	.436*
3. Story-Practical			-	.610**
4. Story-Theoretical				-

**p<.05, **p<.01*

As seen in Table 2, there were no significant differences between pre-test mean scores of experimental and control groups. This means that before the training sessions both experimental and control groups had the same mean scores in all of the tasks and that they were distributed equally.

Table 2. Pre-Test Differences in Design and Story Tasks

	Experimental (n=14)		Control (n=14)		t	*p*
	Mean	SD	Mean	SD		
Design-Theoretical	1.89	1.94	2.60	1.30	1.14	.264
Design-Practical	10.75	1.28	10.85	2.01	.168	.868
Story-Theoretical	3.10	1.82	2.32	1.64	-1.19	.242
Story-Practical	5.64	1.08	5.32	1.17	-.755	.457

Comparison of Creative Performance on the Design Task Within Group

As seen in Table 3 and 4, participants' post-test scores on the theoretical and practical part of the design task differed significantly from the pre-test scores with a considerable increase (pre-test mean= 1.89; post-test mean= 4.25, p= .000 in theoretical part and pre-test mean= 10.75; post-test mean= 12.96, p= .006) in the experimental group. In contrast control group participants' scores were not significantly different (pre-test mean= 2.60, post-test mean=2.07, p= .182 in theoretical part and pre-test mean= 10.85; post-test mean= 10.00, p= .369 in practical part).

Table 3. Pre-Test And Post-Test Scores In the Theoretical Part of Design Task

Variables	*N*	Pre-test		Post-test		Paired Sample *t*-test				
		Mean	SD	Mean	SD	Mean dif.	SD	*t*	df	*p*
Control	14	2.60	1.30	2.07	1.19	.535	1.42	1.41	13	.182
Experimental	14	1.89	1.94	4.25	2.24	-2.35	1.86	-4.72	13	.000***

****p<.001***

Table 4. Pre-Test and Post-Test Scores in the Practical Part of Design Task

Variables	*N*	Pre-test		Post-test		Paired Sample *t*-test				
		Mean	SD	Mean	SD	Mean dif.	SD	*t*	df	*p*
Control	14	10.85	2.01	10.00	3.19	.857	3.44	.931	13	.369
Experimental	14	10.75	1.28	12.96	2.05	-2.21	2.53	-3.27	13	.006**

****p<.01***

Comparison of Creative Performance on the Story Task

As seen in Table 5 and 6 the results were similar for the theoretical and practical story tasks. The mean post-test scores of the participants who received the training were significantly higher than their pre-test scores in both story tasks (pre-test mean=3.10, post-test mean=5.14, p= .000 in theoretical part and pre-test mean= 5.64, post-test mean= 6.35, p= .017 in practical part). As it was expected the mean post-test scores of control group were not higher than their pre-test scores since they didn't receive the S-SRL training (pre-test mean= 2.32, post-test mean= 3.46, p= .084 in theoretical part and pre-test mean= 5.32, post-test mean= 5.35, p= .873 in practical part).

Table 5. Pre-Test and Post-Test Scores in the Theoretical Part of Story Task

Variables	*N*	Pre-test		Post-test		Paired Sample *t*-test				
		Mean	SD	Mean	SD	Mean dif.	SD	*t*	df	*p*
Control	14	2.32	1.64	3.46	2.06	-1.14	2.28	-1.87	13	.084
Experimental	14	3.10	1.82	5.14	2.07	-2.03	1.64	-4.62	13	.000***

****p<.001***

Tablo 6. Pre-Test and Post-Test Scores in the Practical Part of Story Task

Variables	*N*	Pre-test		Post-test		Paired Sample *t*-test				
		Mean	SD	Mean	SD	Mean dif.	SD	*t*	df	*p*
Control	14	5.32	1.17	5.35	.770	-.035	.819	-.163	13	.873
Experimental	14	5.64	1.08	6.35	.602	-.714	.974	-2.74	13	.017*

****p<.05***

Comparison of Creative Performance on the Design and Story Tasks Across Groups

As seen in Table 7 there were significant differences between post-tests mean scores of experimental and control groups. This means that after the training session's experimental groups' mean scores significantly increased in all tasks.

Tablo 7. Post-Test Differences in Design and Story Tasks

	Experimental (n=14)		Control (n=14)		t	*p*
	Mean	SD	Mean	SD		
Design-Theoretical	4.25	2.24	2.07	1.19	-3.211	.004**
Design-Practical	12.96	2.05	10.00	3.19	-2.923	.007**
Story-Theoretical	5.14	2.07	3.46	2.06	-2.150	.041*
Story-Practical	6.36	0.60	5.36	0.77	-3.827	.001**

Discussion

Previous literature has suggested that creative people frequently are independent thinkers (Davis & Rimm, 2004). Self-regulation is also a concept that needs independent and autonomous work. Thus, self-regulation was introduced in the study as a related concept to creativity according the independent thinking and autonomy. Therefore, the purpose of this study was to examine the effect of self-regulated learning on increasing SCAMPER tasks scores among gifted teacher candidates. Since, creative thinking skills were assumed to be a very wide topic; SCAMPER technique was used as a creative thinking tool.

Before interpreting the findings in detail, it should be noted that no training was provided about designing and story writing during the instruction. Instead, the purpose of the training was to increase the capacity to use SCAMPER letters and to make participants create novel ideas by using SCAMPER letters in designing a chair and re-writing a well-known story through self-regulated learning.

The findings that emerged from this study showed that self-regulated learning is an effective technique to increase creative thinking and SCAMPER using skills. While there were no significant differences between the pre-tests' mean scores of experimental and control groups, the experimental groups' post-tests' scores were significantly higher than control groups' in all tasks. According to those results, the hypothesis of the study was corrected. The possible explanation for these expected results might be related with autonomy which is both a part of creativity and self – regulated learning. Autonomy is one of the personal traits influential on creativity and one of the aims of self-regulated learning (Kozbelt, Beghetto, & Runco, 2010; Sierens, Vansteenkiste, Goossens, Soenens, & Dochy, 2009).

Another explanation of the current results is that both self-regulated learning and creativity potential can be enhanced by education. For example, Zimmerman (2002) discussed how a person could be a self-regulated learner. In another study Zimmerman, Bonner and Kovach (1996) showed that training of self-regulatory learning can develop several academic skills. In a very recent study Sontag and Stoeger (2015) found out that gifted students were benefiting from self-regulated programs even in a regular classroom. Similarly, creativity is also believed to be taught in the regular classroom (Nickerson, 2009). Felder (1988) proposed that creativity should be exercised through a suitable environment where students meet with effective exercises and the use of various techniques. There are studies presenting evidence to claim that measurable indicators of creativity can be enhanced by proper curriculum (Bodrova & Leong, 2001; Craft, 2000; Diamond, Barnett, Thomas, & Munro, 2007; Kessler, 2000). The studies especially emphasized to guide children to think alternative ways to solve problems to be able to develop creativity (DeHaan, 2005). There is also a meta-analysis study concluding that creativity can be developed by training (Rose & Lin, 1984).

The findings also demonstrated that there was a significant increase of the experimental groups' post-tests scores in all tasks; while there was no significant difference in control group's post-test. It is possible to assume that giving opportunity to participants to choose SCAMPER exercises according to their interests, making fruitful discussions between the students and instructors about the SCAMPER letters, examples and novel ideas; determining and sharing the strong and weak parts and therefore noticing the creative potential (Schunk, 1996), setting daily and general goals (Schunk, 1990), finding the effective strategies for themselves (Weinstein, Ridley, Dahl, & Weber, 1989), self-monitoring (Lan, 1996) and adapting the learning strategies according this monitoring process and reviewing their learning process might have positively affected the experimental groups' post test scores. Hence, it was emphasized that the learning process was in the students' control. The participants experienced that they could enhance their creative potential by using self-regulated learning. In contrast, there was not any guidance about learning processes in the control group. The participants in the control group were only presented the SCAMPER letters and examples by the instructor. Indeed, the control group experienced creativity using the SCAMPER letters only via the examples presented by the instructor, instead of choosing the examples according to their interests. One can interpret via the results of the control group that teaching SCAMPER as a creative technique may not be that effective, especially if participants do not have enough and effective practice with the technique. As a matter of fact, Barak and Mesika (2007) showed in their studies that teaching creative thinking techniques was useful for creativity if only students were allowed to develop their thinking methods and to explain their ideas. This finding is in alignment with the assumptions of the current study that autonomy is important for creativity and creativity training should guide people to create something new in their own ways (Kerr, 2009).

In the literature it is generally considered that divergent thinking exercises such as brainstorming or specific techniques such as SCAMPER, analogical thinking etc. are useful ways to encourage creative potential (Davis & Rimm, 2004). Although they help students understand creativity and strengthen their creative abilities, they are not sufficient. As it was emphasized in this study, creativity thinking needed a deeper approach like self-regulated learning. It can be assumed that metacognitive processes should be imposed to create novel ideas. Therefore, more practical studies

and empirical research are to be conducted and there should be studies to provide in-depth understanding about teaching creativity. In addition, because the creative thinking training is a main part of gifted education (Davis & Rimm, 2004), the teachers of gifted students should specifically be trained in this topic. Furthermore, creativity learning via self-regulated learning should be included to the creativity curriculum of gifted education. Since SCAMPER is only one of the creativity techniques there should be more studies using other creativity techniques.

There are limitations to be mentioned here. In this study, the same tasks for the pre-tests and post-tests were used. However, it may be assumed that this limitation might contribute mostly to the paper and pencil tests findings, because prior experience is often important for those instruments. When it comes to the tasks as in this study aiming to evaluate the creative potential of students, the authors believe that the growth in the students' creative ability prevents the effect of prior experience. Another limitation of the study was the representation issue. Participants of this study were undergraduate students and this is a limitation to apply the finding to all age groups.

As a conclusion self-regulated learning is an effective tool for enhancing creativity. Thus it is suggested by the authors that creativity training programs, gifted education curriculum and teacher training programs should be carried out by self-regulated learning. Further studies can be conducted with gifted students. Also alternative research can be carried out to examine effect of self-regulated learning on other creativity techniques. Last but not the least, quantitative studies referring participants' ideas about their progress and awareness on creativity and self-regulation can be done as following research.

References

Amabile, T. M. (1988). A model of creativity and innovation in organizations. *Research in Organizational Behavior*, *10*(1), 123-167.

Baer, J. (1993). *Creativity and divergent thinking*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Bandura, A. (1986). *Social foundation of thought and action: A social cognitive theory*. Englewood Clifss, NJ: Prentice-Hall.

Barak, M., & Mesika, P. (2007). Teaching methods for inventive problem-solving in junior high school. *Thinking skills and creativity, 2*(1), 19-29.

Bodrova, E., & Leong, D. J. (2001). *The tool of the mind: A case study of implementing the Vygotskian approach in American early childhood and primary classrooms*. Geneva, Switzerland: UNESCO International Bureau of Education.

Craft, A. (2000). *Creativity across the primary curriculum: framing and developing practice.* London: Routledge.

Dacey, J. S. (1989). *Fundamentals of creative thinking*. Toronto: Lexington Books.

Davis, G. A., & Rimm, S. B. (2004). *Education of the gifted and talented* (5th ed.). Boston, MA: Pearson Education Press.

Davis, G. A., Rimm, S. B., & Siegle, D. (2011). *Education of the gifted and talented* (6th ed.). Boston, MA: Pearson Education Press.

De Bono, E. (1992). *Serious creativity*. New York: Harper Collins.

De Bono, E. (2000). *New thinking for the new millennium*. Beverly Hills, California: New Millennium Press.

DeHaan, R. L. (2005). The impending revolution in undergraduate science education. *Journal of Science Education and Technology, 14*, 253–270.

Diamond, A., Barnett, W. S., Thomas, J., & Munro, S. (2007). Preschool program improves cognitive control. *Science, 318*, 1387– 1388.

Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, *14*(1), 4-58.

Felder, R. (1988). Creativity in engineering education. *Chemical Engineering Education*, *22*(3), 120-125.

Feldman, D. H., & Benjamin, A. C. (2006). Creativity and education: An american retrospective. *Cambridge Journal of Education, 36*, 319–336.

Feldhusen, J. F. ve Eng Goh, B. (1995). Assessing and accessing creativity: An integrative review of theory, research, and development. *Creativity Research Journal, 8*(3), 231–244.

Feldhusen, J. F., & Treffinger, D. J. (1977). The role of instructional material in teaching creative thinking. *Gifted Child Quarterly, 21*(4), 450-459.

Freiman, V. (2009). Mathematical enrichment: Problem of the week model. In R. Leikin, A. Berman, & B. Koich (Eds.), *Creativity in Mathematics and the Education of Gifted Students* (pp. 367-382). Rotterdam: Sense Publishers.

Jackson, N., & Sinclair, C. (2006). Developing students' creativity: Searching for an appropriate pedagogying students' creativity: Searchin for an appropriate pedagogy. In N. Jackson, M. Oliver, M. Shaw, & J. Wisdom (Eds.), *Developing creativity in higher education: An imaginative curriculum* (pp. 118-142). USA, NY: Routledge.

Huang, T. (2009). Creativity training. In B. Kerr (Ed.), *Encyclopedia of giftedness, creativity and talent* (Vol. 1, pp. 219-221). London: SAGE Publications.

Kerr, B. (Ed.). *(2009). Encyclopedia of giftedness, creativity and talent.* California: Sage Publications.

Kessler, R. (2000). *The soul of education: helping students find connection, compassion and character at school.* Alexandria, VA: Association of Supervision and Curriculum Development.

Kolloff, P., & Feldhusen, J. F. (1984). The effects of enrichment on self-concept and creative thinking. *Gifted Child Quarterly*, *28*, 53-57.

Kozbelt, A., Beghetto, R. A., & Runco, M. A. (2010). Theories of creativity. In J. C. Kaufman & R. J. Sternberg (Eds.), *The cambridge handbook of creativity* (pp. 20-48). New York: Cambridge University Press.

Lan, W. Y. (1996). The effects of self-monitoring on students' course performance, use of learning strategies, attitude, self-Judgment ability, and knowledge representation. *The Journal of Experimental Education 64*(2), 101-115.

Linke, S. (2010). *A new dynamic model of creativity***.** Hamburg: Verlag Dr. Kovac.

Lubart, T.I., Besançon, M., & Barbot, B. (2011). *Evaluation du potentiel créatif (EPoC): Test psychologique et manuel* [Evaluation of creative potential: Test and manual]. Paris: Editions Hogrefe France.

MacKinnon, D.W. (1978). *In search of human effectiveness*. Buffalo: Creative Education Foundation.

Meissner, H. (1999, July). *Creativity and mathematics education.* Paper presented at the Creativity and Mathematics Education of the International Conference.

Nickerson, R. S. (2009). Enhancing creativity. In R. J. Sternberg, *Handbook of creativity*. USA: Cambridge University Press.

Özyaprak, M. (2012). Ü*stün zekâlı ve yetenekli öğrencilere yönelik farklılaştırılmış matematik öğretiminin erişi, tutum ve yaratıcılığa etkisi* [The effect of differentiated math curriculum for gifted and talented students on achievement, attitude and creativity]. Unpublished doctoral dissertation, University of Istanbul, İstanbul, Turkey .

Pintrich, P. R. (2000). An achievement goal theory perspective on issues in motivation terminology, theory, and research. *Contemporary Educational Psychology, 25*(1), 92-104.

Reis, S. M., & Renzulli, J. S. (2009). Creativity productivity. In B. Kerr (Ed.), *Encyclopedia of giftedness, creativity and talent* (Vol. 1, pp. 194-197). London: SAGE Publications.

Rhodes, M. (1961). An Analysis of Creativity. *The Phi Delta Kappan, 42*(7), 305-310.

Rose, L. H., & Lin, H. T. (1984). A meta-analysis of long-term creativity training programs. *The Journal of Creative Behavior*, *18*(1), 11-22.

Runco, M. A. (2007). *Creativity: Theories and themes: Research, development and practice.* San Diego, California: Elsevier Academic Press.

Sak, U. (2014). *Yaratıcılık gelişimi ve geliştirilmesi* [Development and enhancement of creativity]. Ankara: Vize Yayıncılık.

Sak, U., & Oz, O. (2010). The effectiveness of the creative reversal act (CREACT) on students' creative thinking. *Thinking Skills and Creativity, 5*(1), 33-39.

Schunk, D. H. (1990). Goal setting and self-efficacy during self-regulated learning. *Educational Psychologist, 25*(1), 71-86.

Schunk, D. H. (1996). Goal and self-evaluative influences during children's cognitive skill learning. *American Educational Research Journal, 33*(2), 359-382.

Sierens, E., Vansteenkiste, M., Goossens, L., Soenens, B., & Dochy, F. (2009). The synergistic relationship of perceived autonomy support and structure in the prediction of self-regulated learning. *British Journal of Educational Psychology, 79*(1), 57-68.

Smith, J. K., & Smith, L. F. (2010). Educational creativity. In J. C. Kaufman, & R. J. Sternberg (Eds.), *The cambridge handbook of creativity* (pp. 250-264). Cambridge University Press: New York.

Sontag, C., & Stoeger, H. (2015). Can highly intelligent and high-achieving students benefit from training in self-regulated learning in a regular classroom context? *Learning and Individual Differences, 41,* 43-53.

Sternberg, R. J. (1997). A triarchic view of giftedness: Theory and practice. In N. Colangelo & G. A. Davis (Eds.), *Handbook of gifted education* (2nd ed., pp. 43–53). Boston: Allyn and Bacon.

Sternberg, R. J., & Lubart, T. I. (2000). The concept of creativity: Prospects and paradigms. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 93–115). New York: Cambridge University Press.

Sternberg, R. J., O'Hara, L. A., & Lubart, T. (1997). Creativity as investment. *California Management Review, 40*(1), 8 – 21.

Sternberg, R. J., & Williams, W. M. (1996). *How to develop student creativity.* Alexandria, VA: Association of Supervision and Curriculum.

Stoeger, H. (2013). Learning as a creative process. In A. Tan (Ed.), *Creativity, talent and excellence* (pp. 3-13). Singapore: Springer.

Stoeger, H., & Ziegler, A. (2005). Evaluation of an elementary classroom self-regulated learning program for gifted math underachievers. *International Education Journal, 6*, 261-271.

Torrance, E. (1972). Can we teach children to think creatively?. *The Journal of Creative Behavior*, *6*(2), 114-143.

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

Weinstein, C. E. (1978). Elaboration skills as a learning strategy. In H. G. O'Neil (Ed.), *Learning strategies*. New York: Academic Press.

Weinstein, C. E., Husman, J., & Dierking, D. (2000). Self-regulatiıon interventions with a focus on learning strategies. In M. Boekaerts, P. R. Printrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 816). Oxford, UK: Academic Press.

Weinstein, C. E., Ridley, D. S., Dahl, T., & Weber, E. S. (1989). Helping students develop strategies for effective learning. *Educational Leadership*, *46*(4), 17-19.

Winne, P. H., and Perry, N. E. (2000). Measuring self-regulated learning. In M. Boekaerts, M. Zeidner and P. Pintrich (Eds.), *Handbook of self-regulation* (pp. 531-566). Orlando, FL: Academic.

Ziegler, A. (2014, November, 6). An interview with Prof.Dr. Albert Ziegler about gifted education. *Journal for the Education of Gifted Young Scientists 2 (2),* 98-100.

Ziegler, A., Stoeger, H., & Vialle, W. (2013). *Learning how to learn through homework: A six week training program for children in the middle primary years with sample mathematics content*. Australia: Hawker Bronwlow Education.

Zimmerman, B. J. (1986). Becoming a self-regulated learner: Which are the key subprocesses? *Contemporary educational psychology, 11(4)*, 307-313.

Zimmerman, B. J. (2000). Attaining self-regulatin: A social cognitive perspective. In M. Boekaerts, M. Zeidner, & P. Pintrich (Eds.), *Handbook of self-regulation*. Oxford, UK: Academic Press.

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice, 41*(2), 64-70.

Zimmerman, B. J., Bonner, S., & Kovach, R. (1996). *Developing self-regulated learners: Beyond achievement and self-efficacy*. USA: American Psychological Association.