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## Developing Productive Thinking Skills in the field of Artistic Works using the SCAMPER Strategy for Twice Exceptional Students

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**Abstract.** This study investigates whether the SCAMPER technique is an appropriate tool to develop productive thinking skills related to artistic works among gifted students in general and students with Twice Exceptionality (2e) in particular. The current study aims to verify the effectiveness of the SCAMPER technique for the aforementioned purpose. The sample consisted of 35 2e students aged 8-12 from Al-Ahsa, Saudi Arabia. A quasi-experimental approach was used, and the study sample was divided into three experimental groups. The first experimental group included nine gifted students with autism spectrum disorder (ASD); the second group consisted of 15 gifted students with learning disabilities (LD); and the third group included 11 gifted students with attention deficit and hyperactivity disorder (ADHD). The researchers developed a measure of productive thinking skills related to artistic works (PTSRAW) and a training program based on the SCAMPER technique. The statistical methods that have been used were the Wilcoxon and the Kruskal-Wallis tests. The findings of the study consisted of differences between the mean ranks of the three study groups on the post-test of the PTSRAW test in favor of gifted students with LD, followed by gifted students with ADHD, followed by gifted students with ASD. The authors suggest more studies to enhance understanding of the benefits of this method and its use in various disciplines of education and arts.

**Keywords:** SCAMPER technique; productive thinking; twice exceptional; artistic works; art education

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## 1. Introduction

The 20th century information revolution has heightened the need for students to develop adaptive thinking skills. Art education involves experimentation with different materials, media and resources, and requires specific instructional techniques to shape thinking skills. The Saudi Ministry of Education's education policy document has highlighted the importance of providing students with the knowledge, skills, and constructive behaviors to prepare the students to be part of the economic and cultural progress and prosperity of society (Al-Wadey & Al-Ajmi, 2022).

To teach students the skills required to develop new ideas, new teaching strategies need to be researched, such as experimentation with materials, and mind mapping (Purtee, 2015). Among these strategies is the SCAMPER model, developed for artistic expression and composition using raw materials. It is celebrated as an educational tool that enhances awareness, leadership, fluency, flexibility, and originality. The word "SCAMPER" is an acronym where each letter represents a different way to change the properties of a structure or system, physically or metaphorically, to form new relationships. The SCAMPER model comprises the following elements, namely substitute, combine, adapt, modify or magnify, eliminate or minify, put to another use, and reverse or rearrange (Serrat, 2017). Using this model, learners can generate new ideas through playing with, and synthesizing materials. This activity develops productive thinking, also noted in the problem-solving model proposed by Guilford (1964). This model consists of a succession of processes interacting with items stored in the memory with the aim of enhancing cognitive faculties (Barakat, 2022).

Several studies have shown how the SCAMPER technique can be used to develop the higher mental faculties of the artistically gifted and to prepare programs that satisfy their needs (Mahmoud, 2017). In his 2022 study, Abbas suggested establishing educational institutes for handicrafts training and called for a study on the role of artistic works in improving the imaginative abilities of middle school students. Cohen (2012) proposed a study linking creative adaptation in childhood with the type of creativity observed in adults. The global education index confirms that education must facilitate the development of crucial skills such as critical thinking and problem-solving using talented teachers to guide students to acquire the crucial skills they will need in the future (Walton, 2017).

Thinking is an approach to learning and problem-solving where thinking represents a set of applicable abilities that are implemented in teaching in structured frameworks that refine ideas, which help in improving the learning processes and the advancement of students. Productive thinking is also a scientific method that combines creative thinking skills with critical thinking to solve problems. Combining creative thinking with critical thinking can be employed to maximize achievement and reach practical results (Hurson, 2008).

The term "twice exceptional (2e)" refers to people who are bright or skilled in one or more categories yet have a handicap, disorder, or difficulties in others. Because giftedness and handicap are addressed simultaneously, this scenario has made

the definition and acceptance of the term problematic (Şentürk et al., 2022). Students who are 2e are extraordinarily skilled in one or more areas such as academic ability, creativity, leadership, and visual arts, coupled with problems in other areas such as reading, writing, and arithmetic (Yenioğlu et al., 2022).

Klingner (2022) suggests that the biggest obstacles confronting 2e students are misunderstanding and misdiagnosis. They are frequently reprimanded, underchallenged, and left behind, which underlines the need to better understand them. Students may be eligible for special education services as a result of their handicap under the 2004 federal Individuals with Disabilities Education Improvement Act (IDEIA). Once students qualify for IDEIA services, they are entitled to free and appropriate public education (Bell, 2020).

Although 2e students are gradually receiving more recognition and intervention, they are still a grossly underserved segment of the school population, and educators still lack effective methods for identifying and supporting them (Kircher-Morris, 2021).

*"A Call to Action: Identification and Intervention for 2e Students" begins with basic information about 2e students who are both gifted and talented and who also have LD and provides strategies for how educators can identify these students. It is imperative that classroom teachers provide intervention to address this exception since these students often score at grade level on standardized tests, with the giftedness score lowered by the learning disability and raised by the giftedness, resulting in neither this exception nor the other being addressed because they do not qualify for either of the special services (Sosland, 2022).*

This study applies the SCAMPER technique to the field of art to develop technical excellence and creative and critical thinking skills among students with 2e. Using the SCAMPER technique can enhance critical thinking in 2e students, enabling them to analyze and evaluate various artistic ideas and concepts and apply them to their art. This also promotes comprehensive learning by developing higher-order thinking skills (analysis, synthesis, evaluation, and application) for artistic work. This study contributes to developing 2e students' creative and critical thinking skills in the field of arts and supporting ongoing academic achievement.

Productive thinking skills are considered one of the basic aspects of developing creativity and innovation in the field of the arts. The problem of the study emerged through the workshops conducted by the researchers of the current study which aimed to conduct a group of practical applications in the field of raw material synthesis to produce some artistic works for 2e students. The researchers noticed the need for these students to improve their artistic production skills in the field of raw material synthesis. They found in their art work a stereotype in the design and production of the artistic product, in line with the recognized standards in the field of artistic production. Therefore, 2e students face difficulty developing these skills due to the unique challenges they face, which is what Feldhusen emphasized in 1997. He suggested four areas that must be nurtured among gifted students, including the field of artistic creativity and the field of the

arts, because these students have latent abilities that need to be developed in proportion to their strengths.

In this study, the SCAMPER technique was selected as a suitable technique for developing creative and productive thinking. The technique motivates students to generate new ideas and develop them through the use of six different techniques: substitution, adaptation, modification, composition, challenge, and synthesis. However, there are not many studies that focus on using the SCAMPER technique to develop 2e students' productive thinking skills in artwork. Therefore, this study aims to answer the following four questions:

- Q1. Are there statistically significant differences between the mean ranks of gifted students with ASD in the pre- and post-tests on the PTSRAW?
- Q2. Are there statistically significant differences between the mean ranks of gifted students with LD in the pre- and post-tests on the PTSRAW?
- Q3. Are there statistically significant differences between the mean ranks of gifted students with ADHD in the pre- and post-tests on the PTSRAW?
- Q4. Are there statistically significant differences between the mean ranks of the three study groups in the post-test on the PTSRAW?

## **2. Literature Review**

### **2.1. SCAMPER and Thinking**

First introduced by López-Mesaa (2011), the SCAMPER technique uses a series of questions directed to learners to encourage the processes of productive thinking and creativity. It is also an educational tool that promotes awareness, leadership, fluency, flexibility, and originality (Serrat, 2017). It can be used as a simple problem-solving technique, a brainstorming tool, or as a stand-alone technique to help generate new and unfamiliar ideas (Loop, 2021). SCAMPER uses questions as subframes in addition to various stimuli to promote divergent thinking by answering the questions that the student raises and the variables that SCAMPER symbolizes (Ozyaprak, 2016; Serrat, 2017). Each letter of SCAMPER refers to a specific thought process, where (S) indicates alternatively, the formation of ideas, (C) denoting fusion which refers to the combination of different ideas or materials and multiple techniques, and (A) for adaptation which depends on the response of the trainee in modifying a living organism or its parts, making it more suitable for existence under the conditions of the environment. Creative adaptation is the ability to adapt flexibly to circumstances by introducing (M) modifications or improvements to develop new ideas or products (Cohen, 2012). It is also possible to “minify” reduce, change shape, or modify attributes. There is also (P), put to other uses; (E), delete or simplify an element; and (R), rearrange (Sabri & Al-Ruwaithi, 2013). Therefore, it can be said that SCAMPER questions are consistent with Bloom's taxonomy of cognitive critical thinking skills, as identified by Anderson and Krathwohl (2011) in terms of Remembering, Analysis, Evaluation, and Composition.

### **2.2. Productive Thinking**

The concept of productive thinking was first proposed in the early 1930s by German psychologist Otto Selz and was expanded by Canadian author Tim Hurson, who proposed a structured approach to problem-solving or idea generation that combines knowledge with creative and critical thinking

(AlleyDog, 2023). Hurson (2008) defined productive thinking as a pattern of thinking that combines critical thinking skills and creative thinking and employs them together to produce new ideas in which sensory perception interacts with experience. Herein lies its importance in the educational process because it combines more than one type of thinking. This helps in better understanding the cognitive content and linking its elements to each other (Razzouqi et al., 2016). In research conducted in 1967, Taylor recognized productive thinking as one of nine capabilities considered essential (Al-Jughaiman, 2023). It is also a psychological process of learning how to absorb problems and determine the method of solution. Through feeling the need to achieve a goal, work can be done to reach the desired situation (Auernhammer & Roth, 2022).

### 2.2.1. *Creative thinking*

Creativity is valuable in education because it relies on deep knowledge and the ability to use it effectively to achieve valuable results. It is often developed as a competency and skill within educational frameworks. Moreover, education moves from acquiring knowledge to developing competencies (Patston, 2021). Some definitions of creativity have been formulated as any act, idea, or product that changes or transforms an existing field into a new field (Franken, 2023). Hurson (2008) confirmed that creativity is an indispensable element in solving problems. He devised a model of productive thinking that consists of stages. Questions are asked at each to emphasize the various aspects of the problem in order to reach a better understanding of the solution (Kumar, 2021). The model is represented by six steps in the form of questions: "What's going on?" "What is success?" and "What is the question?" Generate the answers, create the solution, and align the resources (Stormz, 2023). The Torrance Scale of Creative Thinking includes three main skills: fluency, flexibility, and originality (Al-Atoum et al., 2009).

Flexibility is one of the cognitive processes that shapes creativity and enhances productive thinking in which the individual is quick to adapt and respond to change without affecting the original goal and is able to move freely from one process to another with the freedom to choose different vehicles or media. Fluency is a flow of expression in producing a number of ideas (Caldwell & Dake, 2009). The field of arts is a fertile land for developing thinking skills. True fluency lies in the quality of creative expression and the ability to build intricate connections and meanings (Matney, 2014). Originality is one of the skills most associated with creativity and refers to the ability to produce the largest number of unique responses (Al-Mashrafi, 2005). Ozyaprak (2016) indicates that creativity can be developed by focusing on general creativity theories such as lateral thinking, creative problem-solving, and productive thinking, as well as some strategies and creative thinking techniques such as brainstorming.

### 2.2.2. *Critical thinking*

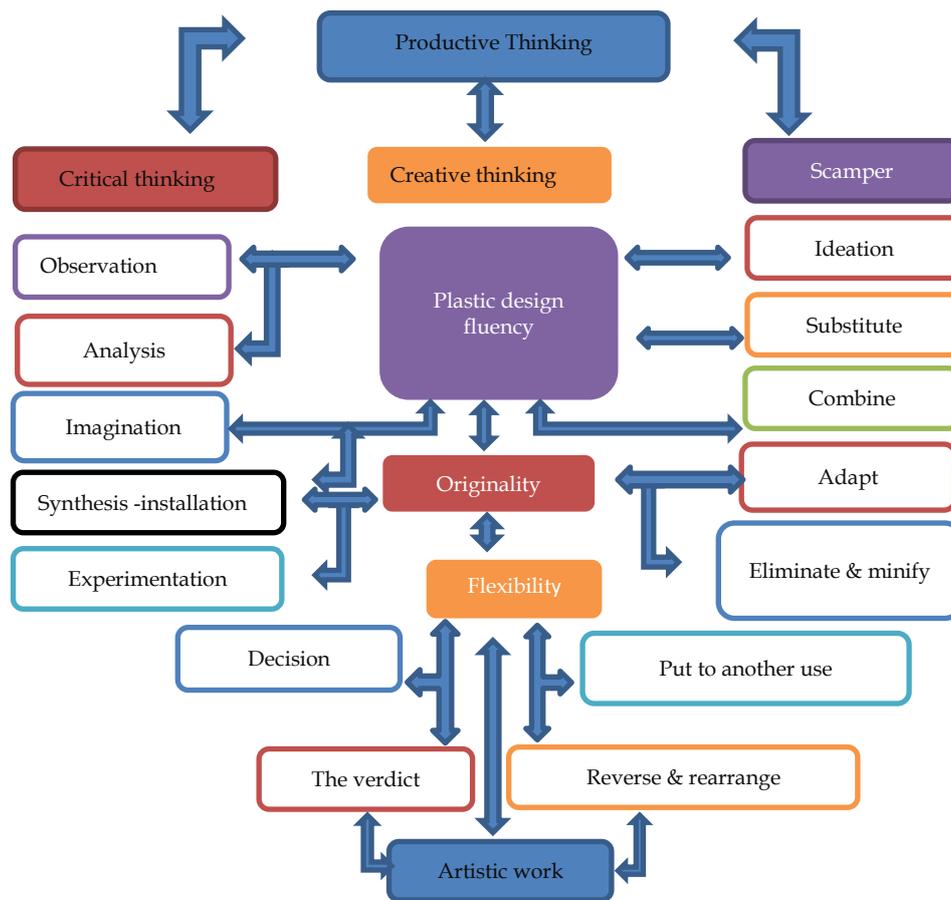
Critical thinking is accurate thinking directed toward a goal, and its components have been adopted as educational goals on the basis of respecting the autonomy of students (Hitchcock, 2022). Mixing creativity and critical thinking is necessary for productive thinking in the field of artistic works because of its ability to

facilitate reaching high-quality creative solutions based on the synthesis of raw materials. According to the Critical Thinking Subcommittee for AoL Learning Goal looking at Bloom's classification of critical thinking in 1956, students apply previous knowledge and skills creatively or differently to produce something new. The value of materials is based on personal values and opinions, which ultimately leads to a new product (Anderson & Krathwohl, 2001; Hirakubo, 2022). Therefore, it is a disciplined process of conceptualization that works by applying mental actions such as analysis, synthesis observation, experience, thinking, and inference (Foundation for Critical Thinking [FCT], 2023). Hitchcock (2022) identified other critical thinking processes, such as experimentation, counseling, judgment, and decision-making. It is logical thinking that works to restore its process, or evaluative thinking that works to restore its goal (Rusbult, 2021). When students engage in synthesis in the field of artistic works, they practice logical thinking, decision-making, and problem-solving as well as divergent thinking and convergent thinking, which makes them develop their thinking, as pointed out by Razzouqi et al. (2016) This reshapes ideas in different formulations through free thought, allowing the student internal insight to accommodate unfamiliar situations. According to Sun et al. (2020), implementing a training program on divergent thinking improves school students' scientific creativity.

Through the above, it can be concluded that critical thinking depends on the three principles of autonomy, self-awareness, and learning.

### *2.2.3. Productive thinking skills*

Productive thinking skills can be defined as fluency, flexibility, originality, problem analysis, expansion or detail, imagination, and production (Ali & Ibrahim, 2018; Al-Quraiti, 2019; Mustafa, 2013).



**Figure 1: The SCAMPER model and productive thinking in the field of handicrafts**

#### 2.2.4 Handicrafts

Handicrafts have their own nature, as part of the process of artistic creativity and its various components. They require a type of cognitive representation with the ability to find non-stereotypical plastic and aesthetic solutions through manipulating raw materials. Handicrafts are considered one of the artistic formation systems that are the focus of expression and the basic foundation for producing artistic work. It is a field that actively involves the student, building their knowledge and experience through solving real problems in their interaction with the material through research and experimentation (Ali et al., 2022). It is one of the axes of creativity based on diverse experiences of forming multiple materials and the organization of units in the process of creating the artwork (Al-Essa, 2021). The student reshapes, reassembles, adds, or deletes from the materials, using various experiences, information, and skills to adapt these materials to their needs. These are the requirements of a creative attitude (Dewey, 2008).

In creative expression, synthesis endeavors to achieve compatibility and harmony among different raw elements, where the combined ingredients improve the artwork (Al-Deeb, 2020). As a result, synthesis necessitates a thorough grasp of the foundations of artistic creation as well as the capacity to manipulate and modify the material. The learner reformulates these technical and creative

experiences through experimental practices that employ new methodologies based on the situation (Ali et al., 2022). Synthesis is classified into three types: gluing, mounting, and assembling (Al-Shammari, 2019).

*Techniques in art production:* These are the methods, industrial assets, skills, and processes required to change raw materials into an artwork. Technique is also considered the fourth element of the four elements of artistic production (raw materials, subject, and expression). It is the gateway to practical applications in various fields related to intellectual construction (Ali, 2022). Technique also includes synthesis. There are frequent preferences for the raw materials utilized and the suitable technique in the field of synthesis using raw materials. The student chooses the best way to express themselves (Shahat et al., 2023).

*Experimentation:* Artistic vision is considered the source of experimentation and one of the cognitive processes that connects the activities of thinking, perception, and feeling. It is a process that combines logical and divergent thinking as the experience in art is different from scientific experimentation in the vocabulary of the creative process and the nature of the product (Barakat, 2021). It also combines methods to achieve compatibility and harmony among different materials in the structure of artistic creativity (Shahat et al., 2023). It is a scientific procedure that depends on proving a cognitive fact. Experimentation also helps expand the student's perspective as a creator because as they freely experiment, they are freed from seriousness and the demand for perfection (Hayes, 2022).

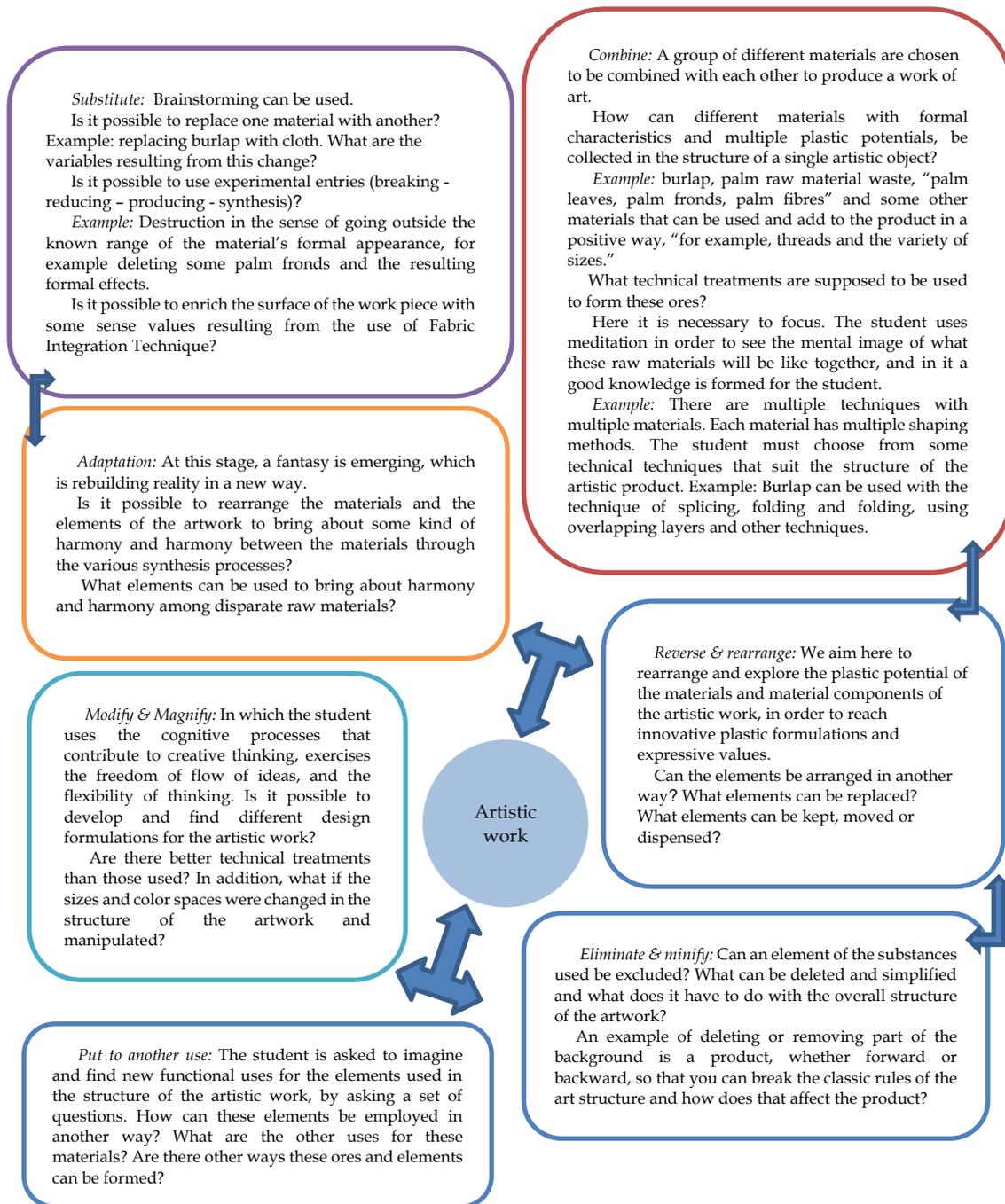


Figure 2: Applying the SCAMPER technique in the field of handicrafts

### 2.3. Twice Exceptional

The term "twice exceptional" was first coined by Gallagher in 2004 to describe uniquely gifted students who have a talent and at the same time have a disability. Other terms have been used, such as "dual exceptionality," "gifted with disabilities/difficulties," "paradoxical learners," and "gifted handicapped." Some descriptions specify the disability-gifted with "LD," "autistic savant," and the like

(Al-Jughaiman, 2022; Şentürk et al., 2022). Students with autism spectrum disorder (ASD) who are gifted are commonly referred to as 2e students (Cain et al., 2019). There is significant disagreement in the literature on the prevalence of 2e (Ronksley-Pavia, 2020). Gierczyk and Hornby (2021) established that 2e students might be taught well in inclusive education settings if they have access to suitable special education and gifted education methodologies and programs. Therefore, because governments anticipate numbers when formulating education policy and providing budgetary support, it is critical to quantify the number of 2e students as accurately as possible.

Foley-Nicpon and Teriba (2022) point out that regulations for 2e students exist in just a few states across the USA and suggest 2e policies be revised to include best practices to identify 2e students, such as interventions using universal screening methods linked to curriculum, and developing gifted individualized education plans in conjunction with IEPs. These ideas detail not only how to provide services for one's condition but also how to cultivate potential in 2e students.

Amran and Majid (2019) reviewed 44 studies on 2e therapies conducted between 2000 and 2018, independent of disability area. The findings are organized into five major topics, beginning with the most commonly utilized in research, academic or learning methods, and continuing with support, strength or talent-based, technology or music, and art. Grigorenko (2020) showed that there is a growing interest in the phenomenon of 2e students in the performing arts. In a research study conducted in 1997, Feldhusen presented a model for identifying and developing talents, which he called "talent identification and development in education," where he regards talent as a general ability based on genetic predisposition with added life experiences represented by home and school. He proposed four areas that must be nurtured by the school providing appropriate care for students with talent, namely (a) the field of artistic creativity: movement, music, drawing, sculpture, and photography; (b) the field of academic excellence: science, mathematics, language, social studies, and computers; (c) the field of social relations: leadership, social welfare, commerce, and human services; and (d) the field of art: home economics, trade and industry, industrial arts, agriculture, and business administration. In 2005, Feldhusen also believed that abilities in general are often latent and are preparations of other various abilities, and the school's primary mission is to stimulate and develop these preparations in accordance with students' strengths (Al-Jughaiman, 2022).

Al-Haj Issa (2007) believed that research into the gifted with LD can be categorized in three axes: case studies, comparative studies between the experimental performance of the gifted with LD and their number, and studies that dealt with the effectiveness of the available educational programs. Some of these studies examined the compensatory strategies and self-regulatory strategies that these students use to succeed in school. Al-Suwait (2014) highlighted the effectiveness of a training program based on the Schwartz model for developing critical thinking skills among gifted students with LD in the Kingdom of Saudi Arabia. The results showed that the training program had an impact on the development of critical thinking skills for gifted students with LD.

Mahmoud (2019) investigated the effectiveness of a program based on the Six Thinking Hats to develop leadership behavior in gifted students with LD. Gerges et al. (2020) looked at differences in executive function (working memory, planning, problem-solving, and verbal fluency) between gifted children with ADHD and their non-gifted counterparts. The results revealed that there were no statistically significant differences.

Salem et al. (2021) built an integrative model of emotional creativity among gifted students with LD. They identified negative emotional characteristics that can be modified: low self-concept, low self-esteem, perfectionism, a sense of inferiority, and the consequent turbulent emotional behaviors, with the aim of integrating the prescriptive theories. The different levels of emotional creativity and its sub-skills and the results indicated the arrival of a proposed integrative model for the development of emotional creativity through a number of procedural steps aimed at developing emotional creativity among gifted students with LD.

Gaber (2022) showed that attitudes toward creativity may play a critical role in the development of creative talents in children with ASD, highlighting the need to investigate attitudes toward creativity. The study assessed the efficacy of a training program to develop attitudes about creativity, encouraging the production of a diverse range of ideas about talent, marked by freshness and originality. These ideas should be practical and beneficial, as well as well received in the community in which these gifted children live. Gaber suggests that the required resources and finances be made available to help gifted youngsters with ASD realize their gifts, and research on giftedness and ASD should be increased. Qomawy and Melhem (2022) assessed the positive impact and potential of a training program on developing awareness of the gifted with ASD in families, and enhancing their attitudes toward caring for them. The program is part of a series about awareness and care for gifted students with ASD.

### **3. Methodology**

#### **3.1. Study design and participants**

Given that the study is an experiment aimed at verifying the effectiveness of the SCAMPER strategy to develop productive thinking skills in the field of artistic works among 2e students, the researchers used a quasi-experimental approach. The study measures the effect of the independent variable on the dependent variable. The independent variable is the training program, which is based on the SCAMPER strategy. On the other hand, the dependent variable is establishing productive thinking skills in the field of artistic works in the three study groups.

The study population consisted of all 2e students in Al-Ahsa in the Kingdom of Saudi Arabia (214 males and 57 females), diagnosed as gifted, and having ASD, LD, or ADHD. The study sample consisted of 35 males, aged 8–12 years, with 2e students gifted in artistic vision but lacking productive thinking skills. They were chosen intentionally and divided into three groups randomly. The three groups were equivalent of each other in terms of the degree of disorder and age as follows: (gifted students with ASD = 9 students, mean = 9.87, standard deviation±1.51), (gifted students with LD = 15 students, mean = 10, standard deviation±1.46), and (gifted students with ADHD = 11 students, mean = 9.93,

standard deviation $\pm$ 1.33). A one-sample experimental design (pre-post) was chosen to verify the effect of the SCAMPER technique on developing productive thinking skills in the field of artistic works in the three groups. This experiment was implemented in the third semester of the 2022-2023 academic year after obtaining scientific research ethics approval from the Deanship of Scientific Research at King Faisal University.

### **3.2. Productive Thinking Scale**

This scale measures a productive thinking skills in 2e students. The scale in its final form consists of 12 statements measured on a Likert type scale: Applies = 3, Applies to some extent = 2, and Does not apply = 1. Thus the maximum score on the scale is 36, the average is 24, and the lowest score is 12. A score higher than average indicates that the student possesses good productive thinking skills, while a lower score indicates a deficit in productive thinking.

To verify the validity of the scale, the internal consistency of the scale was used where the correlation coefficients ranged from 0.521 to 0.776. The stability of the scale was also verified using the Trumpet Alpha coefficient until the reliability coefficient in this way reached 0.702.

### **3.3. Training Program**

A training program was created to develop the productive thinking skills of students with 2e in the field of artistic works and provide them with the skills of synthesis and experimentation with materials.

The goal of the program was to provide exceptional students with raw materials and allow them to choose appropriate technical treatments. They were encouraged to adapt ideas aligned with the nature of the product and employ various experimental approaches as required by the product. This enabled students to benefit from previous experience and generate ideas to solve problems which enhanced their proficiency. The program is based on the SCAMPER model, which consists of seven steps. Each step has a set of questions that help 2e students develop productive thinking skills in the field of artistic works, recall relevant knowledge, and gain the ability to reorganize the elements of an artistic work.

The validity of the program was confirmed by presenting it to a group of arbitrators in the field of artistic works, and the proposals and recommendations of the arbitrators were taken into account. The program was implemented in six stages, with each stage consisting of a group of sessions. Each session had its own objectives and appropriate teaching strategies. Table 1 shows the stages and strategies for implementing the training program to develop productive thinking skills among 2e students.

**Table 1: Stages of training program implementation**

<b>Training program stages</b>	<b>Training program objectives</b>
Introduction stages 1,2	<ul style="list-style-type: none"> <li>- Introduce the SCAMPER model steps and their importance in developing productive thinking skills in the field of handicrafts.</li> <li>- Define the SCAMPER technique and its purpose.</li> <li>- Explain the basic concepts of productive thinking, creative thinking (fluency, flexibility, originality) and critical thinking.</li> <li>- Highlight the concept of "Handicrafts," as the synthesis of experimenting with raw materials to produce artifacts.</li> </ul>
Stages 3-6	<ul style="list-style-type: none"> <li>- Follow procedural steps to create the artistic product through the application of the SCAMPER technique and motivational questions to stimulate students' to cultivate a wide range of ideas, using brainstorming and mental processes such as observation, analysis, and imagination.</li> </ul>
Stages 7-10	<ul style="list-style-type: none"> <li>- Follow experimental practices based on problem-solving and formative assessment for synthesizing raw materials to produce novel artifacts through the application of strategies such as constructive learning.</li> <li>- Synthesize raw materials, collect ideas, adapt, experiment, make decisions, make some modifications, put them to other uses, rearrange the elements of the artistic work. The verdict.</li> </ul>
Stages 11-12 Evaluation	<ul style="list-style-type: none"> <li>- The finishing stage and an overview of the finished work.</li> </ul>

### 3.4. Data analysis

The researchers conducted statistical analysis using SPSS version 26. The Wilcoxon test was used to indicate the difference between the paired samples in the pre- and post-tests. An analysis of variance was also conducted using the Kruskal-Wallis test to indicate the differences between the means ranks for the three experimental groups in the post-tests.

## 4. Results

### 4.1. Results related to RQ 1:

RQ 1 was "Are there statistically significant differences between the mean ranks of gifted students with ASD in the pre- and post-tests on the PTSRAW?" To answer this question, the Wilcoxon test was used to detect the significance of the difference between the mean ranks of two related samples on the PTSRAW before and after applying the training program, as shown in Table 1.

**Table 1: Results of the Wilcoxon test showing the difference between the pre- and post-tests on the PTSRAW**

<b>Gifted Students With ASD Pre-and Post-tests</b>	<b>N</b>	<b>Mean Rank</b>	<b>Sum of Ranks</b>	<b>Z</b>	<b>P</b>
Negative Ranks	0	0	0	-2.754	0.006
Positive Ranks	9	5.00	45		
Ties	0				

Table 1 shows that there is a statistically significant difference between the mean ranks of gifted students with ASD in the pre- and post-tests on the PTSRAW. By referring to the mean ranks in the two tests, it is clear that this difference is in favor of the post-test, which highlights the effectiveness of the training program in developing productive thinking skills related to artistic works for gifted students with ASD.

#### 4.2. Results related to RQ2

RQ2 was "Are there any differences between the mean ranks of gifted students with LD in the pre- and post-tests on the PTSRAW?" The results are shown in Table 2.

**Table 2: Results of the Wilcoxon test showing the difference between the pre- and post-tests on the PTSRAW**

Gifted Students With LD Pre-and Post-tests	N	Mean Rank	Sum of Ranks	Z	P
Negative Ranks	0	0	0	-3.420	0.001
Positive Ranks	15	8.00	120		
Ties	0				

Table 2 shows that there is a statistically significant difference between the mean ranks of gifted students with LD in the pre- and post-tests on the PTSRAW in favor of the post-test.

#### 4.3. Results related to RQ3

RQ3 was "Are there any differences between the ranks of the mean of gifted students with ADHD in the pre- and post-tests on the PTSRAW?" The results are shown in Table 3.

**Table 3: Wilcoxon test results showing the difference between the pre- and post-tests on the PTSRAW**

Gifted Students With ADHD (Pre and Post) Tests	N	Mean Rank	Sum of Ranks	Z	P
Negative Ranks	0	0	0	-3.017	0.003
Positive Ranks	11	6.00	66		
Ties	0				

Table 3 shows that there is a statistically significant difference between the mean ranks of gifted students with ADHD in the pre- and post-tests on the PTSRAW in favor of the post-measurement. By referring to the mean ranks in the two tests, it is clear that this difference is in favor of the better measure, which is the post-test, which points to the effectiveness of the training program in developing productive thinking skills related to artistic works among gifted students with ADHD.

#### 4.4. Results related to RQ4

RQ 4 was "Are there any differences between the mean ranks of the three study groups in the post-test on the PTSRAW?" To answer this question, the Kruskal-Wallis test was used, and the results are presented in Table 4.

**Table 4: Results of the Kruskal-Wallis test to indicate the differences among the mean ranks of the three study groups in the post-test on the PTSRAW**

Scale	Groups	N	Mean rank	df	$\chi^2$	P
PTSRAW	Gifted students with ASD	9	9.17	2	17.695	<0.001
	Gifted students with LD	15	26			
	Gifted students with ADHD	11	14.32			

Table 4 shows that there are statistically significant differences between the mean ranks of the three study groups in the post-test on the PTSRAW. To verify which of these three groups caused these differences, the Mann-Whitney test was conducted between groups (1) and (2), between (1) and (3), and between (2) and (3). The results are presented in Table 5.

**Table 5: Results of the differences among the mean ranks of the three study groups**

The difference between the mean ranks of the groups	Gifted students with LD (26)		Gifted students with ADHD (14.32)	
	Z	p	Z	p
Gifted students with ASD (9.17)	-3.593	<0.001	-1.542	0.123
Gifted students with LD (26)			Z	p
			-3.2	0.001

Table 5 shows that there are statistically significant differences between groups (1) and (3), and groups (2) and (3), but no differences between groups (1) and (2).

## 5. Discussion

The results indicate that the SCAMPER technique promotes productive thinking and enhances creative and critical thinking in 2e students (students with LD, ADHD, and ASD). It teaches them divergent thinking and creative problem-solving. Moreover, it strengthens design flexibility and fluency in technical treatments related to the synthesis of materials in the field of handicrafts.

The students with LD outperformed the students with ADHD and ASD in improving productive, critical and creative thinking in artistic works. The results are consistent with the Özyaprak (2016) study, which found that the SCAMPER technique supports cognitive skills in terms of gathering information, flexible thinking, originality, and problem-solving. It also confirms the findings of Mahmoud (2017) on the necessity to develop gifted students' higher mental skills. The 2e students were encouraged to practice productive thinking in the field of artistic works using understanding, interpretation, analysis, and synthesis.

Decision-making regarding the material, synthesis processes, and experimental approaches requires logical reasoning skills to deal with the varied characteristics of the materials. This requires fluency of thought and flexibility to arrive at novel solutions for plastic treatments of the material. Ali and Ibrahim (2018) showed that the SCAMPER technique can develop productive thinking skills in educational media. The SCAMPER technique allowed the participants to think consciously about material combinations using experimental approaches, developing imagination and planning, and translating ideas into tangible products.

Therefore, using the SCAMPER technique is useful and important (Hamza 2017; Naji 2017) It develops students' creative imagination, and teaches them the skills of generating ideas, improving productive thinking skills, and developing curiosity and risk-taking. Moreover, the self-concept is enhanced when divergent thinking improves the ability to benefit from previous experiences in novel situations by utilizing creative approaches.

The results of the current study are also consistent with previous studies in that it is possible to improve 2e students' attitudes toward creativity, art, and other types of thinking (Al-Suwait, 2014; Grigorenko, 2020; Salem et al., 2021; Gaber, 2022; Qomawy & Melhem, 2022).

It is believed that the SCAMPER model is an organized thinking strategy process that enhances the ability of outstanding 2e students to use their imagination to create new designs by using materials to construct artworks through the processes of experimentation, deletion, addition, rearrangement, merging, consolidation, and synthesis. The researchers posit that the reason the LD students obtained higher grades than those from the other two groups was because they explored experimental processes and were able to acquire cognitive and technical skills related to shaping materials. There were some obstacles among students with ADHD, namely attention deficit, motivation, and hyperactivity, as well as ASD, which are characterized by deficiencies in communication skills, and by stereotypical behavior, and difficulty in breaking routine. The group of students with ADHD also outperformed the ASD group in productive thinking skills in the field of artistic works, which is possibly owing to the fact that students with ASD show fewer responses in artistic production processes and have lower productive critical, and creative skills, in addition to not having positive communication skills to convey their opinions on artistic production processes to their peers.

## **6. Limitations**

Despite the positive results of the study, the researchers faced a number of challenges. The study population in Al-Ahsa is small; therefore, the sample was chosen intentionally, which limits the generalizability of the study. Also, with respect to the size of the population, had it been larger, the standardization of the instrument would have been more accurate and thus more reliable and effective in assessing changes in productive thinking skills. Moreover, there was a lack of the optimal level of resources such as time, money, technical materials, and space for training and implementation. For instance, a reasonable period must be allocated to develop productive thinking skills in the field of artistic works,

especially in using the SCAMPER technique. Finally, individual differences, attitudes, and different learning styles are a number of possible confounding variables that could have affected the outcome measures of the study.

## 7. Conclusions and Recommendations

In conclusion, using the SCAMPER technique to develop productive thinking skills in the field of artistic works is an effective tool for 2e students. The study found that using this model helps students develop their creative abilities and critical and analytical thinking when producing unique and innovative works of art. The study also found that using the SCAMPER technique helps students develop their skills in planning, organizing, implementing, and evaluating, which contributes to enhancing their mental and creative abilities in the field of arts. One positive aspect of strengthening productive thinking skills for 2e students is that it promotes active and interactive learning and encourages students to collaborate, think creatively, and innovate in producing unique works of art. In conclusion, it can be said that using the SCAMPER technique is a powerful tool for developing productive thinking skills in the field of artwork for 2e students.

Further research is recommended to broaden understanding of the benefits of this strategy and its application in other fields of education and the arts. It is suggested that a study be conducted using the SCAMPER technique for developing the creative thinking skills of 2e students in artwork. In addition, the use of the SCAMPER technique to develop creative and analytical thinking skills among 2e students in digital arts and graphic design is recommended. More studies are also recommended to improve the understanding of the benefits of the SCAMPER strategy and its use in various fields of education and the arts, such as gifted education, special education, and art education.

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