

ANALYZING THE EFFECTS OF IMPLEMENTING DIVERGENT CREATIVE
THINKING ON THE INQUIRY-BASED LEARNING OF ELEMENTARY
STUDENTS

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Dedicated to my research assistants: Prince Harry, Queen Cleopatra, & Chairman Meow.



Analyzing the Effects of Implementing Divergent Creative Thinking on the Inquiry-
Based Learning of Elementary Students

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June 2025

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ABSTRACT

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Based Learning of Elementary Students

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This study examined the relationship between creative thinking skills and inquiry learners at the elementary level. The study was conducted using a mixed methods research design, collecting data from an Alternate Uses Test (AUT) as well as from participant reflection questions. The research study used a quasi-experimental approach and applied a creative thinking intervention in lessons with participants. This study utilized Guilford's model of creative thinking and focused on the elements of fluency, flexibility, originality, and elaboration. The context of the study was an international school in Türkiye implementing the International Baccalaureate Primary Years Program (IB PYP) curriculum. The results observed an effect of the creative thinking intervention on the divergent thinking abilities of fourth-grade students, as measured in this study. Each of the four elements as well as the overall scores showed improvement from the pretest to the posttest. The study also uncovered findings to suggest that the participants developed their understanding of creative thinking, extended their self-perceptions as creative thinkers, and identified possible areas to apply their learning. This research reveals the importance of explicitly teaching creative thinking skills in elementary school contexts, especially with inquiry-based curricula.

Keywords: creative thinking, creativity, divergent thinking, inquiry-based learning, PYP

ÖZET

İraksak Yaratıcı Düşüncenin İlköğretim Öğrencilerinin Araştırmaya Dayalı Öğrenmesi Üzerindeki Etkilerinin Uygulanması Ve İncelenmesi

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Bu çalışmada, ilköğretim düzeyinde yaratıcı düşünme becerileri ile sorgulamaya dayalı öğrenenler arasındaki ilişki incelenmiştir. Çalışma, Alternatif Kullanım Testi (AUT) ve katılımcılara yöneltilen yansıtma sorularından elde edilen verilerin toplandığı karma yöntemli bir araştırma deseni kullanılarak yürütülmüştür. Araştırmada yarı deneysel bir yaklaşım kullanılmış ve derslerde katılımcılara yaratıcı düşünme müdahalesi uygulanmıştır. Bu çalışmada Guilford'un yaratıcı düşünme modeli kullanılmış ve akıcılık, esneklik, özgünlük ve detaylandırma unsurlarına odaklanılmıştır. Bu çalışma, Türkiye'de Uluslararası Bakalorya İlk Yıllar Programı (IB PYP) müfredatını uygulayan uluslararası bir okulda gerçekleştirilmiştir. Bu çalışmanın sonuçlarına göre, yaratıcı düşünme müdahalesinin dördüncü sınıf öğrencilerinin iraksak düşünme becerileri üzerinde bir etkisi olduğu gözlemlenmiştir. Dört unsurun her birinde ve genel puanlarda ön testten son teste kadar olumlu ilerlemeler kaydedilmiştir. Çalışma kapsamında ayrıca, katılımcıların yaratıcı düşünme anlayışlarını geliştirdiklerini, yaratıcı düşünürler olarak kendilerini algılama biçimlerini derinleştirdiklerini ve öğrendiklerini uygulayabilecekleri olası alanları belirlediklerini ortaya koyan bulgular elde edilmiştir. Bu araştırma, yaratıcı düşünme becerilerinin ilkokul bağlamında, özellikle de sorgulamaya dayalı müfredatla doğrudan öğretilmesinin önemini ortaya koymaktadır.

Anahtar kelimeler: yaratıcı düşünme, yaratıcılık, iraksak düşünme, sorgulamaya dayalı öğrenme, PYP

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CHAPTER 1: INTRODUCTION

Introduction

In a narrative poem entitled *The Little Boy* by Helen E. Buckley, a young boy arrives eager to begin school. He is instructed to draw a picture. The boy is excited, and he thinks of many ideas of things he can draw. He is told the class will draw flowers. He thinks of the beautiful flowers he can draw, and he begins to draw flowers in colors of pink, orange, and blue. But when he begins to draw his ideas, the teacher stops him and he is instructed to draw a red flower with a green stem, just like the teacher's drawing. The pattern repeats. The boy learns to wait, watch, and copy. Soon he does not create his own ideas anymore. At a new school, the little boy is invited to draw a picture. The new teacher encourages him to make the picture any way he would like, using any colors. But in the end, he draws a red flower with a green stem (Buckley, 1961). This poem, available in full in Appendix A, illustrates the dangers of narrowing education to minimize original thought and failing to engage with learners' creativity and creative thinking skills.

Throughout history, creative thinkers have changed the world. Innovation and invention spring from imagination to address the pressing issues of every age. In an increasingly volatile world, young people face the pressing challenge of finding innovative solutions to emerging global issues. Creativity is essential for navigating these complex problems. For instance, the growing concern of climate change presents a number of serious problems. Educational systems have a role to play in advancing the creative thinking skills of learners to address issues such as these. However, many traditional educational systems and methods of instruction tend to

discourage creativity. Some educational systems are evolving to support creativity and build capacity for creative thinking skills. One educational system that explicitly encourages thinking skills is the International Baccalaureate (IB, Faria Education Group, 2023). The present study explores creative thinking in the IB, as well as challenges to measuring creativity.

This study focused on the relationship between creative divergent thinking and learners in an inquiry setting. Within an elementary school classroom setting, this study sought to better understand how elementary students develop creative thinking skills. Divergent thinking was used as the means to measure the potential for creative thinking skills. This study explored the background related to creativity, creative thinking, divergent thinking, and inquiry-based learning. Key information about this study will be shared, including the problem, purpose, and the two key research questions addressed by this study. The significance, broader context of this study, and key terms used throughout the study will also be explained and defined.

Background

Creativity is increasingly recognized as a priority within education that can be applied consistently across multiple contexts (Collard & Looney, 2014). Creativity is a varied set of skills that can be learned and explicitly taught. One way to develop creative thinking skills is through divergent thinking activities and experiences, which can be incorporated across the curriculum. Divergent thinking is a creative thought process where a single stimulus elicits multiple possible solutions (Acar & Runco, 2019).

Creative thinking has a role to play in inquiry-based learning. “The term ‘inquiry-based learning’ generally refers to student-centered ways of teaching in which students raise questions, explore situations, and develop their own ways

towards solutions.” (Maaß & Artigue, 2013, p. 780). Within this learning context, several elements of inquiry-based learning lend themselves to engaging with creative thinking.

The foundation of student-centered teaching and learning values the thoughts, experiences, and learning processes of individual students. Creative thinking also reflects this shared emphasis on student-centered learning. The art of developing questions helps learners to develop better creative thinking and problem-solving skills (Rothstein & Santana, 2014). For students to develop their own ways of building solutions, they must think creatively and consider multiple possibilities. This capacity can be developed through divergent thinking.

Although there is overlap between the ideas of creativity, creative thinking, and divergent thinking, these three ideas have distinct definitions and characteristics. For this study, creative thinking falls under the larger umbrella term of creativity. Creative thinking can be described as a “way of thinking that leads to the generation of valuable and original ideas” (OECD, 2024b, What is Creative Thinking section). Many researchers identify the key themes of originality and value when explaining creative thinking (Robinson, 2011; Runco & Jaeger, 2012). Within creative thinking, divergent thinking is recognizable as one of the key thought processes (Guilford, 1956).

Creative thinking skills are not fixed, static, or vague (Plucker et al., 2004). Instead, some studies indicate that explicit training can increase cognitive flexibility and creative thinking skills overall (Ritter et al., 2020). Divergent thinking is one method to increase cognitive flexibility. As explored in this study, explicitly teaching divergent thinking is a means for learners to develop greater creative thinking skills.

An understanding of divergent thinking was used in this study for two main purposes. The first purpose was to design the workshop used with the teachers contributing to this study. This workshop's main goal was to train them on correctly implementing the study, while also helping teachers to develop their understanding of divergent thinking. It was necessary to ensure a shared understanding of creative thinking and divergent thinking for the teachers involved (Mullet et al., 2016). An additional purpose was to inform and plan the design of this study. The principles of divergent thinking were used as the guidance for selecting an Alternate Uses Test (AUT) as the assessment instrument, as well as shaping the intervention lessons teaching these skills. The elements of divergent thinking were used to design the intervention lesson materials used with the student participants in this study. A nuanced understanding of divergent thinking was essential for designing this study.

The Value of Creative Thinking

Some educators have made the argument for putting creativity and thinking skills in a significant role in schools and educational systems (Richardson & Krstic, 2021). Other experts go further to argue for placing creative thinking skills as a driving force behind education (Robinson, 2011). Creative thinking is one of the essential 21st century skills, and more attention is required to ensure it is fostered in today's classrooms, including elementary school contexts. The identification and evolution of 21st century skills have helped to position the role of educational systems for developing learners equipped to face current and future challenges (Geisinger, 2016).

Several 21st century skills and models of their organization have been suggested as ways to meet the educational and workplace needs of the current age (Geisinger, 2016). Four key learning and innovation skills are included in one model

of 21st century skills from the *Partnership for 21st Century Learning: creativity, Critical Thinking, Communication, and Collaboration* (Guo & Woulfin, 2016).

Some research indicates a relationship between creative and critical thinking, and that both have a necessary role for innovation and problem solving (Wechsler et al., 2017). Creativity and innovation are recognized as being important for learners to be able to think creatively, work creatively with others, and create innovations. Critical thinking and problem solving are essential for reasoning effectively. Communication and collaboration are key skills for clear and positive interactions. Therefore, creativity is a fundamental aspect within the framework of developing 21st century skills.

As an essential 21st century skill that helps learners prepare for the challenges of a changing world, creative thinking skills can be applied to problem-solving. Creative thinking has the potential to solve and improve pressing global issues, such as those identified in the 17 Sustainable Development Goals (SDGs, United Nations, 2024). The SDGs, also known as the Global Goals, define shared benchmarks for the future to make the world more peaceful and prosperous. These goals are a call to action and acknowledge the need for stakeholders to take concrete steps and make investments to reach these goals.

There is a vital role for creative thinking in addressing these global challenges. For example, design thinking can be applied toward developing innovative solutions for sustainable development or in the context of educating for sustainability (Mayr & Vollmer, 2024; Sandri, 2013). Students can design creative solutions to help their schools reduce waste, use less electricity, or help others in their community. As the SDGs are typically used as a part of the PYP Exhibition, learners could use creative thinking skills throughout this learning process. For

example, learners could apply their creative thinking skills to help them plan and take action based on their selected Global Goal.

Creative Thinking in the International Baccalaureate

This study was conducted within the context of a school that follows the International Baccalaureate's Primary Years Program (IB PYP) curriculum framework, which spans from early years through grade five. Specifically, the research took place in a fourth-grade setting, across all classes in the grade. In this school, fourth-grade students engage in the PYP Exhibition, a capstone project marking the culmination of their PYP journey before transitioning to middle school. The PYP relies on an approach of inquiry-based teaching and learning. The IB is a curriculum framework used around the world, based on the ideas of inquiry teaching and learning (Short, 2009).

One of the overarching goals of the PYP is to develop the *Approaches to Learning* (ATL) skills (International Baccalaureate, 2018). The five key ATL skills identified by the IB are: thinking skills, communication skills, research skills, self-management skills, and social skills. Each skill is further delineated into specific subskills; thinking skills are broken down into critical-thinking skills, creative-thinking skills, transfer skills, and reflection or metacognitive skills (Faria Education Group, 2023). These skills are designed to be transdisciplinary and applied throughout the curriculum.

Along with critical thinking skills, the IB considers creative thinking skills to be key for all learners' development. The IB names the subskills of "generating novel ideas" and "considering new perspectives" under creative thinking skills (International Baccalaureate, 2018, p. 29). Under these two categories are listed ten

detailed examples of what students do, as seen in Table 1 below (International Baccalaureate, 2018, p. 33).

Table 1

IB PYP Approaches to Learning: Creative Thinking Skills: What Students Do

Creative thinking skills	
Sub-skills	What students do:
Generating novel ideas	Use discussions and diagrams to generate new ideas and inquiries. Practise “visible thinking” strategies and techniques. Make unexpected or unusual connections between objects and/or ideas. Design improvements to existing products, processes, media and technologies.
Considering new perspectives	Ask “what if” questions and generate testable hypotheses. Apply existing knowledge to design new products processes, media and technologies. Consider multiple alternatives, including those that might be unlikely or impossible. Practise flexible thinking—develop multiple opposing, contradictory and complementary arguments. Practise “visible thinking” strategies and techniques. Generate metaphors and analogies.

This table highlights the two sub-skills identified by the IB under creative thinking skills. The table then includes several examples of specific tasks students can do, related to each sub-skill. While the IB suggests these skills, they also encourage school communities to adjust or add skills, or to choose particular skills as a focus. Communicating their thought processes through visible thinking is mentioned in each section. Several of these items indicate complex or challenging tasks, especially for young learners. This table provides more detail on learning goals related to creative thinking skills in the PYP.

One important application of the ATL skills is in the PYP Exhibition. As the capstone project at the end of the entire PYP curriculum framework, the PYP Exhibition is incredibly important as a synthesis of the skills, understanding, and mindset that a PYP learner builds throughout their PYP learning journey. Students engage in a process to identify their own area of focus related to a Global Goal and develop lines of inquiry. Students formulate questions, research, and engage directly with their focus. They reflect, take action, and share their learning. Throughout this process, students apply their *Approaches to Learning* skills, with creative thinking playing a vital role.

Measuring Creativity

Our understanding of the phenomenon of creativity has grown immensely in recent years. Rather than simply an innate talent, creativity can be grown and developed (Plucker et al., 2004). Creativity is now understood as a complex phenomenon involving multiple factors, including a set of overlapping skills, processes, and mindsets (Runco & Jaeger, 2012). These same multiple factors underlying creative thinking can make it challenging to determine relationships between the several factors. The broad concepts of creativity and creative thinking can be challenging to accurately measure, so it is helpful for researchers to focus on particular aspects of creative thinking.

One of the most extensively validated instruments used to measure creative thinking potential is the Alternate Uses Test (AUT), originally developed by J. P. Guilford (Alternate Uses: Guilford's Alternate Uses, 2024). This assessment was based on Guilford's Structure of Intellect model (Guilford, 1956). It was intended to "represent an expected factor of 'flexibility of thinking' in an investigation of creative thinking" (Guilford et al., 1978, p. 5). The assessment uses divergent

thinking as a way to measure creative thinking potential. In this test, examinees are given the prompt of an ordinary object. They are asked to respond by listing other uses for the object. Thus, this instrument can provide a measurement of creative thinking potential. The AUT has been used in multiple studies and contexts and is a validated tool for measuring creative thinking potential (Acar & Runco, 2019; Metwaly et al., 2017).

Problem

While the IB PYP includes creative thinking skills as one of the goals of the program within the *Approaches to Learning* skills, there is little specific guidance on how these skills should be taught or measured (International Baccalaureate, 2018). In line with creative thinking, there is limited research on divergent thinking in elementary age students, especially in inquiry-based learning and IB PYP curricular contexts. Divergent thinking is recognized as being a crucial thought process in creative thinking and is often used as a way to measure creative thinking potential (Guilford, 1956). This study seeks to address this gap by measuring divergent thinking of students before and after an intervention.

There is a need to have more studies measuring the process of creative thinking with young learners, particularly in an IB PYP context. The IB curriculum framework emphasizes the transdisciplinary nature of the program and the importance of cognitive and metacognitive learning through the interrelated *Approaches to Learning* (ATL) skills. The IB's Learning and Teaching curriculum document suggests a few strategies teachers can implicitly and explicitly use to integrate and develop the ATL skills throughout the classroom culture and inquiries (International Baccalaureate, 2018). However, clear guidelines or an explicit progression of each of the ATL skills is lacking. The IB makes ongoing updates to

the PYP framework and made some substantial changes to their Learning and Teaching guidelines in early 2025. These updates include inquiry learning progressions for the first time as well as new subject guides (Toddle Learn, 2025). These changes are ongoing and reflect the IB's commitment to high-quality teaching and learning that reflects the latest educational research along with the needs of learners and educators. While some of the latest updates touch on related ATL skills, they do not explicitly address creative thinking skills (IBO, 2025). Greater guidance from the IB on teaching and evidencing learning would be helpful to ensure these important skills are put into practice.

Additionally, there are a limited number of studies addressing creative thinking at the elementary level in Türkiye. A few studies have examined creative thinking tools within a Turkish context (Aslan & Puccio, 2006; Togrol, 2012). While it is important not to make the assumption that young children either automatically possess creative skills or that they have the same thought patterns as adults, more research is needed to better understand their creative thinking development within the context of Türkiye. However, there is minimal research into the process and development of creative thinking potential with elementary-aged students in Türkiye.

A gap is apparent in the literature of studies utilizing the AUT for creativity research (Alhashim et al, 2020). While the AUT is widely used, there is no single standard scoring guide or rubric used for assessing the responses. There are a few approaches to scoring the AUT or assessing elements or goals with this instrument (Reiter-Palmon et al., 2019; Silvia et al., 2008). This lack of consistency makes it challenging to compare results accurately across studies.

Divergent thinking tests are often used as a proxy for measuring creative thinking and can be predictive of creative performance and output (Runco, 1992).

These tests could be used more often by teachers to measure creative thinking of their students in classroom settings.

Purpose

The present study aims to better understand the creative thinking skill development of elementary students. This study was designed to test the effectiveness of a creative thinking intervention. Further, it aims to expand the understanding and application of creative thinking within key contexts such as the IB PYP, international schools, and in Türkiye.

The main purpose of this study was to measure the effectiveness of teaching divergent creative thinking skills in relation to elementary inquiry-based classrooms. This study is valuable for expanding the understanding of how creative thinking skills are developed in young learners. Additionally, this study aims to contribute to the literature on creativity, creative thinking, and inquiry learning.

This study explored creative thinking skills within an inquiry context. This pedagogical approach values the development of a range of skills, including thinking skills. The IB PYP uses inquiry-based teaching and learning as its pedagogical foundation. This study attempts to provide one method of explicitly teaching and assessing creative thinking skills within this context. While there have been some studies focusing on creativity or creative thinking within the IB, most have focused on high school students, such as those in the Diploma Programme (DP). This study aims to add to the discourse on how elementary-aged learners within the IB PYP can expand their creative thinking skills.

Part of the intent of this study was to benefit children, particularly the participants in the study, and hopefully beyond this context. It aimed to help them to develop their creative thinking skills as well as to expand their understanding of

creative thinking and its' components. It also aimed to help students to gain a greater self-perception as creative thinkers. As one of the 21st century skills, creative thinking has broad potential and possibilities for applications in these students' futures. Further uses of creative thinking could apply to the student's writing skills, as well as to projects with real-world applications such as the PYP Exhibition.

There was also a pedagogical purpose for this study. It sought to benefit teachers by developing their capacities to teach and assess creative thinking skills. The study gave specific tools to teachers through the intervention used in this study. Part of the study also involved a workshop to expand teachers' appreciation, understanding, and competencies in teaching and assessing creative thinking skills. It is hoped that this study benefits both educators and learners through an exploration of the following research questions.

Research Questions

1. How does a creative thinking intervention influence fourth-grade students' divergent thinking skills, as measured by fluency, flexibility, originality, and elaboration?
2. How do fourth-grade inquiry learners perceive and apply their creative thinking development following the intervention?

Significance

Developing creative thinking skills has broad implications and potential uses within education, including outside of classroom settings. This study seeks to contribute to the field of creativity in education by better understanding how explicit teaching of divergent thinking and creative thinking skills can improve students' creative thinking output, as measured by the Alternate Uses Test. Other researchers and educators may benefit from seeing an example of how creative thinking skills

can be taught and implemented in an elementary classroom setting, particularly in similar IB PYP classroom contexts.

The potential for applying creative thinking skills is broad. Creative thinking skill development can be put into practice by educators and explored by researchers. Developing creative thinking skills can be put in place in classrooms, across schools, as well as in different contexts such as the IB PYP and within Türkiye. With this approach, all educational institutions and educators can support students in developing creative thinking skills.

Creativity is increasingly recognized as something that everyone has the potential to develop. Our understanding of creativity has been gradually democratized, with individuals now understood as having the capacity to be creative and improve their creativity (Newton & Newton, 2014). The present study aims to help all students within a grade level to improve their creative thinking. This study contributes to the literature on creative thinking in the classroom by demonstrating how elementary students can learn about creative thinking in their homeroom classroom settings, as well as why this is beneficial and worthwhile.

Definition of Key Terms

The American Psychological Association defines creativity and creative thinking as follows (APA, 2024):

Creativity: is the ability to produce or develop original work, theories, techniques, or thoughts. A creative individual typically displays originality, imagination, and expressiveness.

Creative Thinking: refers to the mental processes leading to an invention or solution to a problem. Products of creative thinking include new machines, social ideas, scientific theories, artistic works, and more.

The definition of divergent thinking most relevant for this study comes from the Encyclopedia of Creativity, Invention, Innovation and Entrepreneurship (Razumnikova, 2013):

Divergent Thinking: Divergent thinking is defined as producing a diverse assortment of appropriate responses to an open-ended question or task in which the product is not completely determined by the information. So, divergent thinking concentrates on generating a large number of alternative responses including original, unexpected, or unusual ideas. Thus, divergent thinking is associated with creativity.

The International Baccalaureate Organization defines the *Approaches to Learning* and creative thinking skills as follows (International Baccalaureate, 2018, p. 26-29):

Approaches to Learning (ATL): are grounded in the belief that learning how to learn is fundamental to a student's education. Five categories of interrelated skills and associated sub-skills support students of all ages to become self-regulated learners. Through a variety of strategies, teachers collaboratively plan for implicit and explicit opportunities to develop ATL both inside and outside the programme of inquiry.

Creative-Thinking Skills: generating novel ideas and considering new perspectives.

The definitions used in this study of the four elements of divergent thinking are based on Guilford's Structure of Intellect model (Guilford, 1956; 1967). The definitions of each element are as follows (Baer, 2016):

Fluency: (which includes word fluency, ideational fluency, associational fluency, and expressional fluency) is the ability to produce a large number of ideas.

Flexibility: is the ability to produce a wide variety of ideas.

Originality: is the ability to produce unusual ideas.

Elaboration: is the ability to develop or embellish ideas and to produce many details to “flesh out” an idea.



CHAPTER 2: REVIEW OF RELATED LITERATURE

Introduction

Understanding thinking processes can pose challenges for researchers. In particular, creative thinking is frequently viewed as a complex, abstract, and subjective process (Mullet et al., 2016). Divergent thinking is a technique developed by researchers to measure creative thinking potential. This study uses the Alternate Uses Test (AUT) developed by J. P. Guilford as the instrument to measure creative thinking assessment potential (Guilford et al, 1978). A review of the literature is provided to understand the background behind creativity, creative thinking, divergent thinking training and measurement, and related scoring and development methods. The literature relevant to this study was reviewed, including research on creative thinking within inquiry-based learning, particularly in the context of the International Baccalaureate (IB), as well as studies conducted in Türkiye. The theoretical framework underpinning the study is also described.

There are a range of studies related to divergent thinking, utilizing different goals and perspectives. Runco and Acar (2012) reviewed the literature around divergent thinking, how this research has evolved, its implications, and how current research explores the interactions between distinct factors and divergent thinking. An important distinction about the validity of divergent thinking tests emphasizes that “DT [Divergent Thinking] tests are not tests of creativity. They are estimates of the potential for creative problem solving” (p. 72). Therefore, it is important to understand these divergent thinking tests, including the Alternate Uses Test, within this context, and not to extrapolate beyond the limitations inherent in the

assessments. The AUT used in this study should not be assumed to be a test of creativity, but rather a test of creative thinking potential. This study was intended to better understand the relationship between creative thinking and fourth grade inquiry learners in an international school setting. Accordingly, the present study is best understood within this context.

Creativity and Creative Thinking

Creativity, creative thinking, and divergent thinking are key ideas to be unpacked. Part of the inspiration for this present study is the work of Ken Robinson, who championed creativity in education, especially expanding the role of schools to give opportunities to learners to grow their creative thinking potential (Robinson, 2011). Creative thinking is increasingly operationalized and studied, though opportunities for further study remain.

Abstract concepts such as creativity can be difficult to define and measure. The APA definition of creativity is used for this study, as noted in the definition of key terms in the previous chapter. The APA also observes that “analyses have failed to ascertain why one individual is more creative than another, but creativity does appear to be a very durable trait.” (APA, 2024). While creativity generally has an accepted role in modern education, teacher perceptions of creativity are mixed (Mullet et al., 2016). Creativity and examples of creative behaviours in students are defined and perceived differently by researchers and teachers. Some teachers view creativity as a teachable skill, while others believe creativity to be a quality bestowed upon only some lucky learners. Other researchers note the challenges to educators when incorporating creativity in classrooms (Gregory et al., 2013).

Ken Robinson, one of the most notable thinkers on creativity in education, defined creativity in his book *Out of Our Minds* as “the process of developing

original ideas that have value” (2011, p. 2). He further links the idea of creativity to imagination and innovation. He contends that “creativity is the greatest gift of human intelligence. The more complex the world becomes, the more creative we need to be to meet its challenges.” (p. 11). He makes the compelling argument that creativity is a vital skill for the future. Further, he states that learning to be creative is possible for everyone, and that educational systems must do more to value and develop creative potential for all. He challenges schools to not relegate creativity to arts programs, but to encourage creativity across the curriculum.

J. P. Guilford is often considered the founder of the field of creativity. His 1950 article entitled “Creativity” was a call to action to psychologists and researchers to focus their attention on this area of study, stating his view that “it can be said that psychologists have seriously neglected the study of the creative aspects of personality” (Guilford, 1950, p. 454). He shared his emerging research about the factors affecting creativity, continuing that “the factorial conception of personality leads to a new way of thinking about creativity and creative productivity” (p. 454). Guilford’s scholarship on creativity continued in subsequent years. In his “The Structure of Intellect” article in 1956, his model included creativity among several thinking skills (Guilford, 1956).

The Structure of Intellect (SI) model delves into the approximately forty factors Guilford identified as shaping and driving human intellect. Among these factors he named was divergent thinking, in contrast to convergent thinking. The following year, he published the article “Creative Abilities in the Arts” (Guilford, 1957). He describes the factors involved in the process of creative thinking: “a total creative act involves all three aspects—cognition, production, and evaluation” (p. 111). He followed these articles with his book, “The Nature of Human Intelligence”

in 1967. This volume described the factors discovered in his research involved in the structure of intelligence (Guilford, 1967). In this book, he uses the term divergent production abilities and details the factors that affect these abilities (Guilford, 1967). The sections on divergent production abilities explain examples of the figural and verbal tasks used to measure divergent production. Guilford's Structure of Intellect model will be unpacked further in the theoretical framework section of this chapter.

Since Guilford's pioneering body of work, many other researchers have taken up the call to explore and study the factors of creativity in detail. Some researchers have focused on creative thinking and divergent thinking in children (Fink et al., 2019; Michalopoulou, 2014; Runco, 1992). Runco and Acar's work has concentrated on creative ideation, divergent thinking, and creative potential (Acar & Runco, 2019; Runco & Acar, 2012). The studies conducted by Fink et al. and Michalopoulou focused on creative thinking with fourth grade students and early years students, respectively.

One recent addition to the research on creative thinking was in the 2022 PISA study, which measured creative thinking for the first time (OECD, 2024c). In 64 countries as part of the PISA study, the creative thinking skills of 15-year-olds were measured. The report on the results explains why creative thinking was measured, saying that "creativity, creative thinking and innovation are amongst these important competencies" (p. 46). They note that creative thinking appears as an expected student outcome in the national curricula of countries around the world. The PISA model of creative thinking competencies includes the following processes: generate diverse ideas, generate creative ideas, and evaluate and improve ideas.

The tasks in the PISA assessment involved four domain contexts: written expression, visual, expression, social problem solving, and scientific problem

solving. OECD's policy paper summarized several main themes of the results (2024a). The PISA findings suggest that the educational systems that did well on this creative thinking assessment also did well in other domains assessed by PISA. However, the results indicate that academic excellence is not required for creative thinking, although a minimum level of proficiency is helpful. The test also uncovered some gaps in creative thinking, with girls and students of higher socio-economic status scoring higher on these creative thinking assessments. The PISA results reveal a key role for teachers, schools, policies, and curricula in encouraging creative thinking. It will be interesting to see how creative thinking is studied in future PISA studies, and how the results from these studies change over time.

While the PISA study provides one recent example of measuring creative thinking, a range of assessments can be used to measure these skills. One systematic literature review of creativity measurements revealed the different approaches (Metwaly et al., 2017). The authors found four approaches, based on the definition of creativity being used. The instruments used to measure creativity are classified under one of the four approaches of process, product, person, or press. The divergent thinking Alternate Uses Test (AUT) used in the present study falls under the process category, as it seeks to understand the cognitive processes connected to creative thinking.

Creative thinking involves a suite of connected skills. Another example of a resource for understanding creative thinking skills comes from the Australian Council for Educational Research (ACER), which developed a framework of creative thinking skill development (Heard et al., 2025). This framework includes the strands of generating ideas, experimenting with ideas, and identifying the quality of ideas. The first step is most relevant for the present study and includes two specific

aspects for generating ideas. The first aspect is generating a number of ideas, closely related to the notion of fluency of ideas. The second aspect is generating a range of ideas, matching the idea of flexibility. This framework is an example of the possibility of positioning creative thinking in a central location in an educational system and elucidating specific objectives related to creative thinking skills.

Creativity and creative thinking are crucial concepts needed to understand the present study. Ken Robinson makes a clear case for enhancing the role of educational systems to emphasize creativity. The study of creativity has shown promise in better understanding this area of human experience. It is encouraging to see new attention on measuring creative thinking, in the example of PISA as a prominent assessment of students and schools. A strong framework for understanding creative thinking skills in context can help to make this concept clear. Embedded within the concepts of creativity and creative thinking lies divergent thinking.

Divergent Thinking Training and Measurement

Divergent thinking is understood as thinking of multiple possible responses when given a question or task (Razumnikova, 2013). In contrast, convergent thinking is a process that involves arriving at a single, accurate answer for a specific problem. These two types of thinking often work in concert with one another, and both are often engaged during creative processes.

Some divergent thinking studies have focused closely on task-specific creative thinking training. Baer (1996) conducted a study with seventh graders focused on developing poetry-related divergent thinking skills. The creative thinking intervention in this study involved poetry training exercises chosen to improve elements of creative thinking. After the intervention concluded, the participating students wrote poems that were then evaluated by expert judges for creativity. The

results of the study indicated that targeted poetry-specific divergent thinking training had a notable effect on the targeted task of poetry writing. This study supports the notion developed through other research that “the cognitive mechanisms underlying creativity and divergent thinking are task specific” (p. 186). It is important to understand divergent thinking studies alongside the tasks or prompts given in each study.

Divergent thinking tasks have been applied in a range of contexts and purposes, notably within educational settings. A study conducted by Fink et al. administered divergent thinking interventions as lessons in an elementary classroom (2019). The goal of the intervention was to develop creative thinking in the students, especially with typical classroom activities. The researchers then assessed the effects of the intervention using two divergent thinking tasks. This study drew on both the verbal and figurative domain for the training as well as the measurement of the results. The sample of fourth-grade students was split evenly between the two domains and the training involved several game-like tasks. Verbal divergent thinking was measured through an adapted Alternate Uses Task, while figural divergent thinking was measured with a Cued Drawings task that prompted participants to create a new drawing using a given geometrical shape. The results of the study add “further evidence to the common finding that the engagement in creativity exercises generally unfolds beneficial effects on various measures of creative potential” (p. 682). Fink et al.’s study showed that even a short intervention had a measurable impact on creative thinking potential and indicated some of the benefits to learners of engaging with creative thinking.

The relationship between divergent thinking and specific skills and components has been explored in related research. This research indicates that

evaluation of ideas generated is a key component of divergent thinking (Runco & Acar, 2012). Evaluative skills help to put divergent thinking in context, make connections, and understand the use of the ideas generated in divergent thinking tasks. Some of the recent research into creative thinking has explored interactions or supports for the divergent thinking process. While noting the significant role of divergent thinking tests in estimating creative potential, the authors of this article state that, “there is great value in the concept of divergent thinking” (p. 73). There are specific skills and components involved in the divergent thinking process, including evaluative skills. These specific related skills can help researchers to better understand the divergent thinking process.

Divergent thinking tasks are some of the most commonly used tools for measuring creative thinking potential (Acar & Runco, 2019). These tasks have been used widely and in different contexts, allowing researchers to critique, improve, and compare their usage. Many researchers have applied divergent thinking in school settings, while also highlighting areas for further research within educational contexts (Fink et al., 2019; Michalopoulou, 2014; Runco, 1992). Divergent thinking measures require scoring that depends on the goals and focus of the research.

Divergent Thinking Development and Scoring

There are several established ways that have been developed to evaluate and score divergent thinking production (Acar & Runco, 2019; Metwaly et al., 2017). After these measures are completed, researchers have different methods and goals for scoring. There is considerable variation in how divergent thinking tests are scored and analysed.

Guilford’s AUT is often used in research measuring divergent thinking (1978). Building upon Guilford’s work, the Torrance Tests of Creative Thinking

(TTCT) were developed (Torrance, 1966). The TTCT has two versions, Figural TTCT: Thinking Creatively with Pictures and the Verbal TTCT: Thinking Creatively with Words. This test combines several tests into one assessment and is commonly used to individually assess giftedness in children. One component in the verbal section is the different uses for objects. The Wallach–Kogan Creativity Tests (WKCT) also measure divergent thinking (Wallach & Kogan, 1965). The WKCT was designed for young children and involves verbal and visual prompts. This test relies on an associative theory of creativity. One example of the test asks respondents to think of as many items as possible with a specific component. These two tests elaborate on and systematize the ideas on assessing divergent thinking first proposed by Guilford (1967).

The AUT is incorporated into two of the most widely used divergent thinking assessments, the TTCT and WKCT. However, these two assessments are both lengthy to administer and involve a battery of tests. For simplicity and within the logistical and time constraints of this study, the AUT alone was selected to be used as the instrument in this study. More detail on how the AUT was used for this study will be provided in the next chapter.

While divergent thinking is a recognized means of measuring creative thinking potential, there is some variation in scoring of divergent thinking tests. Reiter-Palmon et al. (2019) reviewed different approaches to scoring divergent thinking tests and noted the lack of uniformity in scoring these tests. They also developed a systematic framework for scoring decisions on divergent thinking tests. One of the practical aspects related to scoring mentioned is selection of divergent thinking tasks. Specifically, the study recommends selecting a particular domain for the task and noting the limited application of the study to that domain. The authors

note that some differences between divergent thinking studies will continue as one of their findings “indicates that different goals in research require different choices for scoring” (p. 157). This study was targeted toward researchers and was helpful in developing an understanding of how divergent thinking tasks are typically used and scored. Assessing divergent thinking can provide insight into creative thinking, and researchers have established ways to investigate the development of creative thinking.

Many studies using the AUT focus on just some of the four elements of creative thinking. Indeed, Runco and Acar’s article specifically notes that many tests only evaluate fluency (2019). However, they continue that “for most purposes, fluency should not be used alone” (p. 67). The emphasis on productivity and generating many ideas does not necessarily reflect a strong connection to creativity. This understanding of the interconnectedness of the elements of creative thinking led to the decision to assess all four elements of creative thinking in the data analysis of the present study.

I closely reviewed the existing materials created for administering the AUT in research settings. Most of the available materials using only the AUT were created for adults (Guilford et al., 1978). Other tests, such as the TTCT or WKCT, are detailed batteries of tests involving multiple components and require a lengthy administration time, making these tests less ideal for classroom usage. As limited examples of AUT formats used with children exist, materials were adapted to match the context of the study, especially for use with fourth-grade students. Thus, one outcome of this study was developing materials that could be used by teachers to teach and assess creative thinking skills in simple and accessible ways. More

information about the adjustments made to the instruments used in this study will be detailed in the next chapter.

Different assessments have been developed to measure divergent thinking. These divergent thinking assessments and studies implementing the tests have been used to inform the design of this study. It was necessary to understand the scoring schemes and processes for other studies using divergent thinking measures. Using this information, the present study focused on using the AUT and scoring based on four elements of creative thinking.

Creative Thinking in the IB PYP

This study focuses on creative thinking within the IB PYP framework. The IB PYP's Learning and Teaching curriculum document includes details about transdisciplinary learning, inquiry, conceptual learning, and the *Approaches to Learning* (ATL) skills (International Baccalaureate, 2018). A search of this document reveals five instances of the use of the phrase "creative thinking." Creative thinking is mentioned in the context of the learner profile, collaboration, digital literacy skills, ATL sub-skills, and the transdisciplinary role of subjects. Under the thinking skills ATL, creative thinking is described as "generating novel ideas and considering new perspectives" along with ten items under the heading of what students do (p. 33). This gives educators a general idea of how creative thinking is used within the PYP.

A few studies have sought to learn more about how to facilitate and evidence creativity in IB schools. In collaboration with the IB, researchers began to develop conceptual frameworks for the transversal attributes of curiosity and creativity across the various levels of the IB curriculum framework (Richardson & Krstic, 2021). They acknowledged the importance of "developing resources that enable creativity

and curiosity to be supported, that guide teachers in helping learners gain the skills that underlie these attributes and that enable achievement to be recorded” (p. 2). These researchers developed a definition of creativity and several key strands or aspects: problem finding, generating ideas, and quality of ideas. The authors conceded the difficulty in assessing a transversal attitude such as creativity, and the danger of measuring it too narrowly. They suggested a framework involving reflection on key elements.

Schools can reflect on the extent to which they provide comprehensive enabling environments for developing creativity. Suggestions can be given to teachers on “approaches to support learners in gaining, practicing or enhancing the skills” (p. 5). Learners can be facilitated and scaffolded to reflect on their degree of creativity, for example regarding the PYP Exhibition. While this article reflected a work in progress, the authors emphasize the importance of defining, understanding, and putting into practice attributes such as creativity in classrooms.

Another study looked at how educators facilitate curiosity and creativity specifically within IB PYP classrooms (Hopfenbeck et al., 2022). The study examined how educators in PYP schools around the world foster curiosity and creativity, as evidenced in observation of classroom videos. The authors of this study cited several examples of instructional approaches or practices that facilitate creativity. They specifically highlight divergent thinking as an instructional strategy. Exploration and inquiry-based learning experiences are also mentioned as examples. In gathering data on creativity, Guilford’s Alternate Uses Task was used. This task was scored by raters using a rubric developed for the study, which used a scale from one to three, one being not at all creative and three being highly creative. Each student’s total list of responses was given one score on this scale. The study found

several promising practices aimed at facilitating curiosity and creativity, with themes for both presented together. The main themes they identified were diverse feedback pathways, self-regulated learning, nurturing an inquisitive mind, facilitating collaboration, and choice over self-expression.

One aspect of the diverse feedback pathways theme emphasized giving encouraging feedback to students related to both the creative process and product. The choice over self-expression theme included the importance of “modelling and valuing multiple modes of expression” and the role of individual self-expression in creativity (p. 55). The study incorporated student and teacher interviews on conceptualizing creativity. The authors emphasize the importance of collaboration in creative work and suggest some best practices for collaborative creativity. Overall, this study found close links between creativity and curiosity and observed a range of effective practices to facilitate both mindsets in PYP classrooms.

The IB PYP provides some degree of guidance on creative thinking and creativity, including how they can be used in elementary classrooms. Some recent studies have looked more closely at how creativity or thinking skills are implemented in IB PYP schools. One study examined the relationship between the PYP Exhibition and critical thinking skills (Medwell et al., 2017). The IB has worked closely in association with researchers including Hopfenbeck et al. as well as Richardson and Krstic to improve the fostering of creativity along with curiosity in PYP schools (2022; 2021). This present study provides possibilities for facilitation and evidencing of creative thinking in PYP classrooms.

Creative Thinking in Türkiye

It was important for this study to develop an understanding of the current state of creative thinking research in Türkiye. There have been a few studies

conducted in Türkiye utilizing established tools for measuring creative thinking potential (Aslan & Puccio, 2006; Togrol, 2012). While there are several studies that were carried out in Türkiye related to other parts of the IB program, such as the Diploma Programme in grades 11 and 12, there was a lack of studies in the intersection of the Turkish and elementary PYP contexts (Aktas & Meral, 2015; Dulun & Lane, 2022).

One study on creative thinking conducted in Türkiye explained the results of a test of creative thinking potential in a Turkish context (Togrol, 2012). This study used the Test for Creative Thinking-Drawing Production developed by Jellen and Urban, which shares similarities with the Torrance Test of Creative Thinking (TTCT). The task in this assessment asks participants to finish an incomplete drawing. The author of this study translated this tool from English to Turkish, and draws upon studies conducted using this translation. It has been used in diverse contexts and with a range of age groups, including elementary-aged children. As with many creative thinking researchers, this author notes the challenge of subjectivity in scoring creative thinking assessments. The researcher delves into the issue of cultural fairness, touching on researcher bias and cultural sensitivity. This study reported that Turkish participants had similar tendencies in their responses, as compared to the original test manual, and concluded that the measurement tool analysed is culturally fair. The article reviewed empirical research studies on creative thinking potential in Türkiye and noted that the results are consistent.

Another study developed a Turkish translation of the TTCT and tested it with adults (Aslan & Puccio, 2006). The authors of the study translated the TTCT into Turkish and ensured that the translated version was comparable to the original English-language version. The researchers then tested the Turkish TTCT with an

adult sample and compared the results with an American sample. They observed notable differences between the two samples, particularly that the Turkish scores were lower in verbal fluency, flexibility, and originality. This study noted that “creativity education has taken a prominent place among the objectives of the Turkish Ministry of Education” (p. 163). However, in interpreting the results of their study, the researchers consider potential causes for these scores related to the Turkish educational system. The authors of the study expressed their hope to advance the study of creativity in Türkiye and that further creativity studies in the country will follow.

There has been some research into creative thinking in Türkiye. Some studies have focused on specific domains or types of creativity, such as aesthetic creativity (Gürkan & Dolapçioğlu, 2020). With additional tools now available in Turkish to measure creative thinking potential, it is hoped that further studies will be conducted in Turkish as well as in Turkish contexts. Creative thinking has mainly been studied with older students or adults in Türkiye, and there is potential for more research related to children’s creative thinking potential within the country’s educational system.

Theoretical Framework

The theoretical framework for this study is Guilford’s Structure of Intellect (SI) model (1956, 1957, 1967). This theory was introduced in “The Structure of Intellect” published in 1956 and subsequently developed with “Creative Abilities in the Arts” in 1957. The SI model was further expanded into a book and put in the context of other intellectual abilities in Guilford’s “The Nature of Human Intelligence” (1967).

The SI model takes a multivariate approach to constructing a theory of intelligence. In the SI model, Guilford organized the factors of intellectual abilities into three types of categories: content, operation, and product. Divergent production falls under the operation dimension of the model. The operation categories are each intellectual process: cognition, memory, divergent production, convergent production, and evaluation. These categories are organized to build on each other. Cognition and memory are required for any sort of production, with Guilford stating that “reviving items of information from memory storage in order to meet certain objectives is the basis for psychological production, either divergent or convergent” (p. 138). In his initial publications, he used the term divergent thinking, however he begins preferring to use the phrase divergent production in this book, to match the category designations in the SI model. Later researchers return to divergent thinking as the best description of the target process.

In the chapter of his book about divergent production abilities, Guilford detailed the emergence of key factors in understanding creative thinking processes. Fluency and flexibility are the most readily apparent, “abilities concerned with the ready flow of ideas and with readiness to change direction or to modify information” (p. 138). With the factor of fluency, further iterations are mentioned: word fluency, ideational fluency, and associational fluency. He named flexibility and originality as key factors in divergent production. Considering further studies, he added in “another kind of ability, elaboration, to be considered along with fluency, flexibility, and originality, to make up the set that was to become known as divergent-production abilities” (p. 138).

Guilford also explained and showed examples of tasks and prompts designed for measuring divergent production. There were a wide range of examples given,

both figural and verbal, included as long as the specifications were broad enough to evoke a divergent production of responses. One effective test was the Utility Test, later developed into Unusual Uses and then renamed Alternate Uses Test. The Utility Test was noted as being used for fluency, while the participant “lists uses he can think of for a common brick, a wooden pencil, or a wire coat hanger, the total number of relevant responses being counted” (p. 142).

The Structure of Intellect model is the theoretical framework underlying this study. This model includes the key operational process of divergent production, called in the present study divergent thinking, the term used by current researchers. Within divergent production, four major factors are identified: fluency, flexibility, originality, and elaboration. These factors were used in this study to organize the creative thinking intervention and in the AUT scoring process. Guilford readily acknowledged the complexity of creativity and creative potential, expressing that “by now it should be clear that creative potential is not a single variable, any more than intelligence is” (p. 166).

Conclusion

It is important to understand this study within the context of related research. Particularly with the selection of the AUT as the instrument used in this study, it was necessary to understand how creative thinking is studied and assessed. I reviewed the literature to find out more about creativity overall and creative thinking, as well as divergent thinking training, measurement, scoring, and development. I also reviewed the literature related to creativity in the IB and creative thinking in the context of Türkiye. I selected a theoretical framework to match the goals of this study. Based on the information uncovered in the literature review, a methodology was chosen to better understand creative thinking skill development in the context of this study.

CHAPTER 3: METHODOLOGY

Introduction

This study was designed with an explanatory sequential mixed-methods research methodology to evaluate creative thinking potential. The study was designed to include a pretest and post-test, with an intervention between the two assessments. This study was quasi-experimental, as it used an intervention but did not use a control group. The present study aimed to focus on the context of fourth-grade students in an international school in Türkiye.

This study used the Alternate Uses Test (AUT) as the instrument to measure creative thinking potential, with some adjustments to match the needs of elementary students, which will be detailed in the data collection section. The AUT was used as the quantitative data tool, with data collected and scored from a pretest and post-test AUT. The data was analysed quantitatively by comparing the results of the pretests and post-tests overall scores. Each of the four elements of creative thinking used in this study were also individually scored and compared between the two tests. Additionally, qualitative data was gathered using a final reflection, and this data was analysed to find common themes. This research study was designed to better understand the acquisition of creative thinking skills in elementary students. This chapter will explain the research design, context, participants, instrumentation, methods of data collection, and methods of data analysis used for this study.

Research Design

This study utilized an explanatory sequential mixed-methods research design. The study design was also quasi-experimental, with an intervention but no control

group. The data gathered was primarily quantitative data from the AUT, with additional qualitative data from student reflections collected as well. The quantitative data was gathered first, with qualitative data gathered after the other data collection steps concluded. The balance of data was intended to discover quantitative changes between the pretest and post-test, while also exploring the effects on inquiry learners through qualitative data. The qualitative data helped to explain and give context to the quantitative results. Both data sources are essential for understanding this study and are intended to be considered together.

I followed steps and a timeline in order to ensure successful completion of this study. In March of 2024, I received permission from the Bilkent Ethics Committee to conduct the study. After my application to the Turkish Ministry of Education, I received MEB approval for the study. I delivered the teacher workshop in the middle of May. Next, I sent out the parent consent form and provided information to parents regarding the study. At the end of May, the study began with the pretest. Teachers then taught a sequential series of four lessons as the intervention. In early June, after the intervention had been completed, the posttest and reflection questions were administered. After all steps were completed, I collected all of the items from the collaborating teachers. In September, I collated the data to determine the participants. Over the next several months, I analysed the collected data.

The quantitative data was collected from an Alternate Uses Test (AUT; Guilford et al., 1960) administered as a pretest and post-test. This instrument was used before and after the intervention. The AUT is often used to better understand creative thinking by measuring creative thinking potential (Acar & Runco, 2019; Metwaly et al., 2017). The AUT used in this study was adapted from the one

originally developed by Guilford et al. (1960) and adjusted to be appropriate for fourth-grade students. The instrumentation section elaborates on how the AUT was adapted for the young participants in this study.

The qualitative data in this study was collected from a final reflection, administered after the AUT post-test. The reflection included six open-ended questions. This data was collected to give participants a chance to respond and express their thoughts about the learning process. The qualitative data helped to put this study into context and to make connections to other learning areas.

This study used targeted questions as the qualitative data collection tool. These six questions were designed to elicit feedback from the participants about how they perceived and applied their creative thinking development. These questions were developed using my IB and pedagogical expertise in order to ask about specific aspects of the learning process. I consulted other PYP practitioners to refine and improve the questions.

This research was carried out by following a pretest and post-test quasi-experimental design. This design was chosen to compare the results of the students over time, before and after the intervention. Quasi-experimental designs using pretests and post-tests have been used by several researchers as a way to measure creative thinking ability or potential (Kincal & Avcu, 2016; Yang et al., 2016).

As this study took place in classroom settings utilizing the existing class timetable across several weeks, it was seen as most conducive for student learning for students to stay with their regular classroom teachers and to follow their regular class schedule. Additionally, the school where the study took place expected that learning experiences to be shared and implemented across the grade level, instead of taking place in only certain classrooms. Thus, a fully experimental design using

randomized grouping with a separate control group and treatment group was deemed unrealistic for the context.

Co-Collaborators

There were a total of four teachers working with me as co-collaborators on this study. As the researcher, I was also one of these teachers tasked with gathering data from my class of students. The collaborating teachers were the international homeroom teachers of the fourth-grade classes at the international school described in the context section. The teachers were all Americans, with three female teachers and two male teachers. They had from six to 16 years of total teaching experience, including the school year of this study. All the teachers had spent most or all their teaching careers in international schools.

The implementing teachers had varying levels of experience with the IB PYP curriculum framework. One teacher was in the first year of teaching using the PYP framework and had taken the “Making the PYP Happen” professional development course earlier in the school year, as required for teachers new to teaching using this curriculum framework. Two of the teachers had taken the “Making the PYP Happen” course but had not had the opportunity for further IB professional development. The last teacher had taken several IB courses. These three teachers had taught using the PYP framework for two to nine years, although only at the school that was the context of the study.

While I was the researcher for this study, I was also a contributing teacher. I am an experienced PYP teacher, with fourteen years of experience with this curriculum framework across three schools. I have completed ten IB workshops as well as several other professional development courses focused on inquiry-based teaching and learning. Along with the teachers collaborating with me, I had a role in

gathering data and teaching the intervention lessons with my class. As part of this study, I devoted considerable time to developing my understanding of creative thinking and divergent thinking. Therefore, I had the strongest background and deepest understanding of the content and implementation of this study. Of course, I also had an interest in successfully implementing the study. In order to keep delivery of the study materials objective, I followed the exact same procedures as all teachers collaborating in this study.

Workshop Design

To conduct this study, I collaborated closely with a group of teachers. I conducted a workshop to train the relevant teachers in the key parts of this research study necessary for implementation. The teachers received training from the researcher about the content of the study, including how to conduct the lessons in each classroom. The training included instructions on administering the data collection instruments, information about how to teach the intervention lessons, as well as background on creative thinking. A sample of a slide from the workshop and a link to the full slides used in the workshop are available in Appendix B. Teachers learned about how to implement each step, starting with administering the pretest, teaching the intervention lessons I prepared based on the four elements of creative thinking, and directing students to complete the post-test and reflection. All of the teachers agreed to contribute to the study.

Part of the purpose of this workshop was to ensure consistency in the implementation of the data collection instruments and intervention. It was important to ensure that the collaborating teachers received uniform information and instruction. One aspect of the workshop emphasized following the structure of the intervention exactly, including the order and timing. Teachers were also instructed

on how to neutrally respond to student participation and feedback during the intervention lessons. This workshop guaranteed clear communication and was one way to reduce variation in delivering the key elements of the study.

I developed this workshop in order to clearly communicate the relevant information and instruction to my collaborating teachers. I focused on how we would implement the study, including important logistics and concise directions. I also included a focus on a shared understanding of what creative thinking is and why it is worthwhile. While designing the workshop, I sought feedback from a PYP expert in the same context on the structure and content of the training. I used this feedback to make some adjustments, mainly for clarity. This workshop was developed to prepare the collaborating teachers for gathering data and implementing the intervention.

Intervention

After the workshop and pretest AUT, teachers implemented the intervention, which entailed a series of four lessons based on Guilford's creative thinking model (1960). This model was chosen as it includes four key elements of creative thought: fluency, flexibility, originality, and elaboration. I designed each of these intervention lessons around one of these four elements. Appendix C provides an example of a slide from one of the intervention lessons and includes links to the full slides used for these lessons.

Each lesson included objectives and a summary of previous learning. The specific term for the lesson was shared, followed by a definition and example of the element. Students then went through a process of thinking through the shared example in a "Think, Pair, Share" cooperative learning format, thinking individually first, then discussing with another student, and finally sharing with the whole class (Guenther & Abbott, 2024). With this shared example, possible responses were given

within the lesson and considered by the class. Next, students repeated the process individually, using booklets created to record their process in writing. Students were given directions, guidelines, and the prompt. A few minutes were given for individual responses to each prompt to be recorded, then students shared with the class and reflected. The contents of the lesson were reviewed.

To measure the effectiveness of this intervention, teachers then administered the post-test AUT. The AUT focused on divergent thinking to measure creative thinking potential (Guilford, 1967). The AUT was administered before and after the intervention. Additionally, students and teachers were asked to reflect on the experience through further questions. Although this study involved an intervention, there was no control group; therefore, the study was quasi-experimental.

For the qualitative component of the study, participants were asked to respond to reflection questions after the post-test AUT. These questions helped to place the study in an IB PYP context as well as connect to specific inquiry learning skills and experiences. Creative thinking as a component of inquiry learning has been studied in limited contexts and one of the goals of this study is to uncover more about this connection (Michalopoulou, 2014).

Qualitative data was gathered from the open-ended learning process questions. Participants were given the opportunity to write responses explaining how the creative thinking lessons helped them in different learning areas. The prompts asked students what creative thinking means to them, what the most useful parts of the creative thinking lessons were, and their self-perceptions as creative thinkers. They also had the chance to respond to questions about how creative thinking helped them specifically in relation to writing and the PYP Exhibition project. This

qualitative data gathered helped to complement the quantitative scores calculated from the AUT.

This explanatory sequential mixed-methods research design was chosen to collect both quantitative and qualitative data to better understand how creative thinking skills are developed. This study first gathered quantitative data using a pretest and post-test AUT, to compare the changes in these scores. Data was also gathered qualitatively, to hear directly from participants about their experiences, thoughts, and perspectives. The qualitative data was analysed to find themes in the responses that would help to explain and add context to the quantitative data. It is important to consider both forms of data together. Next, the context for this study will be described.

Context

It is important to consider this study within its' context. The study was conducted in an elementary school, as a part of the regular school day. This study took place in the entire fourth-grade level in this school. This grade had five classes of 18 students each. The location and timing of the study are detailed below.

The location of the study was a private international school located in Ankara, Türkiye. The school has 1200 students overall and serves students from Pre-Kindergarten to 12th grade. Most of the school population is Turkish nationals, with a small percentage of international students as well. The school has been established for over thirty years.

The school has been authorized to use the International Baccalaureate Primary Years Program (IB PYP) curriculum framework. The school follows the PYP curriculum framework, which uses inquiry-based teaching and learning. The PYP is the curriculum framework alongside two other curricula used at the

elementary level of the school, which also uses the Turkish Ministry of Education national curriculum alongside the Cambridge curriculum. The school describes their curriculum as implementing the Cambridge and Turkish national curriculum within the PYP framework.

As this study collected written responses as the data, the school language profile is important to consider. The elementary school is bilingual and uses both English and Turkish for classroom instruction. English was the language of instruction for all lessons for this study. Most of the students spoke Turkish as their first language.

One relevant additional context worth mentioning is that in Türkiye, fourth grade is considered the end of the elementary level. As part of the IB PYP, students also completed the PYP Exhibition in fourth grade. Students were focused on the final steps of their PYP exhibition projects over the same period of time as this study.

This study took place over about three weeks in May and June of 2024, at the end of the school year. Each participating class was asked to complete all the steps within this time frame; however, each teacher had flexibility in their timetable to decide when to schedule each lesson. Including the pretest and post-test, the study was organized into five lessons in total. Each lesson was scheduled to take 40 minutes, during a scheduled creative writing class period. More information about the participants in the classes can be found in the following section.

Participants

This study's participants were a group of elementary students and data was gathered from them following ethical guidelines. As the study participants were children, I went through the process to obtain ethical permissions to conduct the study with this age group. Although the teachers were not participants in the study

and no data was collected directly from them, the collaboration and skills of the teachers were essential for conducting this study within multiple classrooms.

The participating students were a convenience sample of students from the school where the researcher worked. The students were all ten years old and in fourth grade. There was a balance of male and female students, 30 participants were female and 31 were male.

As elementary students were the participants in this study, it was necessary to gather ethical permission before beginning the study. I first sought permission from Bilkent University Ethics committee to conduct the study. Their approval is available in Appendix I. Next, I wrote a thesis proposal to apply for a research permit from Türkiye's Ministry of National Education, or MEB. The MEB approval for my study is included in Appendix D. Part of the thesis proposal I prepared for the MEB application included the parent consent form. Once I received ethical permission to conduct the study, I used this consent form to request the permission of parents for their children to participate in the study. The parent consent form can be found in Appendix E.

Most of the students in the study spoke Turkish as their first language. The majority of the students had also attended this international school for several years. The school uses a co-teaching model, with about half of the classes taught separately in English or Turkish as the language of instruction. Therefore, all students were competent in English, with many of them being fluent. However, there was a wide range of English-language comprehension, including some students below grade level. It is important to understand this demographic in this study as unique, and not necessarily representative of all fourth-grade students or all students in Türkiye.

All fourth-grade students at this school participated in the intervention lessons as part of their English lesson times, however only those whose parents consented to have their data used are represented in this study. Although 90 students were enrolled in fourth grade at this school, there were $N = 61$ students who participated in the study. The number of students participating from each class varied. In one class, all 18 students participated, and in other classes 15, 13, 8, or 7 students were eligible to participate. The participating students were determined based on parent signatures on the consent form agreeing to participate, as well as completion of both the pretest and post-test.

This study involved student participation and data was gathered from the participating students. The appropriate ethical permissions were granted in order to collect data from these participants. The background of the context and participants are essential for understanding how the instruments were used in this study.

Instrumentation

There were two main instruments used in this study. An AUT pretest and post-test were used to collect quantitative data. Open-ended reflection questions provided an opportunity to gather qualitative data. These two instruments helped to build the understanding of the creative thinking skills learning process.

Quantitative Instrument

The quantitative data was collected using an Alternate Uses Test (Guilford et al, 1960). Students who participated received a paper with instructions and space to complete the task. Per the instructions, teachers gave the students three minutes to respond to the prompt asking them to name uses for a specific ordinary object. The task, including modifications, is described below. The adapted forms used in this study can be found in Appendix F, and student samples are shared in Appendix G.

The AUT was given twice, as a pretest and a post-test. The pretest prompt asked participants to name uses for a paperclip. The post-test asked them to name uses for a cup. The format was identical for pretest and post-test, except for the name of the object and a small matching image to illustrate the object. The AUT was administered before and after the intervention.

It was important to adapt the instrument used in this study for use with elementary students. The participants of this study were ten-year-old fourth-grade students, so a developmentally appropriate instrument was essential for collecting useful results. The original Alternate Uses Manual includes two versions of the test booklet (Guilford et al., 1978). This form includes detailed instructions and an example, filling a page. These details can be helpful for clarifying the directions and purpose of the exercise for adult participants. However, for young children, this amount of detail and level of vocabulary was too advanced to be comprehensible. Thus, the directions were simplified into three bullet points. These simple and clear directions were also intended to clarify the process for the teachers administering the AUT, and to ensure consistency.

The response area was further adapted for young participants. In the original AUT form test booklet, six different objects are given as prompts, with the common use stated (Guilford et al., 1978). It was decided for the purpose of this study that one object prompt was sufficient and appropriate for the target age level. For this study, a briefly stated and clearly labelled prompt was used, including a simple image as an example. The image was included to scaffold the prompt and to make the task possible regardless of English language proficiency. The original AUT form contains six spaces for uses of each object, with directions on the top of the page to list as many as six possible uses. The adapted AUT form used in this study included a

response area comprised of a table with ten spaces. This adapted form did not specify a limitation or target number of responses.

A study such as this one, involving scoring participant responses, includes some scoring limitations. The most noteworthy limitation is that the scoring is subjective. The data in this study comes from the scoring carried out by the researcher. There was only one scorer for all the data in this study, with 910 total responses across the pretest and post-test. Without moderation and multiple independent scorers, there is some bias inherent in this type of scoring.

In order to strengthen the scoring in this study, another expert in the same context was asked to score a sample of responses from both pretests and post-tests. A random sample of 20% of the participants were scored. There was 72% agreement between those scores and my scoring for this study. The category with the largest differences in scoring was elaboration. This additional scorer was given the scoring rubric and brief instructions for how to complete the scoring but had limited training and expertise on how to score the AUT.

A key part of the scoring involved sorting the responses into categories. Along with being laborious, this process is also subjective, as some responses could fit into multiple categories, depending on the scheme of organization or the scorer's judgement. These scoring limitations connect back to the need for a clear and standardized scoring system and rubric to be used for AUTs.

Qualitative Instrument

The instrument used to collect qualitative data were open-ended reflection questions. Participants were first asked to rate themselves on their creative thinking skills. The rating section asked participants to use a five-point Likert scale to rate themselves on how well they accomplished creative thinking skills. This section

utilized the IB *Approaches to Learning* skills, specifically skills under the thinking skills area (International Baccalaureate, 2018). The IB defines creative thinking precisely through a list of creative thinking subskills. This list was used in the study to prime participants to reflect on their overall creative thinking skills.

Next, for the reflection, participants were asked a set of six open-ended questions about the learning process. The reflection questions were given to all students as a Google Form, and participants had the chance to type their responses in the open response areas. The following questions were used for the student reflection:

1. What does creative thinking mean to you?
2. What were the most useful parts of the creative thinking lessons?
3. Do you think of yourself as a creative thinker? Why or why not?
4. How did learning about creative thinking help your writing?
5. How did learning about creative thinking help you with the PYP Exhibition?
6. Is there anything else you would like to tell the researcher?

These questions were designed by the researcher to gather information about participants' thoughts on the learning process. The first question was intended to elicit responses from the participants describing creative thinking in their own words. The second question was meant to prompt participants to think about the specific lessons, and to get feedback about the intervention. The third question addressed the mindset and self-perception of the participants. The fourth and fifth questions connect to other areas of learning. Question four related creative thinking skills to creative writing. The fifth question put the study in the context of the PYP exhibition. The last question was optional and gave the participating students the

chance to share with the researcher any additional thoughts not prompted through the other questions.

These questions were developed in order to address the second research question, to better understand how participating students perceived and applied their creative thinking development. The goal of these questions was to elicit feedback from the participants and to put their learning in context. In order to develop these questions, I went through a process to identify the key areas I wished to address. I then used my pedagogical and PYP expertise to develop questions. I consulted with the other teacher collaborators and other curriculum experts to refine and validate the questions for use with fourth-grade students.

This study had two forms of instrumentation. An Alternate Uses Test (AUT) was used for quantitative data and administered as a pretest and post-test. Open-ended reflection questions were asked of the participants at the end of the study and used to gather qualitative data, to be considered alongside the quantitative data.

Method of Data Collection

Quantitative and qualitative data was collected for this study. These forms of data were collected in writing from the participants. The quantitative data from the AUT instrument was collected as a pretest and post-test. These responses were then organized and scored by the researcher. Qualitative data from the reflection questions were collected and reviewed to find themes.

The pretests and post-tests were de-identified to maintain anonymity. The researcher recorded the responses from all the pretests and post-tests. The total scores and four creative thinking element scores for each student were compiled and listed on a spreadsheet. For the originality section, the responses for all students were

compiled and compared to find the level of originality when compared to other participants of the study.

The pretest and post-test AUT took place during fourth grade scheduled lesson times. Students wrote their responses on each page and then the participating teachers collected the pages for the class in folders. The researcher then collected all the consent forms, pretests, and post-tests for the study. All participants completed the pretest and post-test on paper to ensure that technology was not used as an aid to complete the task. After the post-test, students completed the reflection questions on a Google form.

For the AUT, students were given three minutes to write their responses and complete the task to the best of their abilities. Participating students were given instructions to write as many responses as they could, work independently with no assistance, and complete the task within three minutes. In the pretest, the participants were asked to list as many uses as they could think of for a paper clip. For the post-test, the AUT was repeated with identical instructions, this time asking participants to name as many uses as they could think of for a cup. After all participants completed the pretest and post-test AUT, the researcher collected all responses.

After the post-test, students were asked to complete a reflection using the IB *Approaches to Learning* thinking skills, specifically subskills under creative thinking (International Baccalaureate, 2018). The post-test reflection included open-ended questions, allowing the opportunity to collect qualitative data alongside the pretest and post-test scores. After participants completed the reflection questions, the researcher downloaded all responses.

Along with the data collected from this study, some additional basic demographic data was gathered by the researcher. Information was also collected

from the relevant teachers about the gender and age of their students. The researcher also noted information about the participating teachers, including nationality, gender, and years of teaching experience.

The class lists were used to match names to the consent forms and responses. A master list was made of all students, their class, their agreement to participate in the study, and their completion status of pretest and post-test. In order to collect data from each student, the researcher first determined if the child's parents had signed and completed a consent form. If they had, the researcher then checked if the student had completed both the pretest and post-test. If all three items were present, then the students were marked as participating in the study and assigned a number.

Once the participating students were determined, their pretest and post-test AUTs were labelled with their assigned number. The papers were then de-identified by cutting off the top strip of the paper with the student's name. The researcher then took and saved photos of the pretest and post-test for each participating student. These responses would then be scored and analysed, as detailed in the next section. Students who did not agree to participate or who were missing the pretest or post-test did not have their responses recorded.

Once the responses were collected from the paper AUTs, then they were digitized and organized. The responses were all transcribed and typed, following exactly what the participants had written. To compare responses and collect frequency data, the responses were then edited for accurate spelling. The responses were organized by participant number in a table. To sort the responses for part of the scoring, and to further de-identify the responses, all responses were also compiled into a list. There was a single list created for all pretest responses, and another list for all post-test responses.

Data was collected in this study from quantitative and qualitative sources. The quantitative data was collected at two points, the pretest and post-test, using the AUT instrument. Qualitative data was gathered using written responses to open-ended reflection questions. After this data was fully collected and organized, it was analysed.

Methods of Data Analysis

This study analysed the data collected from quantitative and qualitative instruments. The quantitative data was scored according to the four elements of creative thinking used in this study. These element scores were then combined to create an overall score for each participant's pretest and post-test. This data was then compared and analysed to observe changes between the pretest and post-test. A thematic analysis was completed using the qualitative responses to the reflection questions.

The pretest and post-test were scored and analysed according to the four elements of creative divergent thinking (Alternate Uses: Guilford's Alternate Uses, 2024). Participants were given separate scores for each of these four elements of creative thinking. Each student then received a total overall combined score based on the fluency, flexibility, originality, and elaboration of their responses.

Guilford's (1960) theory of creative thinking identified four main elements: fluency, flexibility, originality, and elaboration. These elements were used as the basis for designing the intervention in this study. In the intervention, students had one lesson on each of these four elements of creative thinking. Guilford's four elements of creative thinking were also used to evaluate and score the pretest and post-test.

These four elements of creative thinking formed the basis of this study. The elements were used to develop the scoring guide used to score responses for this study. Fluency is the ability to think of many acceptable responses. Flexibility is the ability to think of distinct types or categories of responses. Originality is thinking of responses different from others, as compared to other participants. Elaboration is adding detail to the responses. The scoring guide is explained below and can be found in Table 2.

A scoring guide was developed to score the responses on each of the four elements of creative thinking and was then used for determining the overall score. The original Alternate Uses Manual was referenced (Guilford et al., 1978). This manual provided a list of rules and examples of acceptable and unacceptable responses matching the objects used in test booklet. The acceptable and unacceptable responses were useful as examples of legitimate responses for the fluency section. However, it did not provide a complete holistic rubric or scoring guide appropriate for including all four elements.

This study was organized around using all four elements of creative thinking and the intervention intentionally taught each of these elements to the students participating in the study. Accordingly, a complete scoring guide was needed to target and measure all four elements. A more detailed scoring guideline with some examples of possible responses can be found in Appendix H. Additionally, it was found to be most useful to score using a rubric, with places to input the responses and then record the scores for each element and the total overall scores. Thus, a scoring guide was developed to be used in this study, as seen in Table 2 below.

Table 2*AUT Scoring Guide*

Study Number	Fluency	Flexibility	Originality	Elaboration	Total
Participant Responses:	Acceptable? 0 = unacceptable 1 = acceptable	Category: Letter for category code (A-O)	Compare category to all responses: 0 = > 5% (common) 1 = ≤ 5% (original) 2 = ≤ 1% (unique)	Score based on meaningful words in response: 0 = 1 word 1 = 2-4 words 2 = 5+ words	
Directions:	Count acceptable responses.	Count number of category codes.	Add response scores.	Add response scores.	
	Fluency Score:	Flexibility Score:	Originality Score:	Elaboration Score:	Total AUT Score:

Following this scoring guide, I analysed the AUT pretests to determine each participant's score for the four creative thinking elements used (Alternate Uses: Guilford's Alternate Uses, 2024). These scores were then combined to find a pretest individual total score. The same process was repeated for the post-test. After all pretests and post-tests were scored, the scores were compared. Individual pretest and post-test scores were compared within each of the four creative thinking domains as well as across the individual total scores. Any differences between the pretest and post-test scores were then calculated for the sample.

The four elements comprising the total were scored as follows. Each participant's pretest and post-test were scored separately. Every individual response

was scored on the four elements. Each participant received a score for their pretest fluency, flexibility, originality, elaboration, and overall. They then received a score for the post-test fluency, flexibility, originality, elaboration, and overall. Thus, between the two tests, each participant had ten scores as quantitative data points.

The fluency of the responses was the number of total acceptable answers given. The researcher first determined if the answers were acceptable or unacceptable for this section. Unacceptable responses were vague, repetitive, impossible, or nonsensical and received zero points. Any responses deemed unacceptable were not scored for the other sections. Acceptable responses were considered to be a plausible use of the object and received one point. The total number of acceptable responses were counted as the fluency score for this area.

Flexibility was the number of different categories in the responses. This researcher used the compiled list of all responses and sorted them into categories. The researcher assigned each response a category and labelled it with a letter code. There were 15 categories found for both the pretest and post-test, labelled with a letter code from A to O. The total number of distinct categories represented was found as the flexibility score for this section.

Originality compared each response to the total responses, with scores as zero, one, or two. The goal of this step was to find which responses were common, original, or unique. To determine the level of originality, the categories from the flexibility section were used. Each category was calculated as a percentage of the total responses given. Common responses given by greater than 95% of participants received zero points. Responses given by only 5% of the group were considered original and received one point. Responses given by just 1% of the group were

unique and given two points. Any points given for this section were added together to find the originality score.

Categories were essential for scoring both previous sections, flexibility and originality. Categorizing all the responses accurately was an important process, although there was a possibility for some category overlap or subjectivity. There was the same number of categories, 15, for both the pretest and post-test. There was also an “other” category designed for any responses that did not fit the other categories that had been determined.

The elaboration was the amount of detail included in the responses. Possible scores ranged from zero to two. To maintain consistency, this score was calculated based on the number of meaningful words in the response. Prepositions, auxiliary verbs, or generic words were not counted as meaningful words. Responses with only one meaningful word received a score of zero. Responses with two to four meaningful words were given one point. A response that included five or more meaningful words received two points. The points from the section were totalled to find the elaboration score.

Once each participant had their score for each of the four elements, these scores were added together to find an overall score. Each participant received an overall score separately for the pretest and the post-test. With all of the participants’ pretests and post-test scored by element and overall, this data was then analysed.

This study compared a particular group using a pretest and post-test. The Wilcoxon signed-rank test was utilized as the method of analysing this data. This is a nonparametric test used to compare two related samples (Rey & Neuhäuser, 2011). As this study had two sets of scores that came from the same participants, this data

analysis tool was appropriate to match the data. IBM SPSS Statistics (Version 30) was used to complete the Wilcoxon signed-rank test.

The data was analysed for each of the four elements and the overall scores. The Wilcoxon signed-rank test generated descriptive statistics, including range, median, and interquartile range. This test also showed how many participants had positive ranks, indicating an increase in their score. Additionally, the test showed the number of negative ranks that signalled a decrease in scores, and ties showing no change in scores. The test statistics produced a Z-score and p -value for the data. The results of the data analysis will be detailed in the next chapter.

For the qualitative data in this study, a thematic analysis was carried out. The researcher read all the responses to the six open-ended questions used in the reflection questions. Within each question and then holistically across all questions, the researcher sought out common themes that arose from the data. This analysis revealed five main themes that came across from this data. The researcher organized these themes using multiple examples from these responses. More information about the findings from the thematic analysis is found in the next chapter.

This study was designed to build a better understanding of the teaching and learning of creative thinking skills in elementary students. The research design considered the context and participants of the study. The instrumentation, methods of data collection, and methods of data analysis matched the goals of the study. The following chapter will share the results and findings of this study's data analysis.

CHAPTER 4: RESULTS

Introduction

This study used both quantitative results and qualitative findings to address the research questions. The pretest and post-test scores were analysed to compare the results of each and to find any changes. These scores were analysed in terms of each of the elements of creative thinking used throughout this study, along with comparing the overall scores. Findings were collected from the participant reflection on the learning process. The responses to these open-ended questions were analysed to find common themes. The quantitative results and qualitative findings are intended to be considered together. The results and findings uncovered are reported below.

Results

This study analysed the quantitative results from the Alternate Uses Test (AUT) and looked at any changes in scores between the pretest and post-test. Each of the four elements of creative thinking: fluency, flexibility, originality, and elaboration were scored and compared separately. These scores were used to determine the overall scores, which were also compared.

The results of this study indicated changes between the pretests and post-tests for each element of creative thinking studied, as well as changes in the overall scores. In the pretest, across all participants ($N = 61$), there were a total of 332 responses, with 1,441 words in all responses. In the post-test, there were a total of 578 responses for all participants using a total of 1,720 words.

Any responses that were found to be unacceptable in the fluency section were not used in any of the remaining sections. The number of unacceptable responses

was similar across tests, with 32 unacceptable responses in the pretest and 33 in the post-test. However, the unacceptable responses as a percentage of the total responses decreased between the pretest and post-test. In the pretest, 9.6% of the responses were determined to be unacceptable responses. In the post-test, 5.7% responses were designated as unacceptable.

This chapter will present the results of the analysis of each element as well as of the comprehensive total. The scoring process and points system for each element and the overall scores will be described, including a reasonable range of possible scores matching the demographic and time limit of this study. Each section will include the number of participants who had increasing, decreasing, or static scores. Descriptive statistics such as the range of scores and median score for both the pretest and post-test for each section will be described. Additionally, there are box and whisker plots included for each section to illustrate the changes.

This study used the Wilcoxon signed-rank test to analyse the data collected in the pretest and post-test. This analysis indicated significant differences in the pretest and post-test overall scores as well as the scores specific to each of the four elements. Significant changes were observed for all elements studied, with $p < .001$ for all. Each of the sections below details the results of this study. The results for fluency are explained, moving to each of the sections for flexibility, originality, and elaboration, and culminating with the section about the overall scores.

Fluency

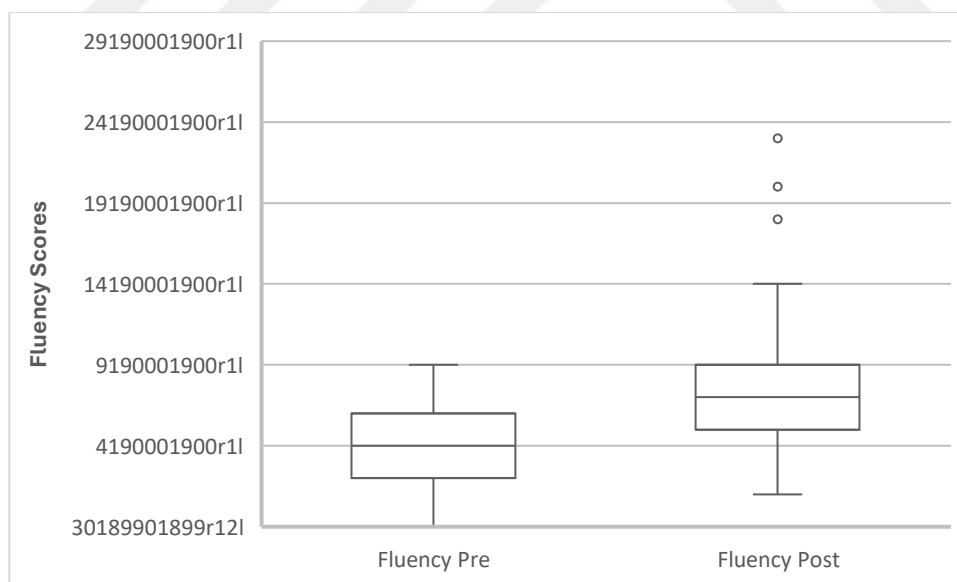
Using the pretest and post-test, participants were assessed on their fluency in generating responses to the prompt. In this section, participants were scored based on the number of acceptable answers. One point was given for each acceptable response. For this study, an acceptable response was defined as a clear use involving

the item in the prompt. Responses that were impossible, vague, or repeated received zero points. The acceptable responses were added together to create the fluency score. The fluency score contributed to the pretest and post-test overall score for each student. This study used an open-ended prompt which allowed an unrestricted possible number of answers. Within a three-minute time limit, a reasonable range of fluency scores for this demographic could be 0 to 30.

With $N = 61$, from the pretest to post-test, 54 participants showed an increase in fluency, while five remained the same and two demonstrated a decrease. The scores in the pretest ranged from 0 to 10 with a median fluency score of 5. The post-test scores had a range of 2 to 24 with a median fluency score of 8. The changes in median and interquartile range can be seen in Figure 1.

Figure 1

Pretest and Post-test Fluency Scores Box and Whisker Plot



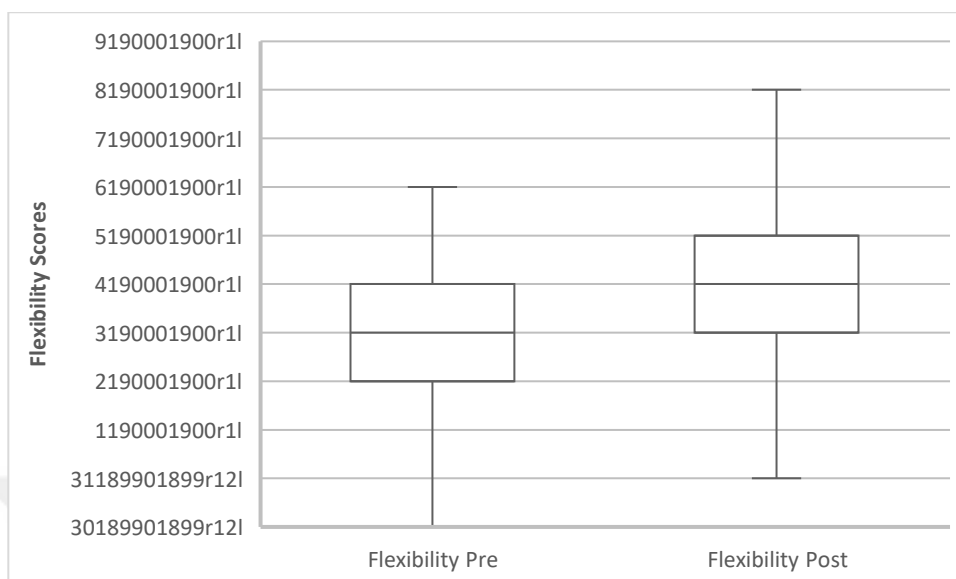
The Wilcoxon signed-rank test indicated a statistically significant change in fluency scores ($Z = -6.420, p < .001$). The observed differences between the pretest and post-test are significant. Therefore, we can interpret that the intervention

contributed to an increase in creative thinking fluency in the AUT, as scored in this study.

Flexibility

Study participants were assessed on the flexibility of their responses. For this section, participants were scored based on the number of different categories in their acceptable responses. Each response was assigned to a category of use for the object prompt. Both the pretest and post-test were determined to have fifteen categories of responses. Distinct categories received one point, while repeated categories received zero points. Unacceptable responses, as scored in the fluency section, were given zero points. Flexibility scores were determined by counting the total number of different categories. This flexibility score was added to the overall score for the pretest and post-test for each participant. With this study's open-ended prompt and three-minute time limit, a reasonable range of flexibility scores for this demographic could be 0 to 10.

This study had N = 61 participants. Between the pretest and post-test, 39 participants demonstrated an increase in their flexibility scores, 12 decreased, and 10 scores did not change. The pretest flexibility scores had a range from 0 to 7, with a median score of 4. Post-test flexibility scores ranged from 1 to 9 and had a median score of 5. Median and interquartile range changes can be viewed in Figure 2 below.

Figure 2*Pretest and Post-test Flexibility Scores Box and Whisker Plot*

Using the Wilcoxon signed-rank test indicated a statistically significant change in flexibility scores ($Z = -4.153$, $p < .001$). There are significant differences observed between the pretest and post-test. Thus, we can interpret that the intervention contributed to an increase in creative thinking flexibility in the AUT, as scored for this study.

Originality

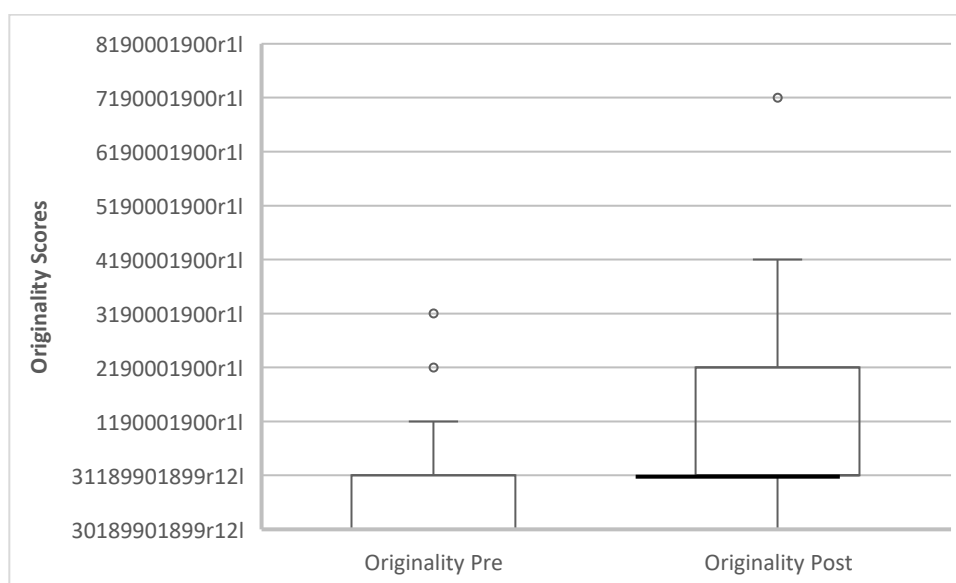
Participants in this study were assessed on the originality of their responses, as compared to the other participants in the study. The originality section used the categories determined for the flexibility section. Using the category of the response, each acceptable response was given an originality score of 0, 1, or 2. A score of zero indicated that the category of the response was common, given in more than 5% of responses. A score of one indicated an original response, as the category was given in 1-5% of responses. A score of two indicated a unique response, as the category was given in less than 1% of responses. Any response scored as unacceptable in the

fluency section received zero points. The scores for each participant's responses were added together to find the total originality score for this section. The originality score was added to each participant's overall pretest and post test score. This study used an open-ended prompt and three-minute time limit, so a reasonable range of flexibility scores for this demographic could be 0 to 9.

There were $N = 61$ participants in this study. There were 43 participants who showed an increase in originality scores between the pretest and post-test, while nine scores were the same and nine decreased. The originality scores in the pretest ranged from 0 to 4 with a median score of 0. Post-test originality scores ranged from 0 to 8 with a median score of 1. Figure 3 below shows the changes in median and interquartile ranges for pretest and post-test originality scores. In Figure 3, the median and the 25th percentile are equivalent.

Figure 3

Pretest and Post-test Originality Scores Box and Whisker Plot



The Wilcoxon signed-rank test indicated a statistically significant change in the originality scores ($Z = -4.613$, $p < .001$). The observed differences between the

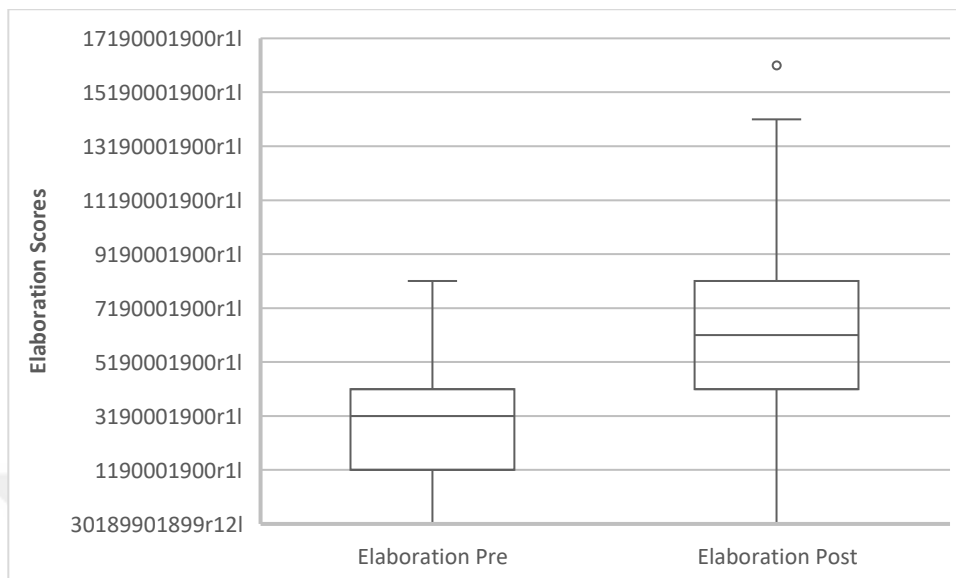
pretest and post-test are significant. We can therefore interpret that the intervention contributed to an increase in AUT creative thinking originality, as scored in this study.

Elaboration

Participants in this study were assessed on the elaboration included in their responses to the prompt. The elaboration section was scored using the number of meaningful words included in each response. Prepositions, auxiliary verbs, or generic words were not determined to be meaningful words. Using the number of meaningful words in each response, participants received a score of 0, 1, or 2. Responses that included only one meaningful word received a score of zero. Responses with two to four meaningful words were given one point. Two points were awarded for responses that included five or more meaningful words. Responses marked as unacceptable in the fluency section received zero points. The points were added together to find the total elaboration score for each participant's pretest or post-test. With this study's open-ended prompt and three-minute time limit, a reasonable range of elaboration scores for this demographic could be 0 to 18.

With $N = 61$ participants in this study, 45 showed an increase in their elaboration scores, while six participant scores remained the same and 10 decreased. The range of elaboration scores in the pretest was 0 to 9 with a median score of 4. In the post-test, the range of elaboration scores was 0 to 17, with a score of 7 as the median. The median and interquartile range changes can be seen in Figure 4.

Pretest and Post-test Elaboration Scores Box and Whisker Plot



The Wilcoxon signed-rank test indicated a statistically significant change in elaboration scores ($Z = -5.214, p < .001$). There are significant observed differences between the pretest and post-test. Therefore, we can interpret that the intervention contributed to an increase in creative thinking elaboration in the AUT, as scored for this study.

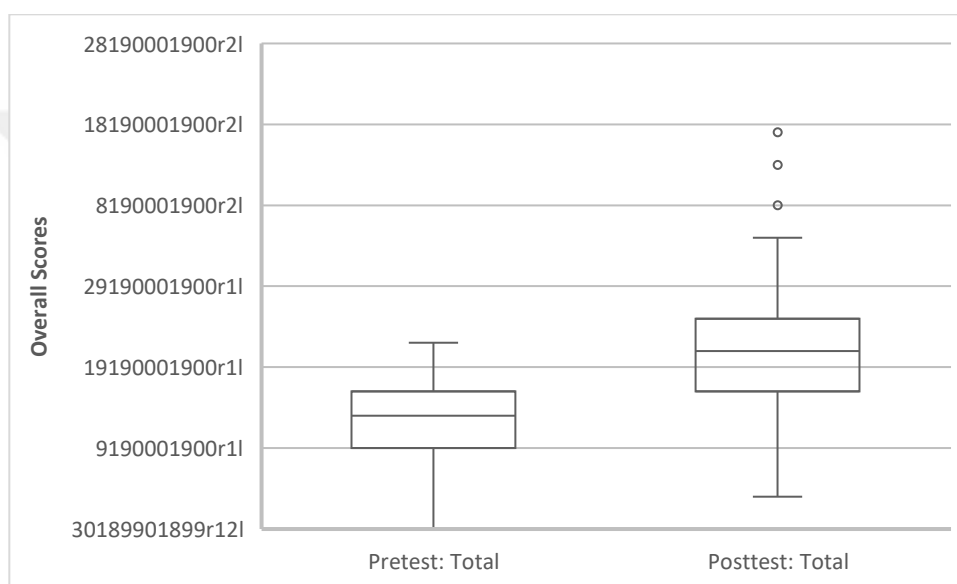
Overall Scores

Finally, participants were assessed on their overall creative thinking skills, as observed in the pretest and post-test. This score included the total of each of the scores from fluency, flexibility, originality, and elaboration. Scores from each of these sections were added together to create the overall score for each participant's pretest and post-test. Considering this study's open-ended prompt and three-minute time limit, a reasonable range of overall scores for this demographic could be from 0 to 60.

This study included $N = 61$ participants. For their overall scores, 55 participant scores increased, three did not change, and three decreased. In the pretest, the overall scores ranged from 0 to 23, with a median score of 14. In the post-test, the overall scores had a range from 4 to 49 and a median score of 22. Figure 5 below shows the changes in median and interquartile ranges.

Figure 5

Pretest and Post-test Overall Scores Box and Whisker Plot



Using the Wilcoxon signed-rank test indicated a statistically significant change from pretest to post-test in overall AUT scores ($Z = -6.404, p < .001$). The observed differences between the pretest and post-test overall scores are significant. Thus, we can interpret that the intervention contributed to an increase in creative thinking skills, as scored in this study using the AUT.

Findings

This study also discovered findings by collecting qualitative data in the participant reflections. After the post-test was completed, participants were asked to reflect on their experiences and learning journey. There were two parts of the

reflection conducted at the end of the study: a questionnaire and open-ended questions. This reflection was administered and collected as a Google Form, as all students had Chromebooks and used Google Classroom throughout the school year. The reflection was intended to gather qualitative data on the entire learning process over the course of the study, including the pretest and post-test along with the intervention lessons.

Participants were invited to reflect on the process of learning about creative thinking. The responses were self-reported by each participant, with specific questions given as the prompts. Students were given the opportunity to respond to six open-ended questions, with the last question being optional:

1. What does creative thinking mean to you?
2. What were the most useful parts of the creative thinking lessons?
3. Do you think of yourself as a creative thinker? Why or why not?
4. How did learning about creative thinking help your writing?
5. How did learning about creative thinking help you with the PYP Exhibition?
6. Is there anything else you would like to tell the researcher?

There were 74 students who completed the reflection questions. There were 90 students in total who participated in the study overall; however, only some were eligible to have their scores compared and analysed for the results section. To respond to the reflection questions, a space for long answer text was provided within the Google Form. Responses ranged from one word to several sentences.

These responses were analysed for common themes. The researcher uncovered five main themes revealed across the responses. These themes were: skill development, mindset, communication, practical applications, and challenges. Each

theme will be briefly defined and summarized. A few illustrative quotes from participants will be included that highlight or demonstrate each theme. For clarity, some of the quotes have been edited for spelling.

Skill Development

Overall, many of the responses indicated growth, greater understanding, and development of creative thinking skills. The first and second reflection questions asked about creative thinking and the intervention lessons. Many participants indicated that they had developed a deeper understanding and appreciation of creative thinking skills and their applications. For example, one participant explained *“The most important part was learning new techniques and using them.”* Some of the participants mentioned the value or importance of creative thinking.

Several participants included language and vocabulary used in this study, including the four elements of creative thinking. Some students explicitly named one of these four elements, explained the element, or provided examples. For example, a participant said that it was helpful to learn about *“the word’s meanings because I can use that word at another space.”* Another participant described the vocabulary as being interrelated: *“Actually all of them [are] really important because they all hold each other.”* This indicated an expanded understanding of the four creative thinking elements used throughout the study. Overall, many of the participants in this study articulated an understanding of the context for creative thinking, and possible applications for using their creative thinking skills.

Mindset

Many participants expressed their self-perception as creative thinkers. The third reflection question asked participants if they think of themselves as creative thinkers, and to explain why or why not. Many students responded in the affirmative

and mentioned an example of their creative thinking. Some participants mentioned imagination or some type of self-expression. Some examples of how the participants described creative thinking included: *“It means thinking of many different things and being unique.”* and *“For me it means to think in different ways and expressing yourself.”* Other students described creative thinking in terms of diverse perspectives, *“Creative thinking means thinking different ideas from others.”* or *“It means a way of generating new ideas in different perspectives and different situations.”* However, another student was still considering who can use creative thinking and asked, *“can some people learn to be creative or is it something some people have and others don’t?”* The responses indicated thoughtfulness and growth in understanding themselves as creative thinkers.

Other participants communicated their appreciation or enjoyment of the creative thinking lessons. Several participants said they felt the lessons were fun, interesting, or enjoyable. Other participants thanked the researcher for organizing the lessons. Some responses revealing positive mindsets included: *“It was very fun and I learned many new things.”* and *“I think doing these lessons helped everyone. And this was a really fun lesson.”* Several of the students expressed appreciation and well wishes to the researcher: *“I want to tell thank you Ms. Linnea for giving us a chance to learn about creative thinking.”* and *“I love your teaching ways.”* Most participants overall expressed some degree of appreciation or positive effect of the lessons.

Communication

Some participants mentioned benefits to their communication skills from the creative thinking lessons. The fourth reflection question asked participants to consider how learning about creative thinking helped their writing. Communication was mentioned in the context of writing, along with the quality of their overall

communication. Several of the participants expressed that they felt greater confidence in their writing, for example that the lessons *“helped me find more unique and exciting ideas.”*

Several students mentioned improvement to their creative writing. The emphasis on creative writing is perhaps expected under the context of the study, as the intervention lessons took place during the lesson time originally allotted for creative writing. Additionally, the lessons utilized writing as a method to express and document creative thinking. Several students stated that they were now finding new ways to describe or add more detail to their writing, saying that the lessons *“helped by helping me think more imaginative.”* Other students mentioned that they felt more confident in thinking of subjects and ideas for their writing, *“It helped because then I started being really creative. It helped a lot with my writing.”* These responses indicate that participants were immediately able to apply their learning about creative thinking and experienced improved communication skills.

Practical Applications

Several of the participants included some practical applications in their responses. Some of the students mentioned problem-solving or aspects of the Primary Years Program (PYP) Exhibition process. The fifth reflection question asked how learning about creative thinking helped them with the PYP Exhibition, an important project at the end of their PYP learning journey. Some of the participants included a context for using creative thinking, including solving problems.

An important circumstance of this study was that it was conducted during the second half of the period of the PYP Exhibition. In their responses, several of the participants mentioned creative thinking as helpful for specific steps of the PYP Exhibition learning process. Some students stated that they had used creative

thinking during the planning, brainstorming, or thinking of topics or ideas phase of exhibition: *“Because we learned about creative thinking we had more interesting ideas at PYP Exhibition.”* Others found it useful while researching, including when formulating questions, interviewing, or explaining their issue. A few said that they felt that creative thinking was helpful for presenting and communicating their learning at the end of the project, *“it helped me make something original.”*

Additionally, participants answered that it helped them to think of ideas for actions to take towards the end of the Exhibition learning process: *“We thought how to connect our passion to action.”* and *“Creative thinking help[ed] me by making action and interviews during PYP [Exhibition] time.”* Some students identified creative thinking as helpful for thinking of solutions to address the issue they had chosen, especially *“to find different ways to solve ideas.”*

In the reflection questions, participants were explicitly asked about creative thinking and the PYP Exhibition. While there was a clear reference to this project from the researcher, participants were not asked about particular phases or components of the learning process. Within this prompt, participants spontaneously mentioned several distinct steps they had learned about as part of their PYP Exhibition learning journey and related these steps to their learning about creative thinking.

Challenges

Several participants mentioned challenges or constructive criticisms of the study. In response to the reflection questions, some of the participants expressed only a basic understanding of creative thinking or the four elements of creative thinking used for this study. Others responded with merely basic responses or did not articulate their answers with additional details. Some of the responses stated that they

did not find the lessons useful overall or that they only saw a minimal value of the lessons, with responses such as “*they did not help me at all.*” Others said that they did not find the lessons helpful for a particular goal, such as for creative writing or the PYP Exhibition. A few of the participants did not see a clear value for creative thinking in general or recognized only a marginal value. Other participants mentioned growth in one area but not in others, indicating inconsistent growth.

Several of the responses expressed that the material of the study was challenging for them. In particular, some of the language used for the reflection questions was difficult for some students to comprehend. Some participants mentioned that some of the vocabulary used was hard for them to grasp, one student lamenting “*why are the words so hard[?].*” Several students said that they felt the lessons were complex or not made at an appropriate level. Some of them made suggestions to the researcher, such as “*you could make it more short and specific*” or “*it could be shorter and more kid friendly.*” These recommendations included making the lessons more engaging, accessible, or simple.

Finally, some participants made suggestions to the researcher about expanding the scope of the creative thinking lessons. A couple of students suggested that other grade levels could also benefit from learning about creative thinking. “*I think creative thinking could help other grades as well. If we are the only grade that is doing this activity, I feel like we could introduce this topic to other grades as well in order to help them with their exhibitions.*” This feedback and constructive criticism are useful to consider in the context of implications for practice and further research.

Conclusion

This study sought to discover more about how a divergent thinking intervention could change students' abilities to express novel ideas. Further, it looked at how creative thinking could affect inquiry learners. The results of the study indicated an effect from the intervention. The findings from this study showed several themes in the participant reflections on their learning journey, related to skill development, mindset, communication, practical applications, and challenges. Next, the implications of this study will be discussed. Possible applications and uses of these results and findings will be explored, in terms of learners and educational practice, as well as for further research.

CHAPTER 5: DISCUSSION

Introduction

This study was conducted in pursuit of a better understanding of creative thinking skills within a fourth-grade international school context in Türkiye. The study used divergent thinking, especially the Alternate Uses Test (AUT), as a means of measuring creative thinking skills. The results of this study revealed the benefit to students of explicitly teaching creative thinking skills and vocabulary. The intervention used in this study indicated an influence on students' divergent thinking skills.

In this chapter, we will consider the purpose and potential benefits of the results of this study. The major findings uncovered in this study will be summarized. We will consider possible implications for practice, including how educators and educational systems could benefit from the results of this study. Opportunities and implications for further research will also be discussed. Finally, it is important to consider the limitations of the study. Taken together, these can help to think about this study within a broader context.

Overview of the Study

This study aimed to benefit teachers, students, and the field of creativity in education. The participating teachers learned new strategies for teaching creative thinking skills. They were also able to see some of the benefits to learners by explicitly teaching these creative thinking skills. Participating students developed their creative thinking skills and grew in their abilities to apply creative thinking. It is hoped that students were also able to apply their creative thinking skills beyond the

given context of the AUT or at least see the possibilities to transfer their learning to other contexts. As part of the reflection questions after the post-test, students were asked specifically about how the creative thinking skills learning process helped them to improve their writing and their PYP Exhibition project. These questions gave an opportunity for students to identify the relevance of their learning for this project beyond the current study. Additionally, this study adds to the body of research related to creativity and creative thinking in education.

Discussion of Major Findings

This study demonstrated that a divergent thinking intervention has the potential to influence students' divergent thinking skills when measuring fluency, flexibility, originality, and elaboration. Furthermore, creative thinking seemed to have a positive effect on inquiry learners and their perceptions and applications for creative thinking, in this fourth-grade international school setting in Türkiye. Therefore, we can learn from this study that a creative thinking intervention has an effect on students' creative thinking.

The intervention used in this study influenced students' scores. There were notable changes observed from the pretest to post-test scores. The effect was visible to varying degrees in each of the four elements explored in this study, measuring fluency, flexibility, originality, and elaboration. There was also a clear improvement in the overall combined scores, indicating general growth in creative thinking skills.

This study evaluated and scored responses based on a model of the four elements of creative thinking: fluency, flexibility, originality, and elaboration (Baer, 2016; Guilford, 1956). The responses revealed a few unique characteristics, in relation to each of these four elements. For example, some of the responses with high fluency scores had low flexibility scores. This indicates that participants were able to

produce many ideas, but within the same category. Some researchers, including Acar and Runco, have mentioned the issue of contamination, with a higher volume of responses usually leading to higher scores for other areas tested (2019). In the post-test of this study, flexibility was notably higher, with more students giving responses in different categories. Several participants gave responses in all or mostly different categories. The notable changes in fluency and flexibility scores could be related to these areas being simpler for the students to grasp.

The scores for originality and elaboration were lower than for the other two categories, showing less variation from pretest to post-test. This is partially because the scores for these elements are based on fluency and flexibility. Also, the scoring rubric for originality and elaboration called for scores for each response of 0, 1, or 2, with most of the responses receiving zero for originality or elaboration. These two categories seemed to be more challenging for students to comprehend, compared to fluency and flexibility. This observation invites the possibility of targeting interventions to focus on specific elements of creative thinking.

There were several interesting themes that arose from the qualitative findings in this study. Several students seemed enthusiastic about the creative thinking lessons and expressed their enjoyment or appreciation. Many of the students seemed more confident with creative thinking and used ideas and terminology from the study. It was gratifying to read that many of the students saw themselves as creative thinkers and had developed positive mindsets toward creative thinking. It also seemed that most of the students found the creative thinking lessons relevant, and they were able to apply their learning toward creative writing and the PYP Exhibition. While there have been a few studies focusing on the PYP Exhibition, I was not able to locate any with a specific emphasis on creativity or creative thinking. For example, a study

conducted with the support of the IB looked at the effect of the PYP exhibition on a few factors, including critical thinking (Medwell et al, 2017).

This study demonstrated the value of teaching creative thinking skills. The results of the study indicated a noteworthy influence of the creative thinking interventions on the inquiry learners of this study. This effect is similar to previous studies undertaken involving creative thinking (Baer, 1996; Fink et al., 2019). With this in mind, we will consider the implications for practice as well as the implications for further research.

Implications for Practice

This study uncovered some important possible implications for practice for educators, classrooms, schools, and educational systems such as the IB. Teachers can consider finding opportunities to connect to creative practices, including teaching creative thinking skills. Connections can also be made to literature and creative writing. The four elements of creative thinking used for this study will be considered in the context of classroom teaching, mainly at the elementary level. I will also think about the implications of teaching creative thinking skills across a school year or across grade levels. Beyond individual classrooms and schools, I will investigate possibilities for practice within the IB curriculum framework as well as in Türkiye.

Classroom Contexts

The results of this study invite contemplation on how to apply creative thinking skills across elementary classrooms. While this study took place in fourth-grade classrooms, other levels could also potentially benefit. Classroom practices involving creativity and creative thinking could help students to develop these skills. As this study demonstrated, creative thinking skills can be improved by explicit, targeted teaching of these skills. With their context and content requirements in

mind, teachers could find opportunities to integrate lessons using creative thinking. Beyond isolated one-off lessons, creative thinking skills could also be taught as a unit, or throughout the year for a stronger cumulative effect. For example, Ritter et al. (2020) conducted a study on a one-year creativity training with students in higher education. It would be interesting to extend this idea to younger grades with a similar long-range study on creativity training with elementary students.

We can engage our imaginations, for a moment, to envision a few specific circumstances, lessons, or projects involving divergent thinking or creative thinking. The AUT itself could be adapted, as a prompt asking learners to consider other uses for an object. Instead of responding to the AUT on paper, students could use physical objects as prompts to handle and manipulate. Students could also take turns sharing responses with a small group, building on the responses of others. Students could be directed to imagine the uses of an object, such as the cup used in the post-test, with different properties. For example, the post-test AUT used a small image of a cup but did not specify the size or material. Students could consider the uses for a giant metal cup or for a tiny paper cup, among other properties. Students could even think about uses for a combination of multiple objects. Beginning with the idea behind the AUT can open some possibilities for developing creative thinking skills.

This study used four elements of creative thinking as the main organizing theoretical framework. Teaching creative thinking skills could also use these elements in different contexts. Fluency, flexibility, originality, and elaboration could be used in relation to several subjects. For example, in math, with a number given as the answer, students could think fluently by using different combinations and operations to create the number. Students could also think fluently by using the same shapes, such as tangrams, to create unique designs. A real-life context for solving a

math problem could be given, requiring students to think of a range of possible solutions. In a science lesson, students could think flexibly and group living things based on distinct categories. As a social studies project, students could think with originality and design their own community. Connecting science and writing, students could think with elaboration, while describing a plant in detail. Creative thinking is an integral part of the subjects related to visual and performing arts. Classroom teachers can think about their learning goals and find chances to integrate creative thinking to enhance learning.

Inquiry-based learning and project-based learning lend themselves to creative thinking. In a science class or as a Science, Technology, Engineering, and Mathematics (STEM) activity, students could be given a set of materials and asked to create a specific structure, such as a tower or weight-bearing shape. When learning about sustainability, students could combine recycled materials to create original artwork or useful objects. Related to algebra and geometry, and to sustainability, students could be challenged to find ways to maximize the volume of a box while minimizing the surface area. Students could study the forms of poetry or structure of short stories and use these as inspiration to compose original poems or stories. Any rich and in-depth unit of inquiry or project can include an aspect of creative thinking.

Literacy learning also has many opportunities for creative thinking. There are several examples of children's literature that connect to the idea of divergent thinking or creative thinking. For example, the books "Not a Box" and "Not a Stick" illustrate for younger readers the power of imagination and connect to the idea of divergent thinking behind the AUT (Portis, 2006; 2007). Several books by Peter H. Reynolds, including "The Dot" and "Ish" invite readers to engage in creative thinking (Reynolds, 2003; 2004). A book that demonstrates thinking divergently

about math concepts is “Zero is Not Nothing” (Sitomer et al., 1978). The intervention used in this study used creative writing prompts, as a way for students to practice their creative thinking skills. Classroom creative writing prompts could include images, questions, short statements, or scenarios. Students could be prompted to focus on a particular element of creative thinking in their creative writing. Creative thinking naturally lends itself to learning through creative writing and creative literature.

Educators can find opportunities to teach, practice, and engage in creative thinking skills throughout the course of the school year. The basic design of this study could be introduced early in the year, then repeated a few times during a school year, using different prompts. Creative thinking could even become a recurring central theme or driving force for an elementary classroom. For example, students could respond to a creative thinking prompt at the beginning of the school day, or each writing lesson could begin with creative writing. Genius Hour is an ongoing project that uses creative thinking to think of ideas and go through the learning process (Ramadhan et al., 2023). The power of using creative thinking as a stance or mindset can be leveraged to engage students across the curriculum.

School-Wide Initiatives

Creative thinking skills can build over time, across not only one school year, but across grade levels within a school or even in a school system. Creative thinking skills could be considered an integral part of the curriculum. A parallel example to consider is the role of critical thinking skills in the IB’s Diploma Programme Theory of Knowledge (TOK) course (Cole et al., 2015). Centering creative thinking skills in the curriculum provides chances for educators to design age-appropriate creative

learning experiences and projects for different age groups. As one student mentioned in their reflection, creative thinking can be helpful for other grade levels too.

Beyond specific grade levels, creativity and creative thinking could be treated as school-wide initiatives. School-wide events, such as a creativity festival or arts fair, can help to showcase and promote a wide range of creative thinking. Creative thinking could also be applied toward school-wide design challenges, for example related to sustainability or shared spaces. Engaging with sustainability could also help students to find real world applications for solutions related to the UN's Sustainable Development Goals (Mayr & Vollmer, 2023). Leadership within schools can emphasize the importance and value of creative thinking by creating and nurturing opportunities for creative thinking across a school.

Teacher Training

A critical component of this study was the teacher workshop. This training was essential for ensuring that the collaborating teachers understood the idea behind creative thinking, as well as preparing educators for their role in implementing the intervention in the study with their students. The workshop used in this study could be extended or delve more deeply into the concepts of creative thinking, divergent thinking, their elements, and applications.

Teacher training on creative thinking methods, tools, and strategies is a key factor in implementing creative thinking in schools (Mullet et al., 2016). Teachers can be encouraged to be creative and bring creativity practices into their classrooms. With the proper training, teachers can implement creative thinking activities and interventions to help their students develop their creative thinking skills.

IB PYP Curriculum Contexts

This study was conducted toward the end of the PYP Exhibition project time for the participating classrooms, and one of the reflection questions asked how the study helped with this project. Creative thinking can be useful throughout the PYP Exhibition learning journey. Creative thinking skills could be broadly applied across this process, including during specific points. For example, brainstorming ideas during the planning stage is a form of divergent thinking. Presenting, sharing, or communicating their learning at the end of the process must include some aspect of creative thinking. The use of creative thinking can be a valuable asset for learners during the PYP Exhibition process.

It is essential to consider this study in the context of the IB curriculum framework and inquiry-based curricula, especially as part of the focus of the study looked at the effect on inquiry learners. To be effective inquiry learners, PYP students must develop a broad base of skills. This study demonstrated the importance of explicitly teaching creative thinking skills. The development of any skill requires a specific context and related content. Creative writing was used as the context for developing these thinking skills, and connections were made to the PYP exhibition. It is important to connect this study to the IB context and the growth of inquiry learners.

As a researcher who is also a PYP educator, these results make me consider how best to teach and assess other thinking skills, especially the *Approaches to Learning* (ATL) skills embedded in the PYP. The ATL skills are an essential part of the PYP and include social skills, research skills, thinking skills, communication skills, and self-management skills. It can be useful for educators to think about the best contexts to teach each of these skills, including which skills require targeted,

explicit instruction. It is also helpful to deliberate on what evidence can be used to appropriately assess the development of these skills, at different grade levels and phases. This study indicated that students had the ability to improve their creative thinking skills when an explicit intervention was used. Within a classroom, additional or more specific evidence could be collected to demonstrate ongoing skill development. Beyond creative thinking skills, other interventions could be evaluated to find the most effective ways of teaching specific ATL skills. PYP educators are wise to take a deliberate approach to the teaching and assessing of thinking skills, along with the other ATL skills.

Türkiye Context

The context for this study was in Türkiye. When considering implications for practice, it is important to reflect on how this study can be useful for its' original context. One option is to emphasize developing creative thinking skills in schools. Developing thinking skills can help to improve the ability to face local and global challenges. Among other skills, teaching creative thinking skills can also help to increase the competencies and competitiveness of the country's young people, thus improving their educational outcomes and contributions to society. There are many opportunities to consider how to develop creative thinking skills within Türkiye.

This study revealed numerous opportunities to put the teaching of creative thinking skills into practice in classrooms and educational institutions. Classroom teachers can find opportunities for their students to engage in creative thinking in lessons, projects, and different subjects. Creative thinking skills can also be developed across a school year or across grade levels. Schools can show their encouragement and value for creative thinking skills. Creative thinking skills can also be explored further across the IB PYP curriculum framework and in Türkiye.

Implications for Further Research

This study's findings suggest opportunities for further research. For example, similar studies could be repeated with varied contexts. This type of study could also be repeated across periods of time. Another area of focus is the design of the AUT and the prompt, as well as the scoring of the responses to this test. Building on the results of this study, other studies could measure the impact of teaching other specific skills or take a broader perspective. The results of this study indicate some areas for possible further research.

Varied Contexts

To strengthen the results of this study, it could be repeated in different settings. While this study focused on fourth-grade students at an IB school in Türkiye, any of those descriptors could be changed for a subsequent study. For example, the study could be repeated with different elementary grade levels to observe variances in results for different ages. Younger children could give their responses orally, instead of in writing. It would be interesting to conduct the study with older students in a secondary school in Türkiye, either in a similar private IB school setting or in a public school. A study comparing creative thinking skills in different curricula could help to better understand the role of each curriculum in fostering thinking skills. The core of the content in the intervention could remain the same, while adjusting for higher grade levels. This study could also be repeated with students in other countries or with a different demographic profile. It would be interesting to look at creative thinking at schools with different curricula. A larger pool of participants could also be used. Another way to conduct further research would be to use a control group to compare to the experimental group. This study could be repeated under different circumstances.

Further research could also see this study being conducted as a repeated measure over time. One way this study could be used in a repeated measure would be if the creative thinking interventions were repeated throughout the course of a school year, using different prompts. This type of study could track changes over the course of the academic year. Researchers could repeat the measurement of creative thinking on a monthly or quarterly basis and then find differences overall as well as between different points. Given more time, the study could be repeated with the same students at a later age. This could help to see the effects of a creative thinking intervention over a longer period of time.

With additional time and resources, a longitudinal study could be undertaken to better understand the outcomes of developing creative thinking skills, to track student growth across multiple years. This type of study could have intermittent checkpoints to measure creative thinking, while also measuring overall growth in creative thinking skills. A longer period of time could be helpful for grasping a better understanding of how creative thinking skills change over time. It would be useful to examine the effect of factors such as creative thinking skills or creative mindsets on the results of the PYP exhibition. With the present study, it would be interesting to follow up with the students who participated at a later date, to see if the attitudes observed remain persistent.

Divergent thinking tests could also be extended to be applied within the PYP. For example, the PYP could develop tools to measure student achievement of the ATL skills, including thinking skills. The Alternate Uses Test could be used as a way to measure the creative thinking of learners, or to determine if a creative thinking learning engagement or intervention is successful.

AUT and Scoring

An approach for further research would be to examine the AUT prompt used in this study. A similar study could be conducted with different objects for the prompts. The prompts themselves could be improved. For example, it would be helpful to add directions to put each response on a new line, for ease of reading the responses, as some participants wrote several responses on the same line. Alternative formats for the prompts could be tested, to determine which is the best fit for the target age group of students. The AUT prompt could be fine-tuned to increase the accuracy of the measure.

The scoring of the AUTs could be refined and improved. Several researchers have suggested adjustments or changes to the AUT scoring process for greater clarity or simplicity (Alhashim et al., 2020; Reiter-Palmon et al., 2019; Silvia et al., 2008). The change that would have the biggest impact is to have clear and standardized scoring for the AUT. This would allow for increased reliability and comparison across studies using this measure to evaluate creative thinking potential. A scoring rubric would be helpful for use across AUTs, even with different objects as prompts.

Different rubrics could even be developed depending on the goals of the researcher. For example, this study evaluated all four elements of creative thinking, while some other studies just focus on fluency. One part of the AUT scoring that would be helpful to improve would be the categories used for the flexibility and originality sections. Other researchers could develop lists of categories and possible responses in each category using the AUT prompts. This would make it easier for other researchers to compare the responses from their studies to an established list. Improvements to the AUT scoring would also make it easier to compare results of these studies.

One key area that could help to improve the AUT in further research is to consider who is doing the scoring. Further studies using a similar model could use independent scorers to increase data reliability. Multiple independent scorers could evaluate the AUTs, then these scores could be used to calculate the average final score for each participant. As there is some subjectivity to scoring the AUT, a process using multiple independent scorers could help to reduce bias and enhance the accuracy of the results. Another strategy to increase the reliability of the scores would be to randomly assign some students to complete the paperclip prompt as the pretest, while others use the cup prompt as the pretest, and then switch for the post-test. This would help to make scorers blind to whether they are scoring a pretest or post-test. Further studies could increase the reliability of the data by including checks on scoring.

Another interesting possibility to simplify the laborious process of scoring is to use automated scoring that matches the scoring rubric. Technology could be leveraged to make the scoring process easier to complete (Acar & Runco, 2019). A website or program could be used to expedite the process for researchers to score and analyse AUTs. This could also be used by teachers or other practitioners to reduce the burden of scoring. Participants could input their responses directly, for automatic scoring. Responses could be automatically sorted into categories, and then originality could be calculated based on all responses. This would create a larger body of responses for the AUT. Researchers or practitioners could still verify the scoring for accuracy. Some researchers have used tools such as Large Language Models to generate categories to analyse flexibility (Hadas & HersHKovitz, 2024).

While this study focused on creative thinking skills, further studies could measure other thinking skills, the ATLs, or other specific skills. For example,

alongside creative thinking in the PYP's ATLs are critical thinking skills (International Baccalaureate, 2018). It would be helpful to further evaluate the best practices in teaching critical thinking skills, as well as how to adequately assess these skills. Other studies could include a broader context, perhaps looking at the best way to integrate or assess ATLs throughout a PYP Program of Inquiry. Further research could examine the relationship between creative thinking skills and other curricula. The results of this research suggest the potential to study other skills in similar ways.

This study strove to gain a better understanding of creative thinking skills in a fourth-grade IB international school context. Further research could go beyond or dig into the finer details of conducting this type of study. Similar studies could be repeated with variations in circumstances and context. Over a set period, this kind of study could be conducted as a repeated measure. The AUT prompts and scoring used in this study could be improved. Other research could go further to look at other skills. The results from this study show opportunities for further research.

Limitations

There are some important limitations to consider when interpreting the results of this study. This study should only be applied and considered within the context used for the study. There are limitations related to the students, classrooms, teachers, school, and curriculum. There are also relevant limitations for the prompts, materials, and scoring, particularly the element of subjectivity and the use of parallel tasks for the pretest and post-test.

This study was limited to the students studying at the school used for the study. The study used a convenience sample of students as participants. All the students in all five fourth-grade classes at this school participated in the creative thinking lessons. This study was fully conducted in English and materials, other than

the parent consent form, were not provided in Turkish. Due to the limitations of classroom schedules, students participated in the intervention lessons in their regular homeroom classes with their international homeroom teachers. Each classroom was unique and had some differences, with the class lists created purposefully before the school year began. The classroom groupings were not randomized and not identical in composition. Additionally, although the participating teachers received the same training, they had different teaching styles, backgrounds, and personalities. The researcher also participated as a teacher for this study and had greater background knowledge on the topic as compared to the other participating teachers. This study had some limitations related to the classrooms and teachers who were a part of the study.

There are a few limitations to consider related to the participants of this study. Due to absences, some students missed some of the lessons. Participating teachers were asked to ensure that all students take the pretest before the intervention lessons began. The teachers in this study were also requested to administer the post-test and reflection questions after all intervention lessons had been completed. However, this study did not track which students missed which lessons.

A few weeks before this study began, students participated in a science activity using magnets and paperclips floating on water to make a compass. In the pretest AUT, many students wrote “compass” or “magnet” as an example of a use for a paperclip. Without this activity being completed recently, few may have mentioned this usage. Students were reminded or primed by recalling this recent activity.

The study was conducted in an international school in Ankara, Türkiye authorized to implement the IB PYP curriculum framework. Alongside the PYP framework, the school also used the Turkish national curriculum and Cambridge

curriculum, with these additional curricula affecting planning and teaching decisions. Therefore, the type of inquiry-based teaching and learning promoted by the IB was not the only or even the primary mode of instruction. Consequently, inquiry learning was only one factor that contributed to the educational environment. The relationship of the results of this study to inquiry learning should be understood as limited.

Another limitation is related to the validation of materials used in this study. The resources developed for this study included the teacher workshop, intervention lessons, qualitative questions, the design for the prompt used for the quantitative data, and the scoring guide. In the initial stage of developing the materials, I researched the background and relevant examples to create preliminary designs. As part of the resource development process, I then consulted experts in the same context and incorporated their feedback in new iterations of the resources. However, these materials did not undergo extensive testing or validation. Within the time limits involved in conducting this study, I was unable to fully test these materials with the relevant audiences before presenting them. Thus, minimal validation is a limitation of this study.

There are also limitations related to the prompts used for this study. While transcribing the participant responses, one issue that arose is that some students skipped to a new line when listing a new response, and others wrote continuously on the lines, as if writing a paragraph. The researcher had to interpret a few of the responses to determine if a new idea was starting, or a previous idea continuing. It would be helpful for clarity to improve the prompt and include directions to put each response on a new line. Another relevant factor was the fact that this study used a repeated AUT test as the source of quantitative data. Students did an AUT twice, so on their second try, they would naturally be more familiar with the format and type

of prompt. The parallel structure of the pretest and post-test could account for some of the improvement in scores.

Other limitations are related to the scoring of the responses, as mentioned in Chapter 3. There was some degree of bias and subjectivity involved in scoring for this study, including the process of sorting the responses into categories. Subjectivity is an important consideration when interpreting the results of this study.

There are important limitations to understand when interpreting this study and considering its' place in the larger context of creative thinking research. This study should only be considered within the circumstances of the study. Some of the limitations are related to the participating students, teachers, classroom, and school, while other limitations are linked to the prompts and scoring of the study.

Conclusion

In this study, we learned that explicitly teaching creative thinking skills improves the ability to think creatively. A divergent thinking intervention was successful in creating a positive change in students' ability to express novel ideas. In this fourth-grade international school setting in Türkiye, creative thinking appeared to have a positive impact on inquiry learners.

Consider the question: How can we use creative thinking skills in education? As we imagine possibilities, we realize that we are engaging in divergent thinking. We can think fluently, as there are many possible ways to use creative thinking. We can think flexibly, as there are many subject areas or contexts to use creative thinking. We can think originally, as there are surely myriad unique ways for learners to think creatively. We can think with elaboration, envisioning detailed scenarios to apply creative thinking skills. Thinking divergently can allow us the potential to discover new opportunities for learning.

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Appendix A

Poem: The Little Boy

By: Helen E. Buckley

Once a little boy went to school.

He was quite a little boy.

And it was quite a big school.

But when the little boy

Found that he could go to his room

By walking right in from the door outside,

He was happy.

And the school did not seem

Quite so big any more.

One morning,

When the little boy had been in school a while,

The teacher said:

“Today we are going to make a picture.”

“Good!” thought the little boy.

He liked to make pictures.

He could make all kinds:

Lions and tigers,

Chickens and cows,

Trains and boats –And he took out his box of crayons

And began to draw.

But the teacher said:

“Wait! It is not time to begin!”

And she waited until everyone looked ready.

“Now,” said the teacher,

“We are going to make flowers.”

“Good!” thought the little boy,

He liked to make flowers,

And he began to make beautiful ones

With his pink and orange and blue crayons.

But the teacher said, “Wait! And I will show you how.”

And she drew a flower on the blackboard.

It was red, with a green stem.

“There,” said the teacher.

“Now you may begin.”

The little boy looked at the teacher’s flower.

Then he looked at his own flower,

He liked his flower better than the teacher’s.

But he did not say this, he just turned his paper over and made a flower like the
teacher’s.

It was red, with a green stem.

On another day, when the little boy had opened
The door from the outside all by himself,
The teacher said,
“Today we are going to make something with clay.”
“Good!” thought the boy. He liked clay.
He could make all kinds of things with clay:
Snakes and snowmen,
Elephants and mice,
Cars and trucks –And he began to pull and pinch
His ball of clay.
But the teacher said,
“Wait! And I will show you how.”
And she showed everyone how to make
One deep dish. “There,” said the teacher.
“Now you may begin.”
The little boy looked at the teacher’s dish
Then he looked at his own.
He liked his dishes better than the teacher’s
But he did not say this,
He just rolled his clay into a big ball again,
And made a dish like the teacher’s.
It was a deep dish.
And pretty soon
The little boy learned to wait
And to watch,
And to make things just like the teacher.
And pretty soon
He didn’t make things of his own anymore.
Then it happened
That the little boy and his family
Moved to another house,
In another city,
And the little boy
Had to go to another school.
This school was even bigger
Than the other one,
And there was no door from the outside
Into his room. He had to go up some big steps,
And walk down a long hall
To get to his room.
And the very first day
He was there, the teacher said,
“Today we are going to make a picture.”
“Good!” thought the little boy,

And he waited for the teacher
To tell him what to do
But the teacher didn't say anything.
She just walked around the room.
When she came to the little boy,
She said, "Don't you want to make a picture?"
"Yes," said the little boy.
"What are we going to make?"
"I don't know until you make it," said the teacher.
"How shall I make it?" asked the little boy.
"Why, any way you like," said the teacher.
"And any color?" asked the little boy.
"Any color," said the teacher,
"If everyone made the same picture,
And used the same colors,
How would I know who made what,
"And which was which?"
"I don't know," said the little boy.
And he began to draw a flower.
It was red, with a green stem.

Appendix B

Teacher Workshop

Teacher workshop sample slide:

OBJECTIVES & GUIDING QUESTIONS

INTRO

HOW How will we implement this study?
Bonus: How can we build our capacity for teaching creative thinking?

WHAT What is creative thinking?

WHY Why is creative thinking worthwhile?

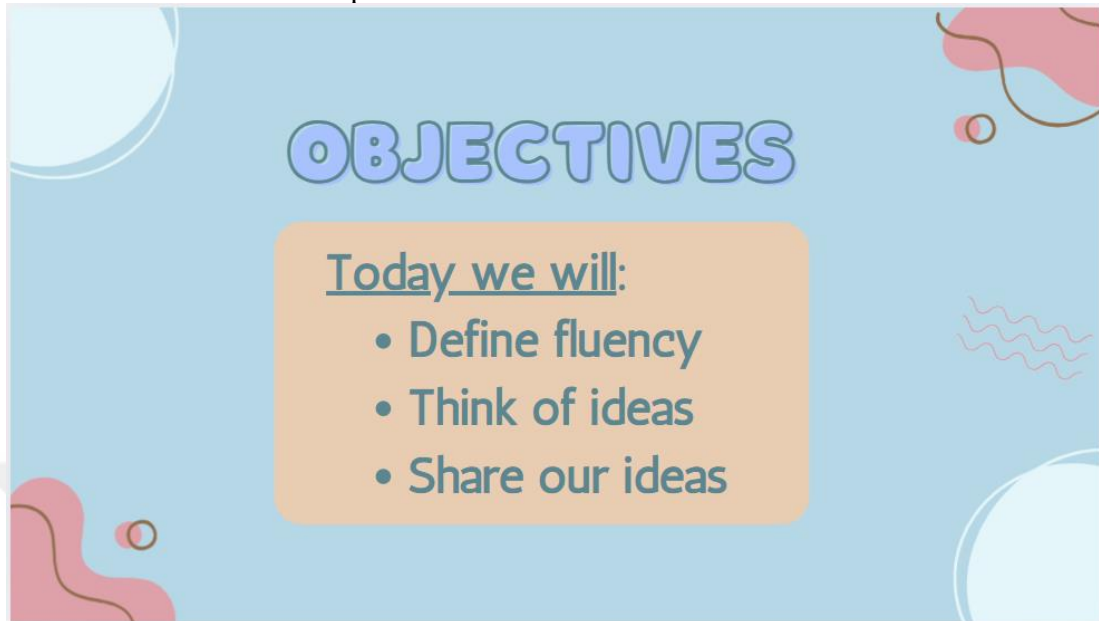
Teacher Workshop Link:

[Teacher Training: Creative Thinking Study](#)

Appendix C

Intervention Lessons

Intervention Lesson 1 Sample slide:



Creative Thinking Lesson Links:

- [Lesson 1: Pretest & Fluency](#)
- [Lesson 2: Flexibility](#)
- [Lesson 3: Originality](#)
- [Lesson 4: Elaboration](#)
- [Lesson 5: Posttest](#)

Appendix D

MEB Approval



T.C.
ANKARA VALİLİĞİ
Milli Eğitim Müdürlüğü



Sayı : E-14588481-605.99-101986581
Konu : Araştırma İzni

09.05.2024

İHSAN DOĞRAMACI BİLKENT ÜNİVERSİTESİ REKTÖRLÜĞÜNE

İlgi : a) MEB Yenilik ve Eğitim Teknolojileri Genel Müdürlüğünün 2020/2 sayılı Genelgesi.
b) 03.05.2024 tarihli ve 33227 sayılı yazınız.

Üniversiteniz Eğitim Bilimleri Enstitüsü Yüksek Lisans Programı öğrencisi Linnea MCCULLY'in "**İraksak Yaratıcı Düşüncenin İlköğretim Öğrencilerinin Araştırmaya Dayalı Öğrenmesi Üzerindeki Etkilerinin Uygulanması ve İncelenmesi**" başlıklı çalışması kapsamında Çankaya ilçemize bağlı ilkokullarda yapılacak uygulama talebi ilgi (a) Genelge çerçevesinde incelenmiştir.

Yapılan inceleme sonucunda, söz konusu araştırmanın Müdürlüğümüzde muhafaza edilen ölçme araçlarının; Türkiye Cumhuriyeti Anayasası, Milli Eğitim Temel Kanunu ile Türk Milli Eğitiminin genel amaçlarına uygun olarak, ilgili yasal düzenlemelerde belirtilen ilke, esas ve amaçlara aykırılık teşkil etmeyecek, eğitim-öğretim faaliyetlerini aksatmayacak şekilde okul ve kurum yöneticilerinin sorumluluğunda, gönüllülük esasına göre uygulanması Müdürlüğümüzce uygun görülmüş olup çalışma tamamlandıktan sonra çalışmanın bir nüshasının **30 iş günü içerisinde arge06_arastirma@meb.gov.tr adresine PDF olarak gönderilmesi** gerekmektedir.

Bilgilerinizi ve gereğini rica ederim.

Yaşar KOÇAK
Vali a.
Milli Eğitim Müdürü

Ek: Uygulama Araçları (3 Sayfa)
Dağıtım:
Gereği:
Bilkent Üniversitesi

Bilgi :
Çankaya İlçe MEM

Bu belge güvenli elektronik imza ile imzalanmıştır.

Adres : Emniyet mah. Alparslan Türkeş cad. no:4 (Ek Hizmet Binası AR-GE)
Yenimahalle
Telefon No : 0 (312) 306 89 07
E-Posta: isticat06@meb.gov.tr
Kep Adresi : meb@hs01.kep.tr

Belge Doğrulama Adresi : <https://www.turkiye.gov.tr/meb-ebys>
Bilgi için: Aysun AKDEMİR
Unvan : Memur
İnternet Adresi: Faks: _____

Bu evrak güvenli elektronik imza ile imzalanmıştır. <https://evraksorgu.meb.gov.tr> adresinden d8b6-2e7a-3772-9f33-e8dc kodu ile teyit edilebilir.

Appendix E

Parent Consent Form

Informed Consent of Parent(s) or Guardian(s) of the Participant to Participate in a Research Study

Study Title: Implementing and Analyzing the Effects of Divergent Creative Thinking on the Inquiry-based Learning of Elementary Students

Researcher: Linnea McCully

Supervisor: Dr. Anita Nicole Alexander

Your student is invited to participate in a research study. This consent form will provide you with information on the research project, what the participant will need to do, and the associated benefits and risks of the research. Participation is voluntary and anonymous. Please read this form carefully. It is important that you fully understand the research in order to make an informed decision.

Purpose: The purpose of this study is to measure the effectiveness of teaching creative thinking skills such as divergent thinking in relation to inquiry-based learning in elementary classrooms. This study draws on the need for elementary students to develop creativity and creative thinking skills. This study also acknowledges that there is limited research on divergent thinking in elementary age students in International Baccalaureate Primary Years Program (IB PYP) contexts.

Procedures: Participants will be asked to complete a pretest and posttest measure of creativity, which will be an alternate use task. They will participate in five 40-minute lessons, taught by their homeroom teachers. After the posttest, students will also be asked to respond to reflection questions.

Benefits: The potential benefits of participating in this study may include allowing for a better understanding of how creative thinking skills relate to inquiry learning. This may allow us to better understand the role of creative thinking in the learning process. Additionally, this research may indicate how explicitly teaching elements of creative thinking may benefit students throughout their educational journeys.

Risks and Discomforts: There are no anticipated risks of this study beyond those encountered in everyday life.

Privacy & Confidentiality: Answers will be collected anonymously. Research participants will not be identified in any publication or presentation of research results; only aggregate data will be used.

Compensation: Participants will not be provided with compensation for their participation.

Voluntary Participation: Taking part in this research study is entirely up to the participant. The participant may choose not to participate or may discontinue their participation at any time without penalty or loss of benefits to which they are otherwise entitled. Participants will be informed of any new, relevant information that may affect their health, welfare, or willingness to continue their study participation. Their acceptance or refusal to participate will not in any way affect

their academic or other standing with Bilkent Laboratory and International School (BLIS).

Contact Information: If you have any questions or concerns about this research, please feel free to contact Linnea McCully.

(Please see the other side for the research study consent and signature space.)

Araştırma Çalışmasına Katılmaya İlişkin Katılımcının Ebeveyn(ler)i veya Veli(ler)i İçin Hazırlanmış Bilgilendirilmiş Onam Formu

Çalışma Başlığı: Iraksak Yaratıcı Düşüncenin İlköğretim Öğrencilerinin Araştırmaya Dayalı Öğrenmesi Üzerindeki Etkilerinin Uygulanması ve İncelenmesi

Araştırmacı: Linnea McCully

Danışman: Dr. Anita Nicole Alexander

Öğrenciniz bir araştırma çalışmasına katılmaya davet edilmiştir. Bu onam formu, araştırma projesi, katılımcının yapması gerekenler ve araştırmanın yararları ve riskleri hakkında size bilgi sunacaktır. Katılım gönüllülük esasına dayalıdır ve isimler gizli tutulacaktır. Lütfen bu formu dikkatlice okuyunuz. Bilinçli bir karar verebilmeniz için araştırmayı tam olarak anlamanız önemlidir.

Amaç: Bu çalışmanın amacı, ilkokul sınıflarında sorgulamaya dayalı öğrenme ile ilişkili olarak iraksak düşünme gibi yaratıcı düşünme becerilerinin öğretiminin etkililiğini ölçmektir. Bu çalışma, ilkokul öğrencilerinin yaratıcılık ve yaratıcı düşünme becerilerini geliştirme ihtiyacına dayanmaktadır. Bu çalışmanın aynı zamanda Uluslararası Bakalorya İlk Yıllar Programı (IB PYP) kapsamında ilkokul çağındaki öğrencilerde iraksak düşünme üzerine sınırlı araştırma olduğu görülmektedir.

Prosedürler: Katılımcılardan bir alternatif kullanım testi olan yaratıcılığa yönelik ön test ve son testi tamamlamaları istenecektir. Katılımcı olarak sınıf öğretmenlerinin vereceği 40 dakikalık beş derse katılacaklardır. Son testten sonra öğrencilerden IB Öğrenme yaklaşımları ölçeği ve öğrenme süreci sorularına yanıt vermeleri istenecektir.

Yararları: Bu çalışmaya katılmanın sağlayabileceği olası faydalar arasında yaratıcı düşünme becerilerinin sorgulayıcı öğrenme ile nasıl bir ilişki içinde olduğunun daha iyi anlaşılması yer alır. Bu da yaratıcı düşünmenin öğrenme sürecindeki rolünü daha iyi anlamamızı sağlayabilir. Ayrıca bu araştırma, yaratıcı düşünme unsurlarının açıkça öğretilmesinin öğrencilere eğitim yolculukları boyunca nasıl fayda sağlayabileceğini gösterebilir.

Riskler ve Rahatsızlıklar: Bu çalışmanın günlük yaşamda karşılaşılanların ötesinde beklenen bir riski yoktur.

Gizlilik: Verilen cevaplar isimsiz olarak toplanacaktır. Araştırma katılımcılarının isimleri, araştırma sonuçları ile ilgili herhangi bir yayın veya sunumda paylaşılmayacaktır; yalnızca toplu veriler kullanılacaktır.

Tazminat: Katılımcılara katılımları karşılığında herhangi bir ücret ödenmeyecektir.

Gönüllü Katılım: Bu araştırma çalışmasına katılmak tamamen katılımcının isteğine bağlıdır. Katılımcı, herhangi bir cezaya maruz kalmadan veya başka şekilde hak sahibi olduğu avantajlardan herhangi bir kaybı olmadan araştırmaya katılmamayı

seçebilir veya katılımını istediği zaman sonlandırabilir. Katılımcılar sağlıklarını, iyilik durumlarını veya çalışmaya katılımlarını sürdürme isteklerini etkileyebilecek her türlü yeni gelişme konusunda bilgilendirilecektir. Araştırmaya katılmayı kabul etmeleri veya reddetmeleri, katılımcıların Bilkent Laboratuvar Okulları ve Uluslararası Okulu (BLIS) nezdindeki akademik koşullarını veya diğer durumlarını hiçbir şekilde etkilemeyecektir.

İletişim Bilgileri: Bu araştırma ile ilgili herhangi bir sorunuz veya endişeniz varsa lütfen Linnea McCully ile iletişime geçmekten çekinmeyiniz.

Research Study Consent/ Araştırma Çalışması Onayı

Research Study Consent & Signatures: I/We have read this consent form and have had the opportunity to have any questions answered satisfactorily. I/We voluntarily agree for our student to participate in this study. I/We understand that a copy of this consent form can be provided to us for future reference.

Araştırma Çalışması Onayı ve İmzalar: Ben/Biz bu onam formunu okuduk ve her türlü sorunun tatmin edici bir şekilde yanıtlanmış olduğunu gördük. Öğrencimizin bu çalışmaya katılmasını gönüllü olarak kabul ediyorum/ediyoruz. Ben/Biz bu onam formunun bir nüshasının ileride kullanılmak üzere bize verilebileceğini anlıyorum/anlıyoruz.

Student's name/ Öğrencinin adı:

Parent or guardian 1 name/ Ebeveyn veya veli 1 adı:

Parent or guardian 1 signature/ Ebeveyn veya veli 1 imzası:

Date/ Tarih: _____

Parent/guardian 2 name (if applicable)/ Ebeveyn veya veli 2 adı (varsa):

Parent/guardian 2 signature (if applicable)/ Ebeveyn veya veli 2 imzası (varsa):

Date/ Tarih: _____

Appendix F

Blank AUT Pretest and Posttest

Name: _____

.....

Date: _____

Pretest: Alternate Use Test

Prompt: Name all the uses for a paperclip.



Directions:

- Write as many responses as you can. (You can use the back if needed.)
- Work independently. (No help from anyone else.)
- You have 3 minutes! Try your best!

[illegible]

Appendix G

AUT Student Samples

Date: _____	Date: _____
Pretest: Alternate Use Test 13A	Posttest: Alternate Use Test 13A
Prompt: Name all the uses for a paperclip. 	Prompt: Name all the uses for a cup. 
Directions: • Write as many responses as you can. (You can use the back if needed.) • Work independently. (No help from anyone else.) • You have 3 minutes! Try your best!	Directions: • Write as many responses as you can. (You can use the back if needed.) • Work independently. (No help from anyone else.) • You have 3 minutes! Try your best!
• to not loose your Paper • Magnet • put it on your nail • bracelet • ring • bookmark • toy game	• to drink water • drink a drink • play games • plant a plant • Put stuff like accesories in it • Pencil holder • Paint it • Art and Craft • Put trash • Put sea shells • put interesting stones and collect • make a telephone

Date: <u>23.05.2024</u>	Date: <u>07.06.2024</u>
Pretest: Alternate Use Test 36C	Posttest: Alternate Use Test 36C
Prompt: Name all the uses for a paperclip. 	Prompt: Name all the uses for a cup. 
Directions: • Write as many responses as you can. (You can use the back if needed.) • Work independently. (No help from anyone else.) • You have 3 minutes! Try your best!	Directions: • Write as many responses as you can. (You can use the back if needed.) • Work independently. (No help from anyone else.) • You have 3 minutes! Try your best!
• To keep more than 1 paper together. • For being organized. • To make shapes out of it. (Some people do it) • To mark things. (Like a book mark) • To use it as a wire.	• To Drink things • Drawing perfect circles • Do a cup tower • To slice food • To do mixtures • Crafts • Making a cup cake • Using it for the water for painting. • Drawing on it • Shapes

Appendix H

Scoring Guidelines

Fluency

Pretest: Paper Clip

Acceptable Responses (clear use involving item)	Unacceptable Response Examples (impossible or vague; repetition)
	for fun, eat, kick, throw, drink, challenge, make a folder, extra piece, things to do when bored,

Posttest: Cup

Acceptable Responses (clear use involving item)	Unacceptable Response Examples (impossible or vague; repetition)
	kick, smell, eat, types of cups, have fun, hit, put, look, stare, tying, lots of things,

Flexibility

Pretest: Paper Clip

Code (15)	Category of Response: Uses	Example Responses
A	Attaching paper	clipping, clip paper, hold papers together,
B	Accessory	earrings, nails, bracelet, ring, hairclip, hairpin, headband, keychain,
C	Tool	hinges, zipper, fixing, screw driver, cotton swab
D	Science	experiments,
E	Marking	bookmark,
F	Magnet	magnets, compass,
G	Crafts	making hearts, shapes, pattern, castle, melt, build, instrument, phone holder,
H	Decorations	art, chain,
I	Sharp End	stabbing, needle, poke, cutting, stitch, when in danger, safety, piercing, open box,
J	Measuring	measure,
K	Wire	unlocking a door, taking something out of somewhere, wire, battery, charge, stick,
L	Game or Toy	spinning wheel, playing, magic,
M	Attaching Items	to hang something, phone holder, hold something, hanger,
N	Keeping	souvenir, selling, collection,
O	Other	

Posttest: Cup

Code (15)	Category of Response: Uses	Example Responses
A	Drinking	drink water, drink milk, drink juice, straw,
B	Food Container	ice cream, fruit,
C	Storing Items	pencil case, products, begging, collecting,
D	Holding Liquid	baby bath, paint brush water, to measure water, pool, mixtures,
E	Crafts	hat, art, paint, draw, castle, decoration,
F	Game or Toy	bowling, flip, tower, acting, trick shots, teaching,
G	Planting	planting, pot, grow a seed,
H	Covering	hide, catch a bug, trap, put on your mouth,
I	Moving Things	catapult, pour, water dispenser, filling, straw,
J	Sound	rhythm, drum, megaphone, microphone, song, phone, music,
K	Shape	make a circle, cut cake, tracing, slice food,
L	Disposal	trash, litter, recycle, fire, rip, break, throw, burn,
M	Making Food	mug cake, cupcake, popsicle, cooking,
N	Paper	cut and make paper, cut,
O	Other	

Originality

Score	Description
0	Common: Given by >95% of sample
1	Original: Given by 5% of sample
2	Unique: Given by 1% of sample

Elaboration

Score	Meaningful Words in Response <i>(Not counting prepositions, auxiliary verbs, or generic words.)</i>
0	1 word
1	2-4 words
2	5+ words

Appendix I

[Bilkent University Ethics Committee Approval



Bilkent Üniversitesi

Akademik İşler Rektör Yardımcılığı

Tarih : 22 Mart 2024

Gönderilen : Linnea McCully

Danışman : Anita N. Alexander

Gönderen : H. Altay Güvenir
İnsan Araştırmaları Etik Kurulu Başkanı

Konu : "Implementing ..." çalışması etik kurul onayı

Üniversitemiz İnsan Araştırmaları Etik Kurulu, 22 Mart 2024 tarihli görüşme sonucu, "Implementing and Analyzing the Effects of Divergent Creative Thinking on the Inquiry-based Learning of Elementary Students" isimli çalışmanız kapsamında yapmayı önerdiğiniz etkinlik için etik onay vermiş bulunmaktadır. Onay, ekte verilmiş olan çalışma önerisi, çalışma yürütücüleri ve bilgilendirme formu için geçerlidir.

Bu onay, yapmayı önerdiğiniz çalışmanın genel bilim etiği açısından bir değerlendirmedir. Çalışmanızda, kurulumuzun değerlendirmesi dışında kalabilen özel etik ve yasal sınırlamalara uymakla ayrıca yükümlüsünüz.

Kovid-19 salgını nedeniyle konulmuş olan kısıtlamaların yürürlükte olduğu süre içinde, tüm komite toplantıları elektronik ortamda yapılmaktadır; aşağıda isimleri bulunan Bilkent Üniversitesi Etik Kurulu Üyeleri adına bu yazıyı imzalama yetkisi kurul başkanındadır.

Etik Kurul Üyeleri:

Ünvan / İsim	Bölüm / Uzmanlık	
Prof.Dr. H. Altay Güvenir	Bilgisayar Mühendisliği	Başkan
Prof.Dr. Haldun Özaktaş	Elektrik ve Elektronik Müh.	Üye
Doç.Dr. Işık Yuluğ	Moleküler Biyoloji ve Genetik	Üye
Dr. Öğr. Üyesi Burcu Ayşen Ürgen	Psikoloji	Üye
Dr. Öğr. Üyesi A.Bariş Özbilen	Hukuk	Üye
Prof. Dr. Özgür Ulusoy	Bilgisayar Mühendisliği	Yedek Üye
Dr. Öğr. Üyesi A.Bariş Özçelik	Hukuk	Yedek Üye

Kurul karar/toplantı No: 2024_03_22_05

Başvuru No: 522