The Relationship between Creativity and Enrollment in Fine Arts or International Baccalaureate Diploma Programme Coursework

by

Gretchen Lynn Teague

August 28, 2014

A Dissertation submitted to the Education Faculty of Lindenwood University in partial fulfillment of the requirements for the degree of

Doctor of Education

School of Education

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 - 1346

The Relationship between Creativity and Enrollment in Fine Arts

or International Baccalaureate Diploma Programme Coursework

by

Gretchen Lynn Teague

This Dissertation has been approved as partial fulfillment

of the requirements for the degree of

Doctor of Education

Lindenwood University, School of Education

Dr. Sherry DeVore, Dissertation Chair — 8-28-2014 Date

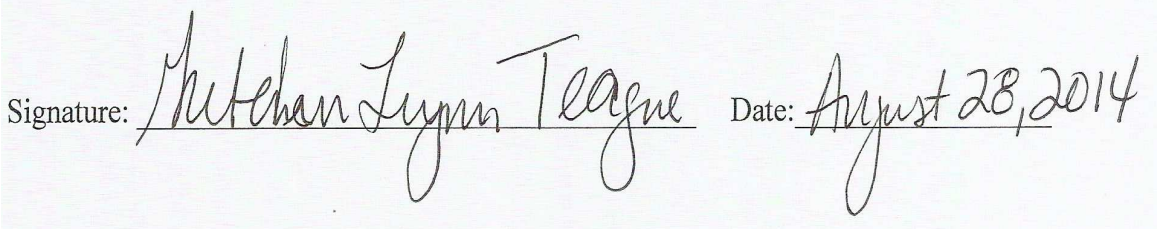
Dr. Lisa M. Christiansen, Committee Member — 8-28-2014 Date

Dr. Rebecca Bernard, Committee Member — 8-28-2014 Date

Declaration of Originality

I do hereby declare and attest to the fact that this is an original study based solely upon my own scholarly work at Lindenwood University and that I have not submitted it for any other college or university course or degree.

Gretchen Lynn Teague



Acknowledgements

Special thanks are given to Dr. Sherry DeVore, Dr. Lisa Christiansen, and Dr. Rebecca Bernard for serving on my dissertation committee. I am especially indebted to Dr. Christiansen for her commitment to the process, encouragement, sense of humor, and frequent reality checks. Thanks to Mrs. Alisa Boyd, Mrs. Donita Cox, Ms. Molly Illum, Mr. Sam Shelton, Ms. Wendy Shepherd, Mr. Kyle Wallace, and Dr. Chris Welch for allowing me time to recruit students from their respective classrooms to participate in this study. Without their assistance, I would never have collected the necessary data. Thank you to Mr. Quinton Smith, Mr. Michael Frizell, and Ms. Elizabeth Kaatz for their proofreading and writing expertise. I am especially grateful to my high school friend, Mrs. Marta Shore, who helped me through the statistical analysis with patience, and to my high school students, who were willing to teach themselves how to do a statistical test in order to explain it to me. I am thankful for all of the people who continued to encourage me and who made me keep going during those times I was so overwhelmed I wanted to quit. I am also thankful for those of you who endured hours of discourse about creativity and especially those who were genuinely intrigued by the research. Finally, I am grateful for my family: To my father who reminded me it does not matter how long you work toward the goal as long as you complete it; to my mother- and father-in-law for their hours of babysitting so I could write and for the reminder that family takes care of family; to my children, Zachary and Charlie, who always instinctively knew when it was time to take a hug-break; and to my husband, Shawn, for his unending support, for continuing to push me to finish, and for reminding me why I was doing this in the first place.

Abstract

The focus of this study was to determine whether a relationship existed between the creativity potential exhibited through creativity index scores of the Torrance Test of Creative Thinking and the enrollment of secondary students in the specific coursework of fine arts classes and the International Baccalaureate Diploma Programme. The framework of the hierarchy for the study of creativity designed by Runco (2007) was used as the underpinning for the literature review and subsequent data collection and analysis. Furthermore, the creativity index scores and the ACT and GPA of subjects were analyzed to determine if a relationship existed. The study was governed by two research questions: (1) Is there a statistically significant difference between the creativity index scores from the Torrance Test of Creative Thinking for students enrolled in fine arts courses and students who are not enrolled in fine arts courses? and (2) What is the relationship between achievement data (ACT and GPA) and the creativity index scores from the Torrance Test of Creative Thinking? Little positive or negative relationship between the variables existed, and often, the results were not statistically significant. In general, a relationship between the coursework and creativity index scores or ACT and GPA and creativity index scores was not evident as a result of the analysis of data. A need for teachers, administrators, and students to receive continued education about the value of creativity was present in the review of literature and was addressed as a topic for further study.

Table of Contents

List of Tables

List of Figures

Chapter One: Introduction

The importance of developing creativity in students as an indicator of success for employees of the 21st century has been a subject for debate in the media, classrooms, school districts, and business reports. Runco (2004) stated, "Because of its role in innovation and entrepreneurship, creativity has become one of the key concerns of organizations and businesses" (p. 659). In fact, Guilford, as early as 1950, recognized the importance of creativity, claiming it was "a vital 'natural resource'" (as cited in Runco, 2004, p. 659).

In this chapter, the background of historic creativity and creative thinking research are explored briefly. A conceptual framework is established to understand the results of the proposed research. In addition, the purpose of the study is discussed along with solutions to specific problems and the limitations to the study.

Background of Study

The emerging focus on creativity in business was highlighted in *Capitalizing on Complexity*, the 2010 IBM study of global Chief Executive Officers (CEOs). Those surveyed indicated the most important leadership skill needed by employees was creativity (IBM, 2010). Approximately 1,500 CEOs recognized the business environment had changed as the global community developed more complex relationships (IBM, 2010). Because of the identification of creativity as an economic commodity, leaders who can think creatively and take disruptive risks often find a greater degree of success (IBM, 2010; Lichtenberg, Woock, & Wright, 2008). IBM (2010) reported, "Standouts (leaders) practice and encourage experimentation and innovation throughout their organizations" (p. 8).

Educators have studied the needs of employers when designing curricula for high school students. In 2008, researchers for the Conference Board (2014), an independent research company that provided "an objective, independent source of economic and business knowledge" (para. 2) ascertained the alignment of educators and businessmen concerning the necessity of creativity in the workplace (Lichtenberg et al., 2008). Lichtenberg et al. (2008) "surveyed 155 U.S. business executives…and 89 school superintendents and school leaders…to determine the skills and abilities that cultivate creativity" (p. 4). Survey questions about traits of creative students and employees as well as how important creativity was to future successes were scored, and the subsamples of business leaders and educators were compared (Lichtenberg et al., 2008). Both business leaders and educators concurred regarding the importance of procuring employees who exhibited the traits of creativity (Lichtenberg et al., 2008).

The problem addressed by the researchers, however, was the lack of mandatory fine arts requirements in K-12 schools and the lack of support provided by employers concerning the encouragement of creative endeavors by employees (Lichtenberg et al., 2008; Robinson, 2011). Some companies, such as Pixar, Google, 3M, and Apple are the exception to this rule (Lichtenberg et al., 2008; Robinson, 2011). The executives of Pixar consider providing opportunities for employees to seek professional development outside of each employee's work area an important dimension of the Pixar management plan (Robinson, 2011). Employees throughout the company are not only allowed time for this type of professional development in the contracted workday, but they are also encouraged to learn about and contribute to the creative development of the company as a part of the Pixar University program (Robinson, 2011).

The third background study was the 2013 Phi Delta Kappan (PDK)/Gallup Poll of the Public's Attitudes toward public schools. In the PDK/Gallup Poll, 1,001 American adults who represented the voice of the American public were surveyed (Bushaw & Lopez, 2013). Fifty-eight percent of those surveyed indicated creativity as a vital skill that should be nurtured in students (Bushaw & Lopez, 2013).

The research conducted by IBM (2010) and Lichtenberg et al. (2008) as well as the inclusion of professional development opportunities at Pixar, Google, Apple, and 3M indicated a shift in thinking for employers, administrators, and adults. According to Robinson (2011), education leaders must reconfigure secondary education curricula with the paradigm shift in mind. The recognition of creative potential in students would provide students with the skills necessary for achievement in the 21st century (Robinson, 2011).

Conceptual Framework

In 1967, Rhoades (1987) categorized the term creativity into several divisions, which differentiated creativity into a creative person, a creative process, a creative product, and creativity as a result of pressures, also called the 4P's (Bruton, 2011; Fleith, 2000; Robinson, 2011; Runco, 2007; Wong & Siu, 2012). Runco (2007) refined the divisions (see Figure 1). First, Runco (2007) defined the framework as a hierarchy in which one of the creative areas established by Rhoades (1987) ranked above the others in generating a creative whole. Second, Runco (2007) organized the differentiated traits into two levels: creative performance and creative potential (Fleith, 2000; Robinson, 2011; Runco, 2007). Both potential and performance were ultimately important to the full development of the creative idea. Performance demonstrated the completion of the final

product of the creative process. Creative potential was embodied in the person, process, and press (Runco, 2007).

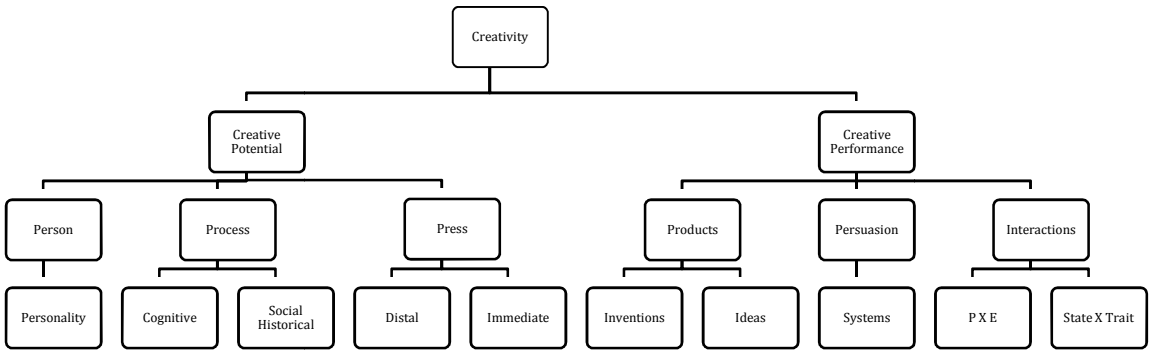


Figure 1. The hierarchal framework for the study of creativity. Adapted from Runco (2007).

Educators find the idea of enhancing creative potential within a child is essential. When educators attempt to teach creativity with a focus on the end product or creative performance task, the teachable potential is missed (Runco, 2003). Robinson (2011) and Runco (2003) reminded educators and parents that all humans have the capacity for creative potential. In order for students to find success in the 21st century, educators must shift from a focus on the product to the development of the creative potential through enhancement of person, process, and press (Runco, 2003, 2007).

Statement of the Problem

The need to cultivate creativity as a 21st century skill is supported by researchers in the literature; therefore, educators should assess curricula in schools in order to determine whether students are receiving adequate training for the 21st century. Before making rash changes in curricula, informed educators should explore the creative thinking skills of students. The most common creativity assessment is the *Torrance Test for Creative Thinking* (TTCT) (Kim, 2006). The TTCT is used by business and education

leaders to evaluate the creative potential of employees and students, respectively (Kim, 2006). In the area of predicting creativity traits, Torrance, Ball, and Safter (2008) "maintained that high degrees of the abilities measured by tests such as the TTCT increase the chances that the possessor will behave creatively" (p. 1). In fact, several researchers, such as Kim (2006) and Millar (2010), documented the longevity of the TTCT in predicting creative potential. Millar (2010) specifically reported on the 50-year longitudinal study conducted by Torrance on creative behavior. According to Millar (2010), "The study demonstrated that there is still a positive relationship between creativity as measured by the Torrance Test of Creative Thinking in children and creative achievement reported fifty years later by the same group as adults" (p. 97).

Lai and Viering (2012) indicated the impact of teaching creative thinking to students was not limited to producing students who demonstrate divergent thinking, but also increased student achievement. Lai and Viering (2012) dissected previous research and determined, "Studies have shown that measures of creative thinking significantly predict first-year college students' grade point averages (GPA) above and beyond high school GPA and SAT scores" (p. 7). Rosen and Tager (2013) determined a negative relationship existed. Therefore, this current study was designed to explore whether a relationship was present between a student's *creativity index score* and a student's enrollment in fine arts classes, IB DP curricula, and GPA and ACT scores. The resulting data were analyzed and reported in order for future researchers to have information pertinent for the beginning of a longitudinal study on the predictive nature of creativity.

In addition, the study of creativity in secondary schools would not be complete without determining if a relationship existed between the varied curricula. The

President's Committee on the Arts and the Humanities (2011) reported the inclusion of more fine arts classes improved the creativity of students. In 2008, the report was published from the committee commissioned by President Obama, who told Americans:

> To remain competitive in the global economy, America needs to reinvigorate the kind of creativity and innovation that has made this country great. To do so, we must nourish our children's creative skills. In addition to giving our children the science and math skills they need to compete in the new global context, we should also encourage the ability to think creatively that comes from a meaningful arts education. (as cited in President's Committee on the Arts and the Humanities, 2011, p. 8)

Arne Duncan, U.S. Secretary of Education, likewise proposed the most efficient way of supporting creativity was through the fine arts (as cited in President's Committee on the Arts and the Humanities, 2011). Although President Obama and U.S Secretary of Education Duncan supported the inclusion and emphasis of the fine arts within the curricula of school systems, critics feared previous emphases on knowledge-based learning from No Child Left Behind caused extensive damage to education because school districts felt compelled to make decisions that eliminated or reduced arts programs (Grierson, 2011; Robinson, 2011).

Despite the availability of assessments designed to measure creativity in students, a gap existed between knowledge about creativity and the discovery of the effects of current curricula on the creative potential of secondary education students (Runco, 2004). An assessment of curricula concerning its impact on student creativity as a part of 21st century skills requires an understanding of the creativity index scores resulting from the

TTCT of current students. Information from this study provides a baseline founded on the predictive nature of the creativity index scores that could assist future researchers as they attempt to answer the question: How do educators and instructional leaders prepare students at the secondary level to enter a world where creativity is a vital commodity?

Purpose of the Study

Business leaders are interested in recruiting and retaining employees with creativity skills (IBM, 2010); therefore, secondary schools shifted their focus on career and college readiness to include creativity skills, in order to better prepare students for the work force. With the introduction of creativity training as a part of 21st century skills, educators responded to the need to teach creative thinking in order to prepare students to be competitive in a global society (Partnership for 21st Century Skills, 2009). Recently, many researchers have continued to define creativity and stress its importance within the education system and as a necessary component of successful career endeavors. In 2004, Bamford "aimed to explore the impact of creativity and the arts within a global education" (as cited in Mrnarević, 2011, p. 13). As a result, Bamford recognized creativity was simultaneously enhanced by education programs using fine arts curricula and limited by ineffective or non-existent poor fine arts programs (Mrnarević, 2011).

In subsequent chapters detailing this study, the relationship between the current high school curriculum, specifically IB DP and fine arts courses, and creative potential of high school students, is explored. As a result of evidence from the TTCT in this study, future researchers will have a baseline concerning the creative potential of students. Resources for additional experimental research to be conducted on systematic changes of

curriculum and how the changes impact the student creativity index scores from the TTCT could also be studied with the results of data collected.

Research questions. The following questions guided the study:

1. Is there a statistically significant difference between the creativity index scores from the Torrance Test of Creative Thinking for students enrolled in fine arts courses and students who are not enrolled in fine arts courses?

2. What is the relationship between achievement data (ACT and GPA) and the creativity index scores from the Torrance Test of Creative Thinking?

Hypotheses. The following null and alternative hypotheses were posed:

$H1_0$: There is no statistically significant difference between the creativity index scores from the Torrance Test of Creative Thinking for students enrolled in fine arts courses and students who are not enrolled in fine arts courses.

$H1_a$: There is a statistical difference between the creativity index scores from the Torrance Test of Creative Thinking for students enrolled in fine arts courses and students who are not enrolled in fine arts courses.

$H2_0$: There is no relationship between achievement data (ACT and GPA) and the creativity index scores from the Torrance Test of Creative Thinking.

$H2_a$: There is a relationship between achievement data (ACT and GPA) and the creativity index scores from the Torrance Test of Creative Thinking.

Definitions of Key Terms

For the purposes of this study, the following terms were defined:

Collaboration. The *Oxford Dictionaries* defined collaboration as "the action of working with someone to produce or create something" (Oxford University Press, 2013).

Collaboration was further clarified by the Partnership for 21st Century Skills (2009) to include such skills as working effectively with teams, exhibiting flexibility and compromise in order to succeed as a team, accepting responsibility for collaboration, and respecting contributions of all members.

Creativity. The term has numerous definitions, which are further explored in Chapter Two. Runco (2004) stated:

> Creativity drives innovation and evolution, providing original ideas and options, but it is also a reaction to the challenges of life. It sometimes helps when solving problems, but also sometimes allows problems to be avoided. It is both reactive and proactive. (p. 678)

Runco (2007) provided a hierarchy for differentiating creativity potential and performance, which included references to the creative person, product, press, and process.

Fine arts. The fine arts were defined in the National Art Education Association (2014) statement as **"**dance, media arts, music, theatre and visual arts, following the National Coalition for Core Arts Standards" (p. 2). For the purposes of this study, the fine arts were limited to those courses (a) allowed by the state of Missouri to be credited toward high school graduation and (b) offered by the high school involved in the study, such as vocal/instrumental music, visual arts, and drama.

International Baccalaureate Diploma Programme (IB DP). The administrators of the International Baccalaureate Organization (IBO) (2007) defined the IB DP as "a rigorous pre-university course of study designed for students in the 16-19 age range" (p. 1). Students participate over the course of two years (generally 11th and 12th grades in

the U.S. high school system) in a balanced curriculum encompassing six academic areas including two languages, humanities, experimental sciences, mathematics, and the arts (IBO, 2007). In addition, the curriculum surrounds a core comprised of three specialty experiences known as the "Extended Essay; Theory of Knowledge course; and Creativity, Action, and Service projects" (IBO, 2007, p. 1).

Learner profile. The curriculum leaders of IBO identified 10 criteria for learners in the 21st century. According to the IBO (2009), the learner profile provides a common set of terminology for teachers and students for the ideals of the whole kindergarten through 12th grade IB continuum (p. 1). Consistent with IB philosophy, "IB learners strive to be inquirers, knowledgeable, thinkers, communicators, principled, open-minded, caring, risk-takers, balanced, [and] reflective" (IBO, 2009, p. 1).

Torrance Test for Creative Thinking (TTCT). The TTCT is considered a highly reliable test for assessing creativity (Kim, 2006; Scholastic Testing Service, Inc., 2013). According to Scholastic Testing Service, Inc. (2013), "Testing only requires the examinee to reflect upon their life experiences. These tests invite examinees to draw and give a title to their drawings (pictures) or to write questions, reasons, consequences and different uses for objects (words)" (para. 1). The test uses five norm-referenced measures of fluency, originality, elaboration, abstractness of titles, and resistance to premature closure, as well as 13 criterion-referenced measures, which include indicators of creative strengths (Torrance et al., 2008). The two sets of measures are combined together to give the scorer a creativity index score for the subject (Torrance et al., 2008).

Twenty-first century skills. According to the Partnership for 21st Century Skills (2009), "Learning and innovation skills increasingly are being recognized as those that

separate students who are prepared for more and more complex life and work environments" (p. 3). The four 21st century skills included creativity, critical thinking, communication, and collaboration (Partnership for 21st Century Skills, 2009). The skills are recognized as necessary for success after completion of secondary education (Partnership for 21st Century Skills, 2009).

Limitations and Assumptions

The following limitations were identified in this study:

Sample demographics. The population of the study was drawn from the junior and senior classes of students at one high school in a large accredited urban district. According to the district website, in 2013, the student enrollment for the school was approximately 1,700, which included grades nine through 12, plus a select group of middle school students, grades six through eight. The district reported a free and reduced price meals population of approximately 55%. Nearly three-fourths of the students were Caucasian. During the 2012-2013 school year, the high school had approximately 344 twelfth grade students enrolled. Two hundred eighty-six of the 344 students graduated; therefore, the graduation rate was 83%.

In addition to state mandated programs, the high school housed three special programs, which drew students from across the district, outside the neighborhood enrollment pattern. The students were enrolled in the Scholars Program, International Baccalaureate Middle Years Programme (IB MYP), or the IB DP. The Scholars Program was designed by the district to serve a population of highly-gifted students who were in grades six through eight. The students receive enrichment of expected grade-level material as well as the opportunity to enroll in high school courses.

The IB MYP and IB DP together allow the school to be designated as an IB World School, because at least one IB program is administered within the school (IBO, 2014b). The students enrolled in IB MYP were in grades six through ten (IBO, 2014a). The IB MYP was shared by the high school and a neighboring middle school, the latter of which used IB MYP to educate students in grades six through eight. The IB MYP was considered pedagogy of learning and teaching rather than a strict curriculum; however, the students complete a culminating personal project at the end of their tenth grade year (IBO, 2014a). The IB DP was an upper level international program for grades 11 and 12 (IBO, 2007).

The curriculum was established internationally in the 1960s (IBO, 2007); however, it was implemented at the high school approximately 15 years prior to the completion of this study. The IBO defined the IB DP as "a rigorous pre-university course of study designed for students in the 16-19 age range" (IBO, 2007, p. 1). Students participate over the course of two years (generally 11th and 12th grades in the U.S. high school system) in a balanced curriculum encompassing six academic areas including two languages, humanities, experimental sciences, mathematics, and the arts (IBO, 2007). In addition, the curriculum surrounds a core comprised of an Extended Essay; a Theory of Knowledge course; and a Creativity, Action, and Service project (IBO, 2007). Approximately 80 seniors from the high school were registered to test for IB Diplomas during the spring 2014 session. In addition to those testing for IB Diploma status, approximately 30 senior students were also registered to test for subject-specific certificates as an alternative to completion of the full diploma program.

The sample was comprised of 51 students representing the population of the 11th and 12th grades of a high school in a large accredited urban district. To obtain the sample, students were recruited from a variety of classes including IB Psychology, Physical Education, Industrial Arts, English Three, and English Four. The subjects were between 16 to 19 years old and were currently enrolled at the high school.

Two specific programs were targeted in order to discover the relationship between creativity and enrollment in fine arts courses and the IB DP. Since all high school students of the district were required to complete one fine arts credit in order to graduate, the focus of the study was the creativity of students enrolled in fine arts classes at the time of the study versus those who may have taken a fine arts class in previous years or who will take fine arts classes in the future. In addition, because of the rigorous inquiry intrinsic to the IB DP, the students enrolled in the IB DP were targeted because of the expectation of rigor for fine arts. Some students in the IB DP may have chosen an IB elective that met the IB elective requirement but not the state fine arts requirement. In this case, the student may have completed the state graduation requirement for a fine arts credit prior to enrollment in the IB DP or prior to the beginning of the study.

The subjects were divided into four subsamples. The subjects enrolled in fine arts courses included those enrolled in visual arts (such as sculpting, photography, and painting) and performing arts (such as theatre, vocal music, and instrumental music). The first subsample, identified as subsample A, included junior and senior students who were enrolled both in fine arts courses at the high school and also in IB DP courses. The second subsample, B, was comprised of high school students who were not enrolled in fine arts courses but were enrolled in IB DP courses. The third subsample, designated as

subsample C, included 11th and 12th grade students who were not enrolled in IB DP courses but were enrolled in the regular graduation path including a fine arts class. The final subsample, D, represented students enrolled at the high school who were neither enrolled in IB DP courses nor a fine arts class. In summary, the data were coordinated into four designations: IB/fine arts (subsample A); IB/non-fine arts (subsample B); non-IB/fine arts (subsample C); and non-IB/non-fine arts (subsample D). The purpose of these designations was not to establish the preference of one curriculum experience over another, but rather to discover whether a relationship existed between the creativity index scores and the curricula.

Instrument. The assessment of subjects was completed using the TTCT, which has two forms, the TTCT-Verbal and the TTCT-Figural (Kim, 2006; Scholastic Testing Service, Inc., 2013). The TTCT-Figural was intended for examinees 4th grade through adult. This form was the most appropriate choice for the study (Torrance, 2007). The subjects had 30 minutes in 10-minute increments to complete three activities, which included "picture construction, picture completion, and repeated figures of lines or circles" (Kim, 2006, p. 3). Each of the subjects who completed the TTCT-Figural test was scored for the five norm-referenced measures and 13 criterion-referenced measures (Torrance et al., 2008). When figured together, the scoring measures were used to generate a creativity index score along with a norm-referenced national percentile established for each subject using the *Streamlined Scoring Guide* and the *Norms-Technical Manual* (Kim, 2006; Scholastic Testing Service, Inc., 2013; Torrance, 2007; Torrance, 2008; Torrance et al., 2008). According to Torrance (2007), the creativity

index score has been “found to serve well as an overall indicator of creative potential” (p. 9).

Secondary achievement data such as ACT and GPA were utilized as a comparison to the creativity index score. The data were used to verify previous research conducted by Lai and Viering (2012), which determined the creativity index score was a better predictor of success beyond high school than GPA or SAT. In contrast, Rosen and Tager (2013) found a negative relationship between GPA and the creativity index scores in the subjects of their study. As both studies provided distinctly different results, the data from this study will provide future researchers with information pertinent to a potential longitudinal study with current subjects on the predictive nature of creativity.

The following assumptions were accepted:

1. The responses of the subjects were offered honestly and without bias.
2. The subjects completed the assessment to the best of their abilities.

Summary

The IBM (2010) study, PDK/Gallop Poll (Bushaw & Lopez, 2013), and the study for the Conference Board by Lichtenberg et al. (2008) were the foundation for the analysis of creativity in secondary education systems and provided background for the problem. The conceptual framework was defined by Runco (2007), and it provided a hierarchy for the study of creative potential within the constraints of person, process, and press. Within the confines of fine arts courses, researchers observed students were introduced to creativity as a part of their course work (Marshall, 2010), but the use of creative thinking skills as a predictor for academic achievement and adjustments to curricula have not been fully researched (Lai & Viering, 2012). As secondary educators

shift their focus to the college and career readiness of their students (Partnership for 21st Century Skills, 2009), this study provides a baseline of the current level of creative thinking within the curricula.

The following chapters are organized to explore whether a prediction of the success of students can be made based on scores from the TTCT or other general academic assessments. The next chapter expands the definition of creativity within the context of the hierarchy of creative potential outlined by Runco (2007). In addition, an historical context for the study is provided and a direction for future research resulting from this study is offered.

Chapter Two: Review of Literature

Creativity has had a rich history as a research topic since the introduction of creativity as a viable research component by Guilford in 1950. The recent research included the work of Sir Ken Robinson (2011). In his rereleased book, *Out of Our Minds,* Robinson (2011) defined the role of creativity in modern education and as a force in the global economy. According to Robinson (2011), "It is often thought that only special people are creative; that creativity is a rare talent" (p. 3). Major business leaders have asserted that creativity is the skill most desired in employees and leaders (Brenner, 2010; IBM, 2010; Lichtenberg, Woock, & Wright, 2008; President's Committee on the Arts and the Humanities, 2011).

In this chapter, the need for creativity is addressed through the global call for creativity by political, business, and education leaders. The definition of creativity is expanded through the conceptual framework of creative potential and performance developed by Runco (2007). A context for recognizing the importance of creativity in education and the workforce of the 21st century is provided through the review of pertinent literature. A discussion of ways creative thinking has been assessed in the past is also included in Chapter Two, along with an analysis of what these assessments might mean for educators and students in the 21st century.

A Global Call for Creativity

The researchers of the 2013 PDK/Gallup Poll of the Public's Attitudes toward Public Schools interviewed 1,001 Americans over the age of 18 (Bushaw & Lopez, 2013). Eighty percent of the adults "selected critical thinking skills as most important 21st century skills" (Bushaw & Lopez, 2013, p. 18). Seventy-eight percent selected

communication skills; following at 58% and 57%, respectively, were increased student creativity and collaboration as important skills to be nurtured in students (Bushaw & Lopez, 2013).

The Programme for International Student Assessment (PISA) also researched creativity as an important component of a parent's perception of a child's education. The PISA argued in the 2011 report that creativity was "the ultimate expression of educational achievement" and postulated the necessity for inclusion of creativity within the curriculum (IBO, 2011, p. 1). Prior to this research conducted by the PISA, many researchers thought creativity had no link to academic achievement (IBO, 2011). The PISA provided evidence of "a strong correlation between excellence in creative subjects and high scores in languages, maths and science in certain countries" (IBO, 2011, p. 2).

Most notably, the students from schools in Scandinavian countries displayed increased academic scores resulting from enrollment in fine arts courses (IBO, 2011). The PISA surmised the increased achievement was due to the government's involvement in the implementation of creativity as a part of the curricula (IBO, May 2011). The International Baccalaureate Organization (IBO) (2011) acknowledged creativity was obviously a part of an arts curriculum.

Although the arts courses are a natural starting point for nurturing creativity, the 21st century students who are competing in the business world also need to experience opportunities to develop creative skills within academic subjects, such as math and science (Robinson, 2011). Often, as Robinson (2011) purported, creativity flourishes in interdisciplinary activities because connections are made among the subjects, which activates the whole student in learning (IBO, 2011). Whole school involvement also

means teachers of all subjects are compelled to explore opportunities for promoting creativity within their work. Teachers, therefore, are modeling creativity behaviors beyond high school. One IB World School principal John Jose affirmed he "believes human creativity is the ultimate economic resource" (IBO, 2011, p. 3).

Educators, parents, students, and employers agree creativity appears to be necessary for the 21st century. What exactly does creativity mean in these contexts? The authors of the literature reviewed provided insights into the thinking of researchers regarding the importance of creativity for educators and the economy.

What is Creativity?

Creating a concrete definition for creativity has been a topic of hot debate among researchers. The range of definitions varies from long explanations to avoidance of the topic (Mishra & Henriksen, 2013). In fact, Mishra and Henriksen (2013) reported "an investigation of more than 90 articles from top peer-reviewed journals, all dealing specifically with the topic of creativity, …determined that only 38% of these articles offered an actual definition of the term creativity" (p. 11).

It was essential for the purposes of this study to establish common language concerning the definition of creativity. The definition used in the literature review changed depending on how researchers assessed the concept and the ways in which creative thinking was applied (Dacey, 2013; Grierson, 2011). Harris, Collins, and Cheek (2013) contributed, "Exactly how validly and reliably creativity can be identified and measured remains an issue. Just as beauty is often in the eye of the beholder, creativity may depend on one's vantage point, content knowledge, experience, and presuppositions" (p. 19). Robinson (2011) explained the definition of creativity:

> Being creative involves *doing* something…. To call somebody creative suggests they are actively producing something in a deliberate way. People are not creative in the abstract; they are creative in something…. Creativity involves putting your imagination to work. In a sense, creativity is applied imagination. (p. 142)

Furthermore, Csikszentmihaiyi, who developed the systems model for creativity, offered the definition of creativity as "any act, idea, or product that changes an existing domain, or that transforms an existing domain into a new one" (as cited in Milbrandt & Milbrandt, 2011, p. 9). Using these definitions as a springboard for research into creativity, Robinson (2011) argued creative thinking allows students and employees to pursue the outcomes of their ideas actively in order to breed change or innovation.

Clarifying the definition of creativity further, Brinkman (2010) and Rosen and Tager (2013) introduced the terms *Big C* and *little c* as ways to focus research. Big C and little c provide insights resulting from the creative product (Brinkman, 2010; Rosen & Tager, 2013). Rosen and Tager (2013) stated:

> {Big C} occurs when a person solves a problem or creates a product that has a major impact on how other people think, feel, and live their lives. This level of creativity consists of clear-cut, eminent creative contributions. Little-c creativity, on the other hand, includes actions in which a non-expert may adapt to changes each day. (pp. 3-4)

In other words, Big C creativity is the goal of innovative business leaders and entrepreneurs, and little c creativity primarily exists as a day-to-day problem solving approach (Rosen & Tager, 2013). All aspects of this creativity definition are necessary in

the education field as students learn to apply their creative thinking skills in preparation for post-secondary education opportunities (Brinkman, 2010).

Creative Potential

Runco's (2007) hierarchy is used as a guide for the study of creativity. The level of creative potential includes the categories of person, process, and press. Each category is codependent on the others (Runco, 2007). For example, creative potential is manifested in the process of creating, but without the personality traits evident or the pressures of environment, the creative person finds the number of ideas also limited (Runco, 2007). Runco (2007) explained, "Simply put, then, there is an important interplay between the person category and the press category of creativity research, at least if we wish to predict actual creative behavior" (p. 4).

The movement toward predicting creative behavior in employees has been identified as important to employers of the 21st century (Brenner, 2010; Bruton, 2011; IBM, 2010; LEGO Systems Inc., 2007; Lichtenberg et al., 2008). In fact, Brenner (2010) reported a survey of Fortune 1000 companies indicated the necessity of creativity to the financial outcome of the company. As a result, a variety of computer programs, such as WorkKeys, have become commonplace in the assessment of character traits of future employees (ACT, Inc., 2013; Brenner, 2010). Students leaving secondary schools for university or careers must be prepared to demonstrate creativity through personality tests and other assessment tools, which prescreen employees (Brenner, 2010).

Admissions coordinators of colleges and universities responded to pressure from the business world through the creation of new ways to ensure that the creative students were being enrolled. Pérez-Peña (2013) described the recent trend for universities, such

as Chicago and Brandeis University, to ask unusual questions in place of the standard college essay on the application. High school counselors who were interviewed by Pérez-Peña (2013) indicated many seniors would not have the skills necessary to respond to essay prompts focusing on the creativity and unique perspective of the writer. With these pressures looming over students and employees, educators also face pressures concerning equipping students to demonstrate creative potential through person, process, and press.

Person. According to Barbot, Besançon, and Lubart (2011), prior to the introduction of creativity as a researchable topic by Guilford in 1950, "The study of the creative person was…essentially limited to the gifted and talented individuals" (p. 58). Robinson (2011) determined this practice to be a fallacy and stated all people have the capacity for creativity. When identifying creative potential, Runco (2007) began the definition with the creative person. Although no two creative people are alike, researchers, such as Brinkman (2010), Fleith (2000), and Wagner (2012), found common traits exist among the creative persons. Wagner (2012) reiterated successful educators develop the creative potential in their students through the encouragement of recognizable creativity traits.

Milbrandt and Milbrandt (2011) defined the creative person in a similar fashion to the definition of creativity offered by Grierson (2011) and Robinson (2011). A creative person "is someone whose thoughts or actions change a domain or establish a new domain" (Milbrandt & Milbrandt, 2011, p. 9). True innovators use innate creative traits to cultivate creativity and to enhance the creative process (Wagner, 2012). Brookhart (2013) defined the creative person as one who provides a product that is original and of high quality. The flaw in this definition of the creative person is its focus on the final product,

because this limits the creative person to only a successful outcome (Runco, 2007).

Wagner (2012) questioned young innovators and entrepreneurs who demonstrate success in creative endeavors to discover whether commonalities exist. Wagner (2012) studied who a person is, how a person had been raised, and how the person was mentored as factors contributing to a creative individual's success (Wagner, 2012). This information, along with other personality traits, is used to provide dimensionality concerning the character of creative thinkers (Wagner, 2012). Because creative individuals are identified as crucial components in the success of businesses around the world, the traits of a creative person need to be identified and honed (Dacey, 2013).

Common personality traits of the creative person include risk-taking (Brinkman, 2010; Lai & Viering, 2012; Sternberg, 2006), a tolerance for ambiguity (Millar, 2010; Torrance, 2008), intrinsic motivation (Brinkman, 2010; Torrance, 2008; Wagner, 2012), a sense of humor (Millar, 2010; Torrance, 2008), a wide range of interests (Brinkman, 2010; Robinson, 2011), and perseverance (Brinkman, 2010; Dacey, 2013; Millar, 2010; Torrance, 2008). Furthermore, in 1961, psychologist Carl Rogers suggested the key to creativity is the individual's ability to be open to the possibilities within experiences (Gude, 2010; Jaffer, 2013; Kim, 2006; Runco, 2007). The creative individual who exhibits openness to experience also makes connections among ideas from a variety of points of view (Gude, 2010; Robinson, 2011). In the description of the TTCT, Torrance referred to this openness as a resistance to premature closure (Millar, 2010; Torrance, 2008).

Kim (2006) credited Torrance directly for discovering motivation and skills are also traits seen in creative individuals. In fact, Kim (2006) emphasized, "Creative

motivation and skills as well as creative abilities are necessary for adult creative achievement to occur" (p. 3). In interviews with 150 young innovators and entrepreneurs between the ages of 21 and 32, Wagner (2012) uncovered similarities in personality traits among young innovators and entrepreneurs in several areas including motivation. Extrinsic motivators, such as grades, assessment scores, and awards, were surprisingly *not* what motivated young innovators (Wagner, 2012). According to Wagner (2012), young innovators were less concerned about external forces than they were about their own intrinsic motivation, or how they personally felt about the project. The drive to find a solution to immediate problems was how young innovators were motivated to work hard and demonstrate a willingness to experience failure in the pursuit of success (Dacey, 2013). Innovators who excelled at the ability to learn from failure also demonstrated flexibility (Wagner, 2012). According to Runco (2004), "The flexibility of creative persons is what gives them the capacity to cope with the advances, opportunities, technologies, and changes that are a part of our current day-to-day lives" (p. 658).

Furthermore, creative persons demonstrate the courage for risk-taking, according to IDEO leaders David Kelley and Tom Kelley, through their willingness to act on new ideas (Why Creativity is Like Karaoke, 2013). Through the courage to act on ideas, creative persons develop confidence in their creativity (Why Creativity is Like Karaoke, 2013). As a result of his experiences, IDEO's David Kelley also identified confidence as an important trait of creative persons (Why Creativity is Like Karaoke, 2013).

Within IBO (2009), educational leaders and curriculum developers conceptualized a list of desired traits into the *IB Learner Profile*. Through the IB Learner Profile, curriculum developers for IBO (2009) provided students and educators with the

expected characteristics of learning within the whole IB continuum. IBO (2009) specified, "IB learners strive to be inquirers, knowledgeable, thinkers, communicators, principled, open-minded, caring, risk-takers, balanced, and reflective" (p. 1). The traits of the creative person, as defined by Brinkman (2010), Dacey (2013), Kim (2006), Milbrandt and Milbrandt (2011), and Robinson (2011), are mirrored in the IBO's Learner Profile. The IB learner is provided guidelines for who the IB learner is and what this learner looks like within the context of the IB DP (IBO, 2009). In addition, through the IB Learner Profile, IBO (2009) demonstrated the application of research within the curriculum.

Creativity as deviant behavior. Creativity, however, is not always recognized by society as desirable. Runco (2004) inferred, "Because it is so strongly tied to originality, and original behavior is always contrary to norms, all creativity is a kind of deviance" (p. 677). The resulting negative connotation connected to creative thinkers is, therefore, not surprising (Runco, 2004). Creative people often find themselves discouraged from creative thinking, labeled as troublemakers, or viewed suspiciously because their thoughts and ideas deviate from those in the status quo (Lai & Viering, 2012). In fact, Sternberg (2006) studied the effect of risk-taking on creative behavior. Sternberg (2006), in summarizing the results of his own study, stated:

> We found that greater risk-taking propensity was associated with creativity for artwork but not for essays. When we investigated why this was so, we found that some evaluators tended to mark down essays that took unpopular positions. We learned, therefore, that one of the risks people face when they are creative, even in an experiment on risk taking, is that the evaluators will not appreciate the risks if

> they go against their own beliefs! (p. 89)

Sternberg (2006) indicated despite the call for increased creativity within education and business environments, students often feel they must make safe choices in order to succeed. Pérez-Peña (2013) suggested despite college requests for more creative entrance essays, students continue to make the safe choice of writing a standard essay rather than risk failure by creating something unusual. Students limit their creative endeavors within the educational environment, which may result in lower creative thinking skills when the students eventually enter the business world.

The brain of the creative person. Researchers of the creative person previously emphasized the connection between brain hemispheres and creative thinking (Runco, 2004). The attempt was made by researchers to simplify the creative process by making it solely a physiological event (Runco, 2004). Runco (2004) disagreed, "Creative activity cannot be localized as a special function unique to one of the cerebral hemispheres. Rather, productive thought involves the integration and coordination of processes subserved by both hemispheres" (p. 664). In November 2013, Novotney reported:

> The terms "left-brained" and "right-brained" have come to refer to personality types in popular culture, with an assumption that people who use the right side of their brains more are more creative, thoughtful and subjective, while those who tap the left side more are more logical, detail-oriented and analytical. But there's no evidence for this, suggest findings from a two-year study led by University of Utah neuroscientists who conducted analyses of brain imaging. (p. 10)

In fact, although researchers are establishing a connection between intelligence and creativity, equal research exists that demonstrates biologically these two functions occur

in separate locations in the brain (Chrysikou, 2012; Geddes, 2010). Neuroscientists used new techniques and advancements of technologies to create images of specific areas of the brain during the divergent thinking process (Chrysikou, 2012; Geddes, 2010). The resulting images were directly related to changes in how researchers approached learning and creativity (Geddes, 2010) and the connection of creativity and brain function (Chrysikou, 2012). For example, in a study reported by Anstead (2011), neuroscientists conducted an experiment on jazz musicians. Images of the musicians' brains were created in an fMRI scanner as the musician performed improvised music. The images revealed the whole brain of the musician was engaged in the creative nature of the task (Anstead, 2011).

Notar and Padgett (2010) determined, "Brain development is dependent on challenging learning experiences and on providing experience and interactive feedback" (p. 296). In 1956, Bloom and his colleagues developed Bloom's Taxonomy as a way to explain how the brain learned through the process of thinking (Anderson & Krathwohl, 2010). As advances were made in the study of the brain in connection to creativity, a team conducted a reevaluation of Bloom's Taxonomy (Anderson & Krathwohl, 2010). Anderson and Krathwohl (2010) agreed, "The original Taxonomy was best seen as a heuristic for studying, understanding, and solving educational problems" (p. 64).

With progress in the understanding of the psychological make-up of learners and the tools of educators, the proposal was made in 1996 to reevaluate the original taxonomy (Anderson & Krathwohl, 2010). One of the first changes made to the taxonomy was the replacement of the original noun descriptors (Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation) with verb descriptors (Remembering,

Understanding, Applying, Analyzing, Evaluation, and Creating) because "as a taxonomy of cognitive processes, the noun forms used for the original category names were inappropriate; they should have been verbs" (Anderson & Krathwohl, 2010). According to Anderson and Krathwohl (2010), Merlin C. Wittrock was especially interested in changing *synthesis* to *creating.* Wittrock recognized:

> Create goes beyond merely making new knowledge fit with existing knowledge as Synthesize suggests…. Create describes the active processes of constructing meaning and, subsequently, plans of action that need to be carried out. When viewed in this way, it made sense to move Create to the top of the cognitive process dimension. (as cited in Anderson & Krathwohl, 2010, p. 64)

By placing the step of creating at the top of Bloom's taxonomy, researchers connected the way people think and learn directly to the process of creating.

Process. Robinson (2011) argued, "To call something a process indicates a relationship between its various elements: that each aspect and phase of what happens is related to every other" (p. 151). The idea of a creative process has been outlined frequently in the literature by creativity researchers. Fleith (2000) endorsed the creative process as "an original way to produce unusual ideas, to make different combinations, or to add new ideas to existing knowledge" (p. 1). Artists often demonstrate the creative process; however, the process is not limited to artists (Robinson, 2011). Scientific researchers, mathematicians, and engineers also demonstrate knowledge of the creative process in order to be successful in the chosen area of expertise (Mrnarević, 2011). Dividing the creative process into stages helps define the process of creativity.

The creative process is described in two stages, generative and evaluative (Hélie & Sun, 2010; Robinson, 2011). Creative persons use both stages, which requires them to generate new and original ideas, to evaluate those ideas, and to make decisions based on which ideas have the greatest impact on the audience (Hélie & Sun, 2010; Marshall, 2010; Robinson, 2011). Identifying the four stages of creativity established by Wallas in 1926 delineated the process of creativity further (Hélie & Sun, 2010; Marshall, 2010; Runco, 2004; Wong & Siu, 2012). Wallas' stages of preparation, incubation, illumination, and verification clarified the generative and evaluative steps (Hélie & Sun, 2010; Marshall, 2010; Runco, 2004; Wong & Siu, 2012).

In the preparation stage, "information and related ideas are gathered" (Marshall, 2010, p. 17). In Amabile's (1996) creative process model, this stage was divided into two steps: problem/task presentation and preparation (Wong & Siu, 2012). Osborne initiated another model of creativity and defined this stage as "mess finding, data finding, and problem finding" (Wong & Siu, 2012, p. 440). Regardless of the terminology used to define the stage of preparation, Wong and Siu (2012) suggested this phase included "thinking in all directions" (p. 440).

According to Robinson (2011), making connections among ideas that are not usually connected is the foundation of creative thinking. In other words, creative thinking is present in "spontaneous open-ended ways of reflecting to find links, bridges, and … conceptual clusters" (Marshall, 2010, p. 84). In addition, Dacey (2013), Robinson (2011), and Wong and Siu (2012) indicated the importance of divergent thinking as a part of the creative process. An individual compiling a diverse list of ways an object, such as a brick or a paper clip, could be used, would demonstrate divergent thinking (Robinson, 2011).

Runco did not argue with the validity of divergent thinking; however, he believed the key was to think of divergent thinking as an indicator of potential rather than "a synonym for creative skill" (Henshon, 2010, p. 20).

During the incubation phase, "The prepared material is internally elaborated and organized" (Marshall, 2010, p 17). Generally, incubation is observed:

> After a period of conscious activity, creative individuals redirect their activity away from the main problem situation to which they have devoted most of their time and go through a period of Incubation. They either attend to other problems or seek relaxation and recreation, yet remain receptive to internal thoughts and external information that could lead to a solution. (Kirschenbaum, 1998, p. 20)

Commonly, when the subject takes a break from the problem, the incubation stage occurs (Hélie & Sun, 2010; Newell & Rakow, 2011). The break can last for several minutes, hours, or years (Hélie & Sun, 2010; Newell & Rakow, 2011). During this period of unconscious thinking, the creative person discovers solutions to the problem often appear unexpectedly (Hélie & Sun, 2010; Newell & Rakow, 2011).

Although incubation was first defined by Wallas in 1926, there is some debate in the literature about the validity of this phase of incubation in creative thinking (Wong & Siu, 2012). Osborne (as cited in Baer & McKool, 2009; Wong & Siu, 2012) as well as Amabile (1996) offered alternatives to the incubation phase. Wong and Siu (2012) argued despite the label given to the unconscious phase, "It is obvious that models developed by researchers are of a similar pattern" (p. 440).

Illumination "is the stage in which an idea emerges" (Marshall, 2010, p. 17). Hélie and Sun (2010) described the illumination as a moment when the creative person

moves from uncertainty and unknowing to certainty and knowing. The layman's term, *ah-ha moment*, is often used to explain the stage of illumination (Marshall, 2010). Gude (2010) determined the key to developing creative ideas relies on "creative individuals develop[ing] a deeply rooted trust in their own capacity to generate surprising solutions" (p. 37). In short, the inspiration stage of the creative process includes taking a risk to connect ideas in order to generate a novel product (Hélie & Sun, 2010).

Trusting in the ability to generate ideas, a creative person is led to the final step of the creative process: verification. Robinson (2011) characterized creativity as "not only about generating ideas; it involves making judgments about them. The process includes elaboration on the initial ideas, testing, and refining them and even rejecting them, in favor of others that emerge during the process" (p. 153). This is where convergent thinking occurs in the process (Robinson, 2011). Divergent thinking is emphasized as the generation of ideas, and convergent thinking is used to stress the unconscious assessment of the ideas that are generated (Wong & Siu, 2012). During the verification stage, the "idea is evaluated and further elaborated into its complete form" (Marshall, 2010, p. 17).

Process is closely connected to a person's creative traits (Wagner, 2012). How the person acts is often linked to the creative process (Robinson, 2011). Robinson (2011) declared, "Creativity is the process by which … threads are formed and it is in our interactions with others that they are woven into the reach fabrics of human culture. Creativity and culture are the warp and weft of human understanding" (p. 198). The significance of Robinson's (2011) words is that the collaboration with others, directly or indirectly, often shapes the creative processes.

On the contrary, Jaffer (2013) and Rosing, Frese, and Bausch (2011) argued the

process of creativity does not happen in a straightforward manner. Therefore, the assessment and assignation of the steps becomes challenging (Wong & Siu, 2012). Wong and Siu (2012) diagrammed the process and included loops back to previous generative steps, through reflection and evaluation of the idea, to create a cyclical pattern. In addition, Brinkman (2010) asserted, “Creativity takes time. Although we may have flashes of insight, it takes time to work out the implications and uses of that insight” (p. 48). Nevertheless, the process of creative individuals is stimulated by the pressures resulting from creative thinking.

Press. Murray originally introduced press in 1938 as a way “to describe pressures on the creative process or on creative persons” (Runco, 2004, p. 661). In addition, in 1961, Rhodes stated, "Press refers to the relationship of human beings and their environment.” (as cited in Runco, 2004, p. 662). Fleith (2000) agreed the environment is influential in “promoting or inhibiting creative abilities” (p. 1). Sternberg (2006) emphasized the importance of a positive press:

> One needs an environment that is supportive and rewarding of creative ideas. One could have all of the internal resources needed to think creatively, but without some environmental support (such as a forum for proposing those ideas), the creativity that a person has within him or her might never be displayed. (p. 89)

Runco (2007) argued the environment alone did not influence creativity. Runco (2007) cited several studies, such as those completed by Amabile in 1990, Rickards and Jones in 1991, and Witt and Boerkem in 1989, which provided data about the influence of environment.

According to Runco (2007), “None of them [influences of environment] definitely

increases nor decreases creative work, at least not without taking the individual's interpretive tendencies into account" (p. 4). Therefore, Runco (2007) offered an alternative definition of press:

> The key idea being that there are pressures (or influences) on our behavior. That is certainly true of creative behavior, and these may include places or environments. But some are not strictly environmental. Some are more general than that. (p. 3)

Lai and Viering (2012) and Runco (2007) indicated even cultural influences have an effect on creative output. Lai and Viering (2012) specified, "Creativity tends to be more product-oriented in Western cultures and process-oriented in Eastern cultures" (p. 17). Runco (2007) argued cultural pressures "can determine whether or not potential translated into performance, whether or not potential is fulfilled" (p. 6).

Creative Performance

The other side of Runco's (2007) hierarchy for the study of creativity is *Creative Performance*. Creativity is manifested in creative product, persuasion, and interaction (Runco, 2007). Robinson (2011) argued innovation is an extension of creativity. The creative person causes changes to the status quo through the application of creativity (Robinson, 2011). The product itself is considered creative only if it is of value to society (Bruton, 2011; Fleith, 2000; Robinson, 2011; Runco, 2004). In addition, an innovative product, according to Bruton (2011), "involves change, and it ultimately results in a useful product or process that is commercialized and widely disseminated'' (p. 322).

Because of the importance of the final product to society, educational leaders and researchers have emphasized the creative product over the creative process in the

developed curricula (Runco, 2004). On the other hand, Runco (2004) addressed the potential emphasis on the quantity of the product over the creative outcome and admitted in 2007 this emphasis could be a limitation in the study of creativity. Runco (2004) believed the amount of products created "can be quite misleading because what it takes to be productive may differ from what it takes to be creative. An individual can be productive without being original; and originality is the most widely acknowledged requisite for creativity" (p. 663). When teachers allow students to focus on process rather than product, Runco (2007) assured greater gains. For example, this approach is effectively applied to instruction in the field of visual art:

> Georgia O'Keeffe's … instructor required that students work as quickly as possible. The rationale for this technique was that the students would become immersed in the process and could not possibly care too much about the end result because they were working so quickly. Process *can* [emphasis added] be targeted. Products are not all-important. (Runco, 2007, p. 5)

In other words, researchers confirmed the culminating product is subordinate to the creative process that is necessary for the creation of the product (Runco, 2007).

On the other side of the issue, Torrance et al. (2008) reported a positive relationship between the number of responses (fluency) and the originality of the responses on the TTCT. The results, Torrance et al. (2008) implied, were directly related to the subject's ability to generate a large number of responses, which eventually move beyond the obvious. Runco (2003) warned education focuses too much attention on the outcome of creative thinking, making the creative product paramount, rather than acknowledging the importance of those traits that comprise the creative person and the

techniques that enhance the creative process. The differences in creativity between adults and children are based on recognition of the variance in the educational environment concerning its focus on process versus product (Runco, 2003).

Creativity in Education

Early childhood pioneers, such as Friedrich Froebel (1782-1852), the father of the kindergarten movement, and John Dewey (1859-1952), educator and philosopher, "recognized the child's creative self-expression through free play" (Strand, 2011). Milbrandt and Milbrandt (2011) explained, "As a pioneer of progressive education in the early 1900s, Dewey saw the need for centering the child in the educational process and tapping imagination and art as a viable means for transforming society" (p. 10). According to Strand (2011), Froebel found a link between creativity and play in children. Strand (2011) explained, "To nurture the child's ability to play is therefore to nurture the child's future ability to create something new" (p. 345).

Although imagination leads to creative thinking, adults often find imagination and creativity potential stifled in the work place (LEGO Systems Inc., 2007; Robinson, 2011). In fact, Brenner (2010) quoted a 2002 study by Beard and Wilson who asserted, "Many adults have difficulty in learning to play because of much attention being focused on 'ought to be' or 'could be' doing while children are busy experiencing 'being,' naturally living 'the moment,' the 'here and now'" (p. 207). Also at the university level, Palaniappan (2012) stated:

> The infusion of creativity and problem-solving skills in universities have generally been unsuccessful especially because of the focus on content and prescribed text books which has left no room for creative thinking and problem

> solving either from the instructions of teachers or through the initiative from the students themselves. (p. 255)

Furthermore, as Runco (2007) concluded, "Many educators now have pressure on them to insure achievement. This in turn means that there must be objective performances of some sort. It can lead to 'teaching to the test'" (p. 5).

The effectiveness of play in children was apparent in the research by Dewey and Froebel (Strand, 2011). Robinson (2011) echoed the need for play in the work of adults. A disconnection has occurred in the education system as students move from childhood to higher education (Robinson, 2011; Rosen & Tager, 2013).

Limiting creativity in education. Robinson (2011) stated, "Creativity is not solely to do with the arts or about being an artist, but I believe profoundly that we don't grow *into* creativity; we grow *out* of it" (p. 49). In fact, Jeffrey and Craft (2010) accentuated the importance of emphasizing creativity in teaching begins with the definition of the purpose. Defined as "forms of teaching that are intended to develop young people's own creative thinking or behavior," teaching for creativity provides the learner outcomes of increased student empowerment of the student's own learning (Jeffrey & Craft, 2010, p. 77).

Assessing the limitations of creativity in education through the hierarchy for the study of creativity, Runco (2007) asserted the primary failure of the education system in the teaching of creativity results from a failure to recognize and develop creative potential in students. In addition, Rosen and Tager (2013) argued the problem of limiting creativity stems from the environment of the schools: "Educators and researchers believe that it's important to teach and foster creativity inside the classroom, but many of them

claim that the school climate and curriculum guidelines discourage creativity" (p. 2). Process and press limitations stemming from achievement assessments led Rosen and Tager (2013) to clarify:

> Traditionally, the more the student's answer conforms to one or more pre-determined responses, the higher the grade. Thus, in many assessment programs, a culture that rewards uncreative thinking is cultivated, rather than a culture that encourages and rewards creative answers. (p. 2)

Benchmark and other achievement tests tend toward the "right" answer to a question rather than supporting the reasoning behind discovering the answer (Rosen & Tager, 2013).

Another limitation of creativity in secondary education is the notion creativity is restricted to courses designed to teach the arts. Participation in the arts is, in fact, positively linked to increased creativity (Grierson, 2011). Sadly, Grierson (2011) clarified, "The creative arts are too often overlooked in the resource stakes in favour of sciences and technology" (p. 340). The emphasis placed on Science, Technology, Engineering, and Mathematics (STEM) curricula has caused schools to limit arts programs, and as a result, the amount of creative thinking is also limited (Grierson, 2011; Robinson, 2011).

In fact, the researchers demonstrated that the sciences require creative thinking as much as the arts (Constantino, Kellam, Cramond, & Crowder, 2010; Eyster, 2010; Livingston, 2010; Mumford et al., 2010; Robinson, 2011). Eyster (2010) emphasized, "Many students think they are not encouraged—or even allowed—to be creative in the laboratory. When students think there is only one correct way to do a lab, their creativity

is inhibited" (p. 32). Creativity is essential in the sciences in order for experimentation and research to be successfully conducted and completed (Constantino et al., 2010; Robinson, 2011). Furthermore, Constantino et al. (2010) reported, "Nobel Laureates in the sciences were three times as likely to have arts avocations than the average scientist and the general public" (p. 49).

As a result, educators from the Kennedy Center for the Performing Arts (2014) advocated in favor of the addition of arts into the existing STEM programs. The resulting Science, Technology, Engineering, Arts, and Mathematics or *STEAM* program:

> Brings together what have long been thought of as polar opposites in the curriculum. However, the artistic process and the scientific method are more complimentary than we first might expect. Both are about exploration of ideas and possibilities. Both have a "process" and a "product" aspect to them. And both require students to engage in creative and critical thinking that supports collaborative learning. (Kennedy Center, 2014, para. 2)

Data reported by Constantino et al. (2010) also connected skills learned in the arts to the demonstration of higher-level creativity skills in the science lab. Additionally, according to the Kennedy Center (2014), the STEAM program leads to increased student learning and also supports 21st century skills. The STEAM program "is gaining traction across the country with support from a wide range of organizations, including the National Science Foundation, the National Endowment for the Arts, and the U.S. Department of Education" (Kennedy Center, 2014, para. 3).

Students' completion of activities in secondary classrooms also demonstrates limitations in creativity. According to Gude (2010), teachers desire the development of

curricula, which provides "'enhancing creativity' as a key desired outcome of their programs" (p. 31). Gude (2010) also stated, "Analysis of lesson plans used in schools suggests that in practice very little curriculum is specifically geared to developing creative abilities" (p. 31). As a result, Gude (2010) indicated a need for teachers to understand the definition of creativity and how to teach students to exhibit creative behaviors and potential.

Although creativity appears to be an important teachable skill for 2014, Runco (2004) cited a study completed by Bruner in 1962. Even fifty years ago, "Bruner…claimed that we must encourage the creativity of our children and students as preparation for the future, given that the future is more difficult than ever before to define" (Runco, 2004, p. 659). As the necessity for creativity skills becomes apparent in the 21st century, teachers are challenged with the task of providing instruction about creativity (Bruton, 2011).

Teaching creativity. Bruton (2011) debated the question, "Can creativity be taught?" (p. 331). In his research, Bruton (2011) quoted a 1986 study by Davis, which stated, "Despite genetic limits however, it is also absolutely true that virtually everyone's personal creativeness can be increased beyond its present level" (p. 331). Attention to the hierarchy framework of Runco (2007) reinforced Brinkman's (2010) assertion creativity can be taught by being aware of person, process, and press. Specifically, Runco (2007) stated educators should focus on "personality traits that might encourage creative expression and risk-taking" and the process of "teach[ing] and model[ing] techniques for generating ideas" and "allocate[ing] time to creative activity" (p. 48). In other words,

teachers can teach creativity and students can learn creativity when attention is paid to the creative potential of the learner (Brinkman, 2010).

One of the best ways to teach creativity, according to Robinson (2011), is to focus on divergent thinking. In the 1950s, Guilford introduced his model for divergent thinking, which included fluency, flexibility, originality, and elaboration (Shively, 2011). Fluency is the development of many different possibilities before the creation of a solution to the problem (Torrance et al., 2008). In short, fluency is represented by the number of ideas produced (Dhingra & Sharma, 2012; Millar, 2010; Torrance et al., 2008).

Flexibility is defined by Shively (2011) as the ability to look at the problem from a variety of perspectives. Originality in the model is also called novelty and represents the unanticipated direction of thinking (Millar, 2010; Mishra & Henriksen, 2013; Torrance et al., 2008). Finally, elaboration is demonstrated through the addition of elements to existing ideas (Dhingra & Sharma, 2012). Torrance (2007) used these skills as the foundation for the TTCT, which is used generally to assess the creative potential of the subject (Kim, 2006). Teachers who use these terms when implicitly teaching creativity skills create a common vocabulary with which to instruct students within existing curriculum and lesson designs (Shively, 2011).

Constantino et al. (2010) declared, to create leaders of the global economy, schools must address limitations within curricula and work to include the 21st century skill of creativity. Wagner (2012) recognized innovators in modern society have flourished as a result of enrollment in challenging classes, which at the same time provided opportunities for solving problems through creative thinking. While researchers and educators continue to promote the need for increased creativity in curriculums,

businesses leaders of companies such as LEGO Systems, Inc. (2007) also have recognized the need to encourage creativity in students.

In the report of a study conducted by LEGO (2007), the president of LEGO stated, "We know that fostering open-ended creativity at a young age helps children embrace a lifetime of critical thinking and creative problem solving; creativity that our children…will need in an ever-evolving and competitive marketplace" (p.1). Milbrandt and Milbrandt (2011) extended the assertion of LEGO (2007) with the observation, "Without the practice and aptitude for engaging in creative thinking, our citizenry may not be prepared to meet a world in continual flux" (p. 8).

Challenges to the education system in the 21st century. Robinson (2011) argued, "Education has three main roles: personal, cultural, and economic" (p. 66). The economic purpose of secondary education is to prepare students to be college or work ready when the students graduate from secondary schools (President's Committee on the Arts and the Humanities, 2011). The President's Committee on the Arts and the Humanities (2011) revealed, "Many high school graduates lack the skills to make them successful in post-secondary education and later in the workforce" (p. 28).

Hanna, Patterson, Rollins, and Sherman (2011) cited a lack of persistence to graduation for 50% of the student population in some parts of the United States as evidence for a need to reform the current education system. In addition, "Students who do graduate from high school," Hanna et al. (2011) observed, "are increasingly the products of narrowed curricula, lacking the creative and critical thinking skills needed for success in post-secondary education and the workforce" (pp. v-vi).

In terms of creative thinking skills, Robinson (2011) clarified the challenges of education:

> Our best resource is to cultivate our singular abilities of imagination, creativity and innovation. Our greatest peril would be to face the future without fully investing in those abilities. Doing so has to become one of the principal priorities of education and training everywhere. Education is the key to the future, and the stakes could hardly be higher. (p. 47)

Educators feel pressured to increase student achievement, often at the detriment of teaching creative processes (Robinson, 2011). According to Robinson (2011):

> All over the world, governments are pouring vast resources into education reform. In the process, policy makers typically narrow the curriculum to emphasize a small group of subjects, tie schools up in a culture of standardized testing and limit the discretion of educators to make professional judgments about how and what to teach. These reforms are typically stifling the very skills and qualities that are essential to meet the challenges we face: creativity, cultural understanding, communication, collaboration and problem solving. (p. 15)

The President's Committee on the Arts and the Humanities (2011) and Constantino et al. (2010), likewise, emphasized the need to reinforce necessary 21st century skills of communication, collaboration, critical thinking, and creativity.

Creativity is recognized as one of the skills necessary in the 21st century. As a result, Lai and Viering (2012) researched the work done by the organization Assessment and Teaching of 21st Century Skills (ACT21). The ACT21 provided a framework for discussing the primary skills necessary for success in the 21st century and identified

competencies for assessing creativity and innovation (Rosen & Tager, 2013). The competencies included:

> Creative thinking (e.g., using a wide range of idea-creation techniques, creating new and worthwhile ideas), creative work with others (e.g., communicating new ideas to others effectively, being open and responsive to new and diverse perspectives), and the ability to implement the innovation (e.g., implementing creative ideas to make a significant and useful contribution). (Rosen & Tager, 2013, p. 4)

Rosen and Tager (2013) delineated the creative skills, which mirrored the hierarchy of person, process, and press of creative potential established by Runco (2007).

Lai and Viering (2012) credited the Partnership for 21st Century Skills (P21) for the development of a "framework for conceptualizing different types of skills important for college and the workforce" (p. 3). The P21 specifically cited "learning and innovation skills (which) include creativity and innovation, critical thinking and problem solving, and communication and collaboration" (Lai & Viering, 2012, p. 3). Furthermore, the importance of the interactive nature of creativity within the other 21st century skills of collaboration, communication, and critical thinking became clear (Partnership for 21st Century Skills, 2009).

In a 2011 article, U.S. Secretary of Education Arne Duncan, supported by the research of Hattie (2012), encouraged school leaders to provide opportunities for teachers to work as a team and to become inquirers into practices supported by research. In this way, teachers who are the most successful have developed from leaders who allow teachers to model life-long learning and inquiry (Duncan, 2011). Hattie (2012)

encouraged collaboration as one of the best ways to improve student achievement, because he postulated teachers rely too often on the autonomy of how things have always been; however, with collaboration, teachers find many new possibilities become available. Bruton (2011) emphasized teamwork and collaboration are not only essential for teachers, but also necessary for the learning of the creative process. According to Damon and Phelps:

> Reported studies have shown that peer interaction is conducive, perhaps even essential, to a host of important early achievements: children's understanding of fairness, their self-esteem, their proclivities toward sharing and kindness, their mastery of symbolic expression, their acquisition of role-taking and communication skills, and their development of creative and critical thinking. (as cited in Bryant, 2010, p. 46)

Lai and Viering (2012) emphasized the impact of teaching creative thinking to students should not be limited to producing students who think independently and outside of the norm, but that teaching creative thinking also increases student achievement. Lai and Viering (2012) dissected previous research and discovered, “Studies have shown that measures of creative thinking significantly predict first-year college students’ grade point averages (GPAs) above and beyond high school GPA and SAT scores … as well as success in graduate school” (p. 7).

Despite the research, which demonstrated the power of teaching students to be creative, Robinson (2011) stated, “One of the main reasons that so many people think they are not creative is education” (p. 49). Robinson (2011) argued for changes to the press on creativity within education, because “the dominant forms of education actively

stifle the conditions that are essential to creative development. Young children enter pre-school alive with creative confidence; by the time they leave high school many have lost the confidence entirely" (p. 49).

Bryant (2010) drew attention to Howard Garner's work in 2006 as a model for encouraging creative thinking in children. Garner suggested, "Parents 'make sure that ... children pursue hobbies or activities that do not feature a single right answer'" (as cited in Bryant, 2010, p. 45). Executives of top companies, such as 3M, Google, EBay, and Amazon, value the ability to see multiple solutions rather than a single right answer (Bryant, 2010). The executives found the success of these companies resulted from the creative thinking of their employees (Bryant, 2010). Robinson (2011) also stated:

> Employers say they want people who can think creatively, who can innovate, who can communicate well, work in teams and are adaptable and self-confident. They complain that many graduates have few of these qualities…. Conventional academic programs are not designed to develop them and often value the opposite approach: encouraging solo research rather than collaboration, preferring data to be presented in an acceptable format, measuring success according to academic merit. (p. 69)

Livingston (2010) argued for 21st century skills and affirmed, "Although it is a normal form of human behavior, creativity is also a technique, a skill that can be developed and refined over time" (p. 60).

Because of the emphasis on creativity in the business world, researchers of the education system continue to focus on creativity as a skill necessary for success in the 21st century. Beghetto and Kaufman (2013) maintained that "without a clear

understanding of the nature of creativity itself, such well-meaning advocacy may do more harm than good; educators may experience calls for teaching creativity as just another guilt-inducing addition to an already-overwhelming set of curricular demands" (p. 11). Educator understanding of the role creativity could play in education serves to enhance the workplace of the future (Beghetto & Kaufman, 2013). The more research conducted on the value of learning creativity itself, the better curricula could be designed to produce students with 21st century skills (Beghetto & Kaufman, 2013).

Creativity in the Workplace

In many cases, employee creativity provides the impetus behind economic advancement (Gibson, 2005). Prime Minister Blair identified the need for creativity as a way to salvage the waning economy in the United Kingdom (Gibson, 2005). President Obama echoed this sentiment about the economy in the United States (President's Committee for Arts and the Humanities, 2011). Harris, Collins, and Cheek (2013) provided support for the global leaders by defining the role of creativity within the economy as "a segment of the larger economy whose principal orientation is to apply creative ideas and processes to generate goods, services and innovations that provide both economic and aesthetic value" (p. 7). Grierson (2011) speculated, "Creativity is now synonymous with economic productivity as the human subject undergoes transformations of identity as an entrepreneurial self" (p. 336).

Craft (2003) maintained creativity, as a driving force behind economic growth, is not limited to the visual or performing arts. In fact, Mrnarević (2011) identified the Intellectual Property Sector and presented areas of creative thinking, which included the arts as well as innovation in a variety of subjects, such as science and technology.

Mrnarević (2011) specifically mentioned creative thinking provided a surge in patents as a result of advances in the areas of "pharmaceuticals, electronics, biotechnology, and information systems" (p. 16). As a result of these diverse products, services, and processes, Mrnarević (2011) asserted, "Clearly creativity plays a major role in advancing all these fields of economic activity" (p. 16).

Literature on the topic of creativity in the workplace can also be analyzed using the hierarchy for creative research initially established by Runco (2007). In fact, as Runco (2004) himself specified, "Creativity, learning, and achievements are forms of human capital" (p. 670). Primarily, employers are looking for specific personality traits, which indicate a proclivity for creativity potential in leaders and employees (Runco, 2007). Second, employers attempt to create a professional development process designed to improve creative thinking throughout the company (Brenner, 2010). Finally, companies market themselves to future employees with the promise of a creative and innovative work environment (Amazon.com, 2013; Apple Inc., 2013; Dr. Pepper Snapple Group, 2013; LEGO Group, 2013; Walmart Stores, Inc., 2013).

Potential of the creative employee. The creative businessperson is commonly found in Fortune 500 companies from the entry-level employees to leadership (Amazon.com, 2013; Apple Inc., 2013; Dr. Pepper Snapple Group, 2013; Exxon Mobil Corporation, 2013; LEGO Group, 2013; Walmart Stores, Inc., 2013). Cable News Network (2013) identified Walmart as the number one company on the Fortune 500 list in 2013. Employees at Walmart are encouraged to be innovative leaders as a part of a collaborative team (Walmart Stores, Inc., 2013). On the *Jobs at Apple* website, potential employees are greeted with the following: "When you imagine the creative process at

Apple, at first you may not picture someone in HR. Or operations. Or finance. But we expect creative thinking and solutions from everyone here" (Apple Inc., 2013). A cursory survey of other Fortune 500 companies revealed similar results on employment recruitment pages (Amazon.com, 2013; Apple Inc., 2013; Dr. Pepper Snapple Group, 2013; Exxon Mobil Corporation, 2013; LEGO Group, 2013; Walmart Stores, Inc., 2013).

Beginning with the business leaders, Brenner (2010) cited "an October, 2004 piece in U.S. News and World Report (which)… suggests that more and more companies are seeking out arts-based leadership development programs" (p. 164). Looking for specific creativity skills within leaders, Jaffer (2013) recognized, "Organizational leaders play an important role in fostering innovation in the workplace and striking a unique equilibrium between these competing priorities to maximize individual creativity and organizational innovation outcomes" (p. v). Brenner (2010) provided "a direct link between the creativity of work teams and the behaviors exhibited by the leaders of those teams" (p. 44). As a result of the examination of data, Brenner (2010) suggested positive behaviors exhibited by leaders promote creativity among employees, while negative behaviors from leaders reduce the amount of creativity exhibited. Perhaps because of the effect leaders have on an employee's creative output, CEOs surveyed by IBM (2010) collectively promote creativity as the number one priority for leaders (Brenner, 2010; IBM, 2010; Lichtenberg et al., 2008; President's Committee on the Arts and the Humanities, 2011).

Because employers desire to hire employees with appropriate creativity traits, the search criteria for potential employees have changed (Jaffer, 2013). Desirable employee personality traits mirror those included in the definition of a creative person, such as

flexibility, openness to experience, and risk-taking (Gude, 2010; Jaffer, 2013; Kim, 2006; Runco, 2007). According to Jaffer (2013), these traits “can be distinguishing factors between creative individuals and their less-creative counterparts" (p. 32).

Employees of many Fortune 500 companies are encouraged to find creative and innovative solutions to problems (Amazon.com, 2013; Apple Inc., 2013; Dr. Pepper Snapple Group, 2013; Exxon Mobile Corporation, 2013; LEGO Group, 2013; Walmart Stores, Inc., 2013). Livingston (2010) argued, “Although jobs will change, diverge, and morph, employers are more and more going to seek workers who are adept at teamwork and capable of contributing original thought to group assignments and tasks” (p. 60). Collaborative teams that are aware of the talents and strengths of members discover creativity flourishes (Bruton, 2011). Bruton (2011) elaborated that the success of teams happened because teams “encouraged reflection and play” (p. 330). Learning about creativity through play reinforces the stance taken by Robinson (2011). When collaborative teams trust the other members, Bryant (2010) added, “A collaborative atmosphere allows creativity to flourish” (p. 46).

According to Kim, Hon, and Lee (2010), employers who encourage creativity in the workplace often see a gain in the process of creativity through collaboration among employees. Because the employee is comfortable trying new ideas, the traits of the creative person, according to Runco (2007), also increase. In addition, the employees increase the production of creative ideas as well, which “can help organizations gain competitive advantages for organizational innovation, survival, and long-term success” (Kim et al., 2010, p. 37)

Influence of creative process and press in the workplace. Previously, Runco (2007) defined press as those elements producing pressure on the creative person, including time and environment. In order to address at least part of the pressures of creativity in the workplace, Robinson (2011) asserted, "Professional development is at the heart of creative cultures but often…organizations are reluctant to invest in it" (p. 231). In a study on arts-based leadership, Brenner (2010) reported, "The increasing popularity of arts-based leadership development reflects a belief among a growing number of business leaders and practitioners that the arts are a powerful source for unleashing creativity and innovation" (p. 19). During his study, Brenner (2010) cited several companies that have included arts-based professional development as a way to jump-start creative thinking. Participants "engaging in the artistic process through music making, sculpting, or acting … explore their own creative potential, demonstrate critical interpersonal skills, and experience first-hand the sorts of interactions that help facilitate team success" (Brenner, 2010, p. 20).

Professional development opportunities on creative thinking are not the only steps in the creative process to be encouraged (Brenner, 2010). The entire thought process of the team changes to allow for the emergence of a plethora of ideas. Process is defined as the steps taken to produce a creative output (Hélie & Sun, 2010; Marshall, 2010; Runco, 2004; Wong & Siu, 2012). Dacey (2013) identified how Apple produces ideas. According to Dacey (2013), executives of Apple rely on the opinions and ideas of employees from a diverse background. Making connections across employees' specialties allows for creativity to flourish as a result of the different perspectives offered during conversations.

Bryant (2010) suggested the process is not limited to considering the problem from a variety of perspectives. In fact, Bryant (2010) encouraged businesses to establish a strong structure to encourage creative thinking, experiment with multiple options, and ultimately discover solutions. This structure, which provides an employee's contracted time to explore new ideas, was introduced into the workday of 3M and Pixar employees (Robinson, 2011). Runco (2004) reinforced the need to provide time for employees to develop "a creative idea or solution…if they (employees) are expected to do creative work" (p. 662). With more companies not only allowing but also expecting employees to use time for creative play and professional development (Robinson, 2011), increasingly Fortune 500 companies have begun recruiting future employees with phrases such as "experience in working in a creative environment desired" (Apple Inc., 2013).

Summary

Encouraging the teaching and assessment of creativity to high school students has become vital in order to prepare young people for success in future employment endeavors (Robinson, 2011). In addition, Grierson (2011) called policy makers and educators to action because of the "imperative to fold creativity into the industrial paradigm of economic knowledge" (p. 349). Both educators and business leaders have benefited from continued research into the effectiveness of teaching creativity at the secondary level. With a push for 21st century skills, it is also imperative researchers have a baseline for the creativity potential of high school students.

In Chapter Three, the methodology of this study is summarized. The research questions, hypotheses, purpose, and problem are revisited. The research design is

outlined. The design includes the targeted sample and the instrumentation. Finally, information is provided about how the data will be collected and analyzed.

Chapter Three: Methodology

In this chapter, the problem and purpose of instilling creativity as a necessary skill for 21st century students is explored. The framework for research is defined through the exploration of research questions. Finally, the research design is outlined. The design includes the order of steps taken to complete the research, the definition of the target population and resulting sample, process for data collection, and implementation of research.

Problem and Purpose Overview

Business leaders are interested in recruiting and retaining employees with skills in creativity in the work force (IBM, 2010). With the introduction of creativity as a part of 21st century skills, educators have responded to the need to teach creative thinking to students in preparation to be competitive in a global society (Partnership for 21st Century Skills, 2009). The relationship between the current curricula and creative potential of high school students was explored. As a result of this study, future researchers will have a baseline for the creative potential of current students, which will allow experimental research to be conducted on systematic changes of curriculum and its relationship to the student creativity index scores from the Torrance Test of Creative Thinking (TTCT).

According to a 2010 study commissioned by IBM, Global Chief Executive Officers (CEOs) of major corporations indicated a need for leaders who are creative and innovative as the number one priority for 21st century companies. In addition, recruiters from many colleges are advocating for creative standouts in applicants by asking unusual application essay questions (Pérez-Peña, 2013). Examples of questions included the following from Brandeis University: “You are required to spend the next year of your life

in either the past or the future. What year would you travel to and why?" (Pérez-Peña, 2013, para. 2), and "If you could choose to be raised by robots, dinosaurs or aliens, who would you pick?" (Pérez-Peña, 2013, para. 3). The answers students give to these essay questions confirm whether the desirable creative traits are present in the applicants. Both business leaders and college admission directors indicate applicants who are playful, risk-takers, and push the boundaries are desirable (IBM, 2010; Pérez-Peña, 2013).

Business leaders and higher education administrators possess similar expectations for employees and students. Developers of secondary education achievement assessments have not focused on measuring creativity skills, such as playfulness or risk-taking, which are recognized as important to businesses and universities. Instead, assessments relying on right or wrong answers have been developed rather than measurements of the process of thinking (Robinson, 2011).

The Partnership for 21st Century Skills (2009) suggested paradigm shifts are necessary in order for educational leaders to prepare students for success in global organizations in the 21st century. According to the Partnership for 21st Century Skills (2009), the implementation of the 21st century skills of communication, collaboration, critical thinking, and creativity would potentially correct student deficits. Before shifts can be made in curriculums, education leaders must have awareness of creativity occurring in current academic programs (Robinson, 2011). The research questions that were proposed established a baseline of data for the creative potential of students in current curricula.

Research questions. The following research questions were used to guide the study:

1. Is there a statistically significant difference between the creativity index scores from the Torrance Test of Creative Thinking for students enrolled in fine arts courses and students who are not enrolled in fine arts courses?

2. What is the relationship between achievement data (ACT and GPA) and the creativity index scores from the Torrance Test of Creative Thinking?

Hypotheses. The following null and alternative hypotheses were posed:

$H1_0$: There is no statistically significant difference between the creativity index scores from the Torrance Test of Creative Thinking for students enrolled in fine arts courses and students who are not enrolled in fine arts courses.

$H1_a$: There is a statistically significant difference between the creativity index scores from the Torrance Test of Creative Thinking for students enrolled in fine arts courses and students who are not enrolled in fine arts courses.

$H2_0$: There is no relationship between achievement data (ACT and GPA) and the creativity index scores from the Torrance Test of Creative Thinking.

$H2_a$: There is a relationship between achievement data (ACT and GPA) and the creativity index scores from the Torrance Test of Creative Thinking.

Research Design

Fraenkel, Wallen, and Hyun (2012) observed, "Quantitative researchers seek to establish relationships between variables and look for and sometimes explain the *causes* of such relationships" (p. 11). The variables in this study for the first research question were the creativity index scores from the TTCT and the enrollment of subjects into fine

arts courses. Within the second research question, the variables were the creativity index scores within the four subsamples and the additional achievement data, the ACT and GPA.

With the definition of quantitative research established, a quantitative design was used to ascertain the degree of creative thinking present in the subjects in the sample through the TTCT. The descriptive statistics of mean, mode, median, standard deviation, and range of scores were determined for each of the five norm-referenced measures and 13 criterion-referenced measures of the TTCT according to the total sample and the four subsamples. The data from the raw scores, standard scores, and national percentiles from the TTCT were organized into frequency classes and presented in histograms.

Next, the creativity index scores of subsamples were compared to discover the difference, if any, between creative thinking and high school curricula, such as fine arts courses or IB DP courses. To discover if a statistically significant difference existed among the four subsamples, the creativity index scores of each subsample were analyzed using the *t-test for independent means*, which "is used to compare the mean score between two different, or independent, groups" (Fraenkel et al., 2012, p. 234). An ANOVA test was also conducted, because the test can compare several subsamples at once and can be used as a check of the multiple *t*-tests conducted (Bluman, 2010). Statistical analysis using the *Pearson product moment correlation coefficient* (Pearson *r*) was used to discover whether a relationship existed between the subsamples and additional academic data (Bluman, 2010).

Finally, a correlational approach was utilized to discover whether a relationship existed between the creativity index scores of the subsamples and additional achievement

data, specifically ACT scores and GPA. Fraenkel et al. (2012) affirmed the purpose of a correlational study was "to determine relationships among two or more variables and to explore their implications for cause and effect" (p. 12). Furthermore, Fraenkel et al. (2012) asserted, "This type of research can help us make more intelligent predictions" (p. 12). The choice of a correlational study was grounded in the purpose of the second research question of this study, which was to discover whether a relationship existed between creativity index scores from the TTCT, enrollment in fine arts courses, and additional achievement data.

The first step of the study began with recruitment of a sample from 11th and 12th grade high school students. The sample was comprised of 51 students ($N = 51$) representing the population of 11th and 12th grade students from one high school in a large accredited urban district. To obtain the sample, students were recruited from a variety of classes including IB Psychology, Industrial Arts, English Three, English Four, and Physical Education. The students who were chosen represented a wide range of the general student population.

Students in the IB DP courses were engaged in rigorous coursework requirements including the following: two languages, humanities, experimental sciences, mathematics, and an elective from the fine arts curricula (e.g. visual arts, theatre, vocal music, and instrumental music) or a non-fine arts elective (e.g. computer science, media, and psychology). Students in non-IB DP classes were taking courses required for graduation, which included fine arts electives (e.g. visual arts, theatre, vocal music, and instrumental music) and non-fine arts electives (e.g. industrial arts, media, and physical education).

Presentations were made in these classes. Students were invited to participate voluntarily in the creativity assessment tool with parental consent and child assent.

During the oral presentation and within the written parental consent and written child assent, participants were reassured that participation or lack of participation would in no way affect their grades in any course. In addition, students who were recruited and selected for the study were not only assured anonymity in the study, but the students were also guaranteed that participation or lack of participation would not affect the student in any way. The outcomes of the study were not dependent on the individual subjects' names, because the data collected were used to draw conclusions concerning the general student population. No proper names were utilized in the testing, scoring, or reporting of data.

In substitution for each subject's name, a number code (1, 2, 3, etc.) to indicate the total number of subjects was provided. Assignation of a letter code (A, B, C, or D) was coordinated with the subsample (subsample A = IB DP/fine arts; subsample B = IB DP/non-fine arts; subsample C = non-IB DP/fine arts; subsample D = non-IB DP/non-fine arts) with which the subject was associated. Additional achievement data, such as GPA and ACT scores, were collected as secondary data and assigned the same codes in order for GPA and ACT scores to be compared with creativity index scores.

The assessment was the TTCT, and Scholastic Testing Service, Inc. (2013) offers two forms of the TTCT available for use in assessing creativity: the TTCT-Verbal and the TTCT-Figural (Kim, 2006; Torrance, Ball, & Safter, 2008). For the purposes of this study only the TTCT-Figural was used as the TTCT-Figural was intended for examinees fourth

grade through adult (Torrance, 2007). According to Torrance et al. (2008), the TTCT has contributed to over 2,000 studies and research projects.

The scoring norms were developed as a result of scoring tests from 70,093 students from 35 states (Torrance et al., 2008). Torrance et al. (2008) addressed reliability and standard error of the average standard score and creativity index score, which resulted from the TTCT. According to Torrance et al. (2008):

> Reliability coefficients involving the creativity index are centered at 0.90 for the various grades, and at 0.89 for various ages. Coefficients for the average standard score, primarily an intermediate measure involved in developing the creativity index, are only slightly lower. Coefficients at this level for a 'projective' instrument are highly satisfactory. (p. 44)

Although the reliability of the TTCT as a predictor of creative behavior is satisfactory, Torrance et al. (2008) stated, "Certainly, the author of these tests would never argue that possession of these abilities guarantees that an individual will behave creatively" (p. 46). Torrance et al. (2008) added, "Scores on the tests taken during the high school years correlate about 0.51 with adult creative achievement twelve years later" (p. 46). Kim (2006) confirmed, "The TTCT-Figural appears to display adequate reliability and validity" (p. 10). Additional information concerning the rationale for developing the test, the reliability of the test, and the validity of the content can be found Torrance's 2000 publication, *Research Review for the Torrance Tests of Creative Thinking, Figural and Verbal Forms A and B* (Torrance et al., 2008).

When the TTCT testing session began, the subjects had 30 minutes, in three 10-minute increments, to complete three activities that included "picture construction,

picture completion, and repeated figures of lines or circles" (Kim, 2006, p. 3). The TTCT administrator was encouraged in the directions manual to create a relaxed test-taking environment in order to avoid a stressful situation for subjects (Torrance, 2007). The sessions were structured for the subjects to feel free to partake in the "game-like" assessment (Torrance, 2007). As a result of creating an atmosphere of play and reducing the threatening nature of standardized, formative assessments, the subjects felt relaxed during the assessment and free to perform their best work on the TTCT (Torrance, 2007).

Next, the TTCT-Figural was scored for the five norm-referenced measures of "fluency, originality, elaboration, abstractness of titles, and resistance to premature closure" (Torrance et al., 2008, p. 3) using the *Streamlined Scoring Guide*. Following the scoring of the five norm-referenced measures, a standard score and national percentile were established for each subject using the *Norms-Technical Manual* (Torrance et al., 2008). The TTCT was then scored for the 13 criterion-referenced measures, which included "emotional expressiveness, storytelling articulateness, movement or action, expressiveness of titles, synthesis of incomplete figures, synthesis of lines or synthesis of circles, unusual visualization, internal visualization, extending or breaking boundaries, humor, richness of imagery, colorfulness of imagery, and fantasy" (Torrance et al., 2008, p. 3) using the *Streamlined Scoring Guide*. When both of the scoring measures were completed, a creativity index score along with a norm-referenced national percentile and standard score were established for each subject using the *Norms-Technical Manual* (Kim, 2006; Scholastic Testing Service, Inc., 2013; Torrance, 2007; Torrance, 2008). According to Torrance (2007), the creativity index score has been "found to serve well as an overall indicator of creative potential" (p. 9).

After the TTCT of each subject had been scored, each of the norm-referenced measures was organized through the use of frequency classes. The range of scores was divided into between four and 10 classes depending on the measure and the scores. The data were placed within the appropriate frequency class and compared to the results from the other subsamples through the use of histograms. In addition, the creativity index scores for the sample were described. This information was used to determine the levels of not only creative potential, but the strength of individual creativity traits within the sample, before conducting statistical tests to determine if a statistically significant difference was present between subjects enrolled in fine arts course and subjects not enrolled in fine arts courses, as well as the relationship between creativity index and other variables.

After results were analyzed with statistical tests, a determination was made about whether the null hypotheses for each of the research questions should be rejected or not rejected. The research process was completed when data were analyzed, reported, and future steps for additional research suggested.

Population and Sample

The population of the study was drawn from the 11th and 12th grade high school students at one high school in a large accredited urban district. At the time of this study, demographic data from the 2013-2014 school year were not available. In 2013, the Missouri Department of Elementary and Secondary Education (MODESE) reported the total student enrollment for the school was 1,747.

The sample for the study was composed of 51 students ($N = 51$) recruited from the population of the school to create a stratified sample from 11th and 12th grade

students (Bluman, 2010). Participants were approximately 16 to 19 years old and currently enrolled at the high school. The unit of analysis for this study was the individual student, including both fine arts students and non-fine arts students. Additionally, subsamples also identified IB DP students and non-IB DP students. Bluman (2010) stated, "If the researcher investigates the characteristics of the population and determines that the sample is representative, then it can be used" (p. 13). The high school students were recruited from a variety of classes including IB Psychology, English Three, English Four, Industrial Arts, and Physical Education.

Instrumentation

Rosen and Tager (2013), along with Sternberg (2006), declared the TTCT battery of tests were "the most widely used assessments of creative talent" (p. 87). Torrance developed this test originally in 1966 with five uses:

> 1. To understand the human mind and its functioning and development. 2. To discover effective bases for individualizing instruction. 3. To provide clues for remedial and psychotherapeutic programs. 4. To evaluate the effects of educational programs, materials, curricula, and teaching procedures. 5. To be aware of latent potentialities. (Kim, 2006, p. 4)

Kim (2006) reinforced, "Torrance's main focus was in understanding and nurturing qualities that help people express their creativity. The tests were not designed to simply measure creativity, but instead to serve as tools for its enhancement" (p. 4). The TTCT in this study was utilized as Runco (2007) outlined in his hierarchy for the study of creativity. The primary research focus was on the fourth and fifth uses of the TTCT, as outlined by Kim (2006), as a test to assess the creative potential of the subject in order to

discover the ways secondary education teachers could improve their understanding of students and creativity and improve curricula (Palaniappan, 2012; Rosen & Tager, 2013; Runco, 2007). In fact, Kim (2006) cited studies by Plucker in 1999, Torrance and Wu in 1981, and Yamada and Tam in 1996, which "concluded that the Creative Index was the best predictor for adult creative achievement" (p. 7). Kim (2006) further asserted the creativity index scores from the TTCT were a better predictor of success than IQ scores.

Through the questions designed by Torrance, the subjects were assessed based on the five norm-referenced measures of fluency, originality, elaboration, abstractness of titles, and resistance to premature closure. Additionally, subjects were assessed for the 13 criterion-referenced measures of emotional expressiveness, storytelling articulateness, movement or action, expressiveness of titles, synthesis of incomplete figures, synthesis of lines or circles, unusual visualization, internal visualization, extending or breaking boundaries, humor, richness of imagery, colorfulness of imagery, and fantasy (Kim, 2006; Rosen & Tager, 2013; Scholastic Testing Service, Inc., 2013; Torrance et al., 2008). The scores from the norm-referenced measures and the criterion-referenced measures are combined together to create the creativity index score for the subject (Torrance, 2008).

Two TTCT options available through the Scholastic Testing Service, Inc. are the TTCT-Figural, forms A and B, and the TTCT-Verbal. For both versions of the test, Torrance et al. (2008) provided norms based on age and grade of the subject (Kim, 2006; Scholastic Testing Service, Inc., 2013; Torrance et al., 2008). The subjects of this study were assessed using only the TTCT-Figural, Form A. The TTCT-Figural assessment is a

traditional paper and pencil assessment completed in approximately 30 minutes (Kim, 2006; Scholastic Testing Service, Inc., 2013; Torrance, 2007; Torrance et al., 2008).

As a limitation of the test, Kim (2006) stated, "The TTCT can provide useful insights into creativity as long as the tests are used with sensitivity and good judgment by qualified professionals" (p. 9). Scholastic Testing Service, Inc. (2013) requires test administrators to receive permission to order approved testing materials and administer the test. A statement from Scholastic Testing Service, Inc. is included in Appendix A. In addition, preparation for administration and scoring of the TTCT was completed using training materials provided by Scholastic Testing Service, Inc. (2013). The tests were scored using the *Streamlined Scoring Guide* and then referenced to standard scores and national percentile ranks using the *Norms-Technical Manual* provided through Scholastic Testing Service, Inc. (2013).

Data Collection

According to Lapėnienė and Bruneckienė (2010), a psychometric approach to research about creativity makes use of "quantitative methods and tests similar to intelligence tests" (p. 642). This method will prove important because the resulting data will "demystify creative abilities and define everyday creativity" (Lapėnienė & Bruneckienė, 2010, p. 642). As a result, a quantitative study was designed and data were collected from the sample through the assessment of the TTCT. The TTCT was scored using the *Streamlined Scoring Guide* provided by Scholastic Testing Service, Inc. in order to avoid issues resulting from bias (Scholastic Testing Service, Inc., 2013; Torrance et al., 2008).

Data were collected from the sample after completion of the NIH certification

process (see Appendix B). Permission to administer the TTCT and use the results as the data for this study were requested from Scholastic Testing Service, Inc. Permission was granted in the form of a personal email with the restriction that test questions could not be reproduced in any form in the text.

Next, permission was granted to begin the research project from the IRB Board at Lindenwood University (see Appendix C). In addition, the school district approved the research; however, the document is not included to assure anonymity. Approval from the building principal was in the form of an email (personal communication, April 19, 2014).

Following the project approval, students were recruited from various classes. Students received a paper copy of the parental consent and student assent form (see Appendix D). The letter was sent home with the students and returned signed by a parent or guardian and the student.

Once the proper consent was gathered, subjects participated in the TTCT Figural, Form A assessment. Subjects provided responses to the stimuli in the *Thinking Creatively with Pictures: Figural Response Booklets*. The subjects were assessed using three different subtests: picture construction, picture completion, and lines (Torrance, 2007). The subjects were allowed 10 minutes for each of the timed subtests (Torrance, 2007). Following the completed session, each booklet was coded with a number that represented the subject and a letter that represented the subsample the subject represented.

Each TTCT was scored using the *Torrance Tests of Creative Thinking: Streamlined Scoring Guide for Figural Forms A and B* (Torrance et al., 2008). The authors of the guide provided instructions for how to use the guide as well as examples of acceptable and unacceptable responses for each of five norm-referenced measures and the

13 criterion-referenced measures (Torrance et al., 2008). First, the TTCT was scored only for the five norm-referenced measures. The raw score for each of the five norm-referenced measures was entered in the first column on the *Streamline Scoring Worksheet*. Using the *Norms-Technical Manual*, the correct table was found for the subject by age and by grade. The raw score for each of the five norm-referenced measures was used to find the corresponding national percentile rank and standard score by age and by grade (Torrance et al., 2008).

Once the national percentile rank and standard score were determined, the average standard score was the result of adding the standard scores of the five norm-referenced measures together and dividing by five (Torrance et al., 2008). The national percentage for the average standard score was found in another table in the *Norms-Technical Manual* (Torrance et al., 2008). All of the scores were recorded on the *Streamline Scoring Worksheet* (Torrance et al., 2008).

After the process of scoring the five norm-referenced measures was completed, the test was scored again with attention to the 13 criterion-referenced measures. Each of the 13 criterion-referenced measures was scored with a plus (+) when one or two responses show evidence of the measure. A double plus (+ +) was awarded when three or more responses showed evidence of the measure. The exception to this rule was richness of imagery, which received one plus (+) when four or five responses showed evidence of the measure and a double plus (+ +) when six or more responses showed evidence of the measure. The pluses were written on the Checklist for Creative Strengths (CCS) on the *Streamline Scoring Worksheet*. The total number of pluses on the CCS were counted and recorded on the *Streamline Scoring Worksheet*. The CCS was next added to the average

standard score by age and by grade. The resulting number was the *creativity index score* for the subject.

Once the TTCT was scored for all subjects, the data were entered into a spreadsheet. Columns were created for each of the raw data, standard scores, and national percentiles of five norm-referenced measures. In addition, the spreadsheet contained the average standard score for each subject and the 13 criterion-referenced measures from the CCS. Next, the creativity index scores and corresponding national percentile ranks were entered. Finally, the additional achievement data, GPA and ACT scores, were entered into the spreadsheet. In this form, the data could be counted, sorted, and analyzed to address the research questions and hypotheses.

Data Analysis

The selection of data analysis tools that were utilized to answer the research questions posed in this study was carefully considered based on information from Bluman (2010). In the fifth edition of his book, *Elementary Statistics, A Step by Step Approach,* Bluman (2010) provided definitions of analytical tests. In addition, Bluman (2010) recommended how tests were to be used in research contexts.

The first research question was analyzed using a *t-test for independent means*, which is "a parametric test of significance used to determine whether there is a statistically significant difference between the means of two independent samples" (Fraenkel et al., 2012, p. 698). In other words, the *t*-test is generally used to compare Teacher A using Method A on one independent sample and Teacher B using Method B on another independent subsample (Fraenkel et al., 2012). The number of tests necessary to compare all of the subsamples could increase the risk of a Type I error (Bluman,

2010). As a result, an ANOVA test, which compares the variances of all subsamples at once, was conducted to corroborate the results of the *t*-test. The variables in the first question were the creativity index score, the enrollment in fine arts classes, and the enrollment in IB DP courses. After results were analyzed, the data were used to determine whether the null hypothesis should be rejected or not rejected.

The data pertaining to the second research question were analyzed using the Pearson *r* to establish whether a relationship existed between the variables of ACT or GPA and creativity index scores among the four subsamples (Bluman, 2010). The Pearson *r* is "an index of correlation appropriate when the data represents either internal or ration scales; it takes into account each and every pair of scores and produces a coefficient between .00 and either + or – 1.00" (Fraenkel et al., 2012, p. G-6). After results were analyzed, the data were used to determine whether the null hypothesis should be rejected or not rejected.

Summary

In summary, the current study was designed to determine if a statistically significant difference existed between creativity index scores and enrollment in fine arts courses. The sample was comprised of students from one high school in a large accredited urban district. The sample included groups of students enrolled in IB DP, those enrolled in fine arts courses, those enrolled in one or the other, and those not enrolled in either.

The goal of the data analysis was to discover whether a statistically significant difference existed between subjects who demonstrated creative potential and current enrollment in fine arts classes. The data were compared with academic achievement

statistics, such as GPA and ACT scores, to determine whether the enrollment in these courses could be a predictor of future success in college and the business world as was deemed necessary by CEOs in the IBM (2010) study *Capitalizing on Complexity*.

How the data were organized for the statistical analysis is addressed in the next chapter. The steps for analysis were structured into three stages: descriptive analysis, statistical analysis of creativity index and enrollment in fine arts courses using the *t*-test for independent means and ANOVA test, and statistical analysis of additional achievement data using the Pearson *r*. The additional achievement data included both GPA and ACT scores compared to the creativity index scores.

Chapter Four: Analysis of Data

Organization of Data Analysis

As educators are preparing students for success through college and career readiness and the 21st century skills of communication, collaboration, communication, critical thinking, and creativity, a paradigm shift in the design of curricula has become necessary (Partnership for 21st Century Skills, 2009). The Partnership for 21st Century Skills (2009) suggested the implementation of instruction in 21st century skills provides the framework for resolving the problem of current student deficits. The research conducted in the current study will be used to establish a baseline for the creative potential of students within current curricula.

In order to address the research questions, a quantitative design was used. The collection and analysis of data were utilized to determine whether there was a statistically significant difference in creativity index scores based upon enrollment in fine arts courses. In addition, secondary data from additional achievement tools, such as GPA and standardized ACT tests, were compared to the creativity index scores to determine if a relationship existed between the variables.

The current study was conducted within one high school of a large urban district. The sample included 11th and 12th grade students who were enrolled in a variety of combinations of standard curriculum, IB DP courses, and fine arts courses. Subjects' creativity was assessed using the Torrance Test of Creative Thinking (TTCT) created by Dr. E. Paul Torrance (2007). Torrance conducted longitudinal studies of the TTCT, which revealed the creativity index of subjects in his studies had a significant relationship with the creative potential of subjects in the future (Millar, 2010). Norm-referenced

scores were created by Torrance and his team from the normative sample results of 70,094 students from the United States (Torrance, 2008). The established norms were used to determine a standard score and a percentile in relationship to the national results (Torrance et al., 2008). The established norm-referenced scores were used to compare the subjects from this study to each other and to the national standard scores.

Organization of Quantitative Data

First the data were analyzed using descriptive statistics to organize the raw data, standard scores, and national percentiles of the subjects. Each score was counted with frequency classes for each measure and organized by the total sample (*N*) and the subsamples (A, B, C, and D). The results of the frequency counts were displayed in a histogram.

In Stage Two, the creativity index scores were compared using a *t-test for independent means* and an analysis of variance (ANOVA) test to determine whether a statistically significant difference was present between the subsamples. The *t*-test for independent means compares to independent samples and the treatment used (Fraenkel et al., 2012). The subsamples are all independent of each other, because no student could be included in more than one sample. When conducting *t*-test for independent means there is a greater chance for a Type I error (Bluman, 2010). As a result, an ANOVA test was used to "test a hypothesis concerning the means of three or more populations" (Bluman, 2010, p. 602). The ANOVA was used to confirm the results from the *t*-test for independent means. The analysis of the data in Stage Two was used to determine whether the null hypothesis of research question one should be rejected or not rejected.

In Stage Three of the analysis, additional academic secondary data from ACT and grade point averages of the total sample subjects and all four subsamples were compared to the creativity index scores using the Pearson *r*, "which produces a coefficient between .00 and either + or – 1.00" (Fraenkel et al., 2012, p. G-6). The data were plotted in scatter plot graphs in order to create a visual representation of the linear relationship between the variables. The analysis of the data determined whether the null hypotheses of the second research question should be rejected or not rejected.

Stage One: Descriptive Statistical Analysis of Torrance Test of Creative Thinking

Quantitative data in the form of figural responses to the TTCT were collected from a sample of 51 students from one high school in a large urban school district. The subjects were between the ages of 16 and 19 and currently enrolled in grades 11 or 12. During stage one, the subjects responded to the three activities of the TTCT, Form A. The three activities included picture construction, picture completion, and lines. The responses were scored for the five norm-referenced measures of fluency, originality, elaboration, abstractness of titles, and resistance to premature closure as well as the 13 criterion-referenced measures representing the checklist for creative strengths (Torrance, 2007). The creative strengths included emotional expressiveness, storytelling articulateness, movement or action, expressiveness of titles, synthesis of incomplete figures, unusual visualization, internal visualization, extending or breaking boundaries, humor, richness of imagery, colorfulness of imagery, and fantasy (Torrance, 2007).

The raw scores were compared to the tables in the *Norms-Technical Manual* to find the national percentile for each score as well as a standard score based on age or grade for each of the five norm-referenced measures (Torrance, 2007). Finally, the

average standard score for each subject was added to the checklist of creative strengths score (CCS) to create a creativity index score and a national percentile for this score. The scores were compared as individuals of the total sample ($N = 51$) and by subsamples (A, B, C, and D) for each of the norm-referenced measures and for the creative strengths as a whole.

Fluency. According to Torrance et al. (2008), fluency is represented by the number of acceptable responses to the stimulus offered in each activity. Millar (2010) added the essential element of flexibility to this measure, because "flexibility has to do with an individual's ability to shift mental categories or to produce and consider ideas and alternatives that are categorically different from one another" (p. 389). Merely counting the number of responses created by the subject during the test determines the fluency score (Torrance et al., 2008). Abstract responses or those not making use of the stimulus were not counted as appropriate responses and, therefore, not figured into the fluency score (Torrance et al., 2008).

In scoring the TTCT, only activity two (picture completion) and activity three (lines) were scored for fluency (Torrance et al., 2008). The author of the TTCT provided a finite number of stimuli for the subject, thereby limiting the score available for the measure of fluency (Torrance, 2007). In activity two, picture completion, Torrance (2007) designed a total of 10 stimuli; in activity three, lines, Torrance (2007) provided subjects with a total of 30 sets of parallel lines. The total score for fluency is a combination of both activities and could not exceed a score of 40 (Torrance et al., 2008).

The total sample included 51 subjects ($N = 51$) ranging in age from 16 to 19 and enrolled in grades 11 or 12. The total sample ($N = 51$) had a range of raw scores between

six and 30 (30 - 6 = 24) on the norm-referenced measure of fluency. The median score for the sample was 19 (*Mdn* = 19), the mean score was 19.29 ($x\square$ = 19.29), and the mode was 13. The sample had a standard deviation of 7.26 (*sd* = 7.26). Of all subjects of the total sample, six subjects (12%) scored between one and 10. In addition, 26 subjects (51%) scored between 11 and 20, 15 subjects (29%) scored between 21 and 30, and four subjects (8%) scored between 31 and 40.

For the 16 subjects designated as subsample A (n_A = 16), who were both enrolled in IB DP curriculum and a fine arts course, a range of scores for fluency between six and 30 (30 - 6 = 24) was present. The median score was 16 (*Mdn* = 16), the mean score was 17 ($\bar{x}$ = 17), the mode was 15, and the standard deviation was six (*sd* = 6). Of the subjects from subsample A, two subjects (12.5%) scored between one and 10. Additionally, 10 subjects (62.5%) scored between 11 and 20, and four subjects (25%) scored between 21 and 30. None of the subjects scored between 31 and 40 for fluency.

Subsample B was comprised of 12 subjects (n_B = 12), who were enrolled in IB DP curriculum but not enrolled in a fine arts course. For subsample B, the range of scores for fluency was between 15 and 38 (38 - 15 = 23). The median score was 23 (*Mdn* = 23), the mean score 25 ($\bar{x}$ = 25), and the standard deviation 7.44 (*sd* = 7.44). There was no mode for this subsample because none of the subjects had the same fluency score. Of the subjects from subsample B, none of the subjects scored between one and 10; however, the subjects were evenly distributed among the remaining frequency classes. Four subjects (33.33%) scored between 11 and 20, four subjects (33.33%) scored between 21 and 30, and four (33.33%) of the subjects scored between 31 and 40 for fluency.

Subsample C was comprised of 13 subjects ($n_C = 13$) who were not enrolled in IB DP curriculum, but who were enrolled in a fine arts course. For subsample C, the range of scores for fluency was between six and 29 (29 - 6 = 23). The median score was 19 (*Mdn* = 19), the mean score 18.2 ($\bar{x} = 18.2$), the mode 19, and the standard deviation 7.44 (*sd* = 7.44). Of the subjects from subsample C, two (21%) of the subjects scored between one and 10. Seven subjects (54 %) scored between 11 and 20, four subjects (31%) scored between 21 and 30, and none of the subjects scored between 31 and 40 for fluency.

The final subsample was designated as D. The 10 subjects ($n_D = 10$) were neither enrolled in IB DP curriculum nor fine arts courses. For subsample D, the range of scores for fluency was between nine and 26 (26 - 9 = 17). The median score was 19 (*Mdn* = 19), the mean score 18 ($\bar{x} = 18$), the mode nine, and the standard deviation 6.01 (*sd* = 6.01). Of the subjects of subsample D, two of the subjects (20%) scored between one and 10, five subjects (50%) scored between 11 and 20, and three subjects (30%) scored between 21 and 30. None of the subjects of subsample D scored between 31 and 40 for fluency.

In the analysis of frequency table for the raw scores of fluency, the total sample (*N*) and three of the subsamples (A, C, and D) had the highest frequency in the 11 to 20 point range. The exception was subsample B. The frequency distribution was even for subsample B. None of the top three frequency classes had any difference in frequency distribution for subsample B.

In the histogram (see Figure 2), the frequency of fluency was represented for the total sample (*N*) and each of the subsamples (A, B, C, D) in the sample. The use of the histogram supports the first research question, regarding a relationship between creativity index scores and enrollment in IB DP courses or fine arts courses, because fluency

represents one measure from the whole creativity index score. The shape of the lines on the histogram is a bell curve skewed to the right for the total sample (*N*) and each of the subsamples (A, C, D) with the highest frequency in the 11to 20 frequency class. The exception to the bell curve was subsample B, which was indicative of an even distribution.

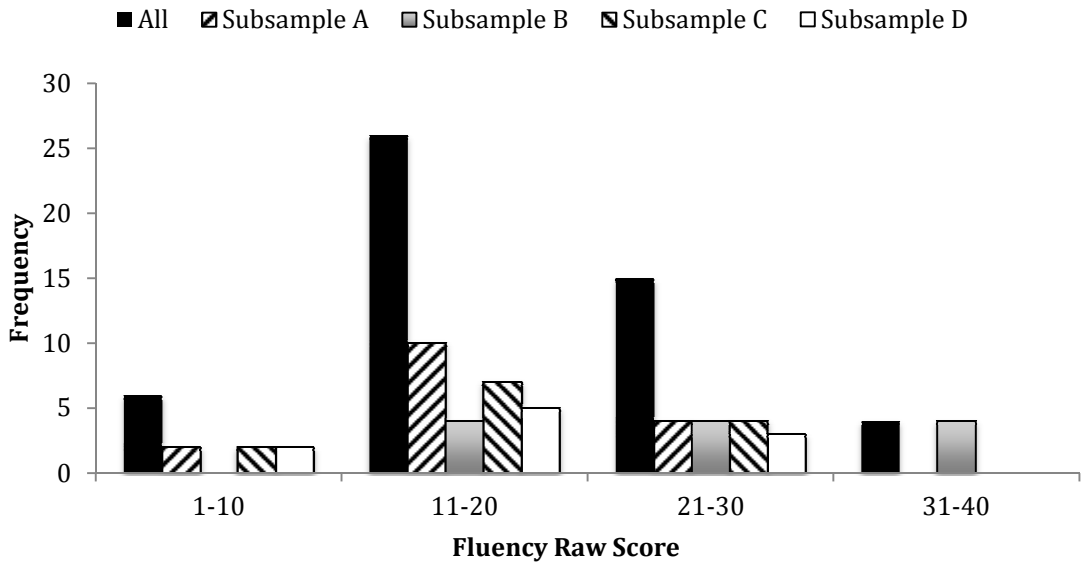


Figure 2. Histogram of fluency raw scores.

In addition to the analysis of the raw data scores, Torrance et al. (2008) provided norm-referenced data, which connected each subject's score with a national percentile and a standard score for each of the five norm-referenced measures. According to Torrance et al. (2008) through the *Norms-Technical Manual* used to find the standard score for subjects, the fluency score by age and by grade has a standard score range of 40 to 160 (160 - 40 = 120). The standard scores of subjects of the total sample (*N*) had a range from 59 through 141 (141 - 59 = 82). A table that lists the frequency counts for the standard scores of the total sample (*N*) and the subsamples (A, B, C, and D) is available (see Appendix E).

Originality. Originality is defined by Torrance et al. (2008) as the "ability to produce uncommon or unique responses that require creative strength" (p. 3). For the scorer, Torrance et al. (2008) emphasized in the *Streamline Scoring Guide*, "The scoring of originality is based on the statistical infrequency and unusualness of the response" (p. 7). Millar (2010) clarified the measure of originality as "looking beyond the obvious and mundane to the novel and inventive" (p. 389). The scorer was provided with a list of common responses to the stimulus, which appeared from the responses of the subjects who comprised the normative sample (Torrance et al., 2008). The common responses were eliminated, and the remaining responses deemed original were counted (Torrance et al., 2008). Bonus points were awarded in this category for connecting multiple separate stimuli in order to create one figural response (Torrance et al., 2008). As a result of the possibility of bonus points, a subject could score higher than 40 points if all responses were deemed appropriate and multiple stimuli were connected together (Torrance et al., 2008).

The total sample ($N = 51$) had originality scores that ranged between two and 32 points (32 - 2 = 30). The first frequency class of originality scores from the total sample (N) included 13 subjects (25%) who scored between one and 10. In addition, 29 subjects (57%) scored between 11 and 20, eight subjects (16%) scored between 21 and 30, and one subject (2%) scored between 31 and 40. Although bonus points were awarded in several cases, none of the subjects received a score higher than 40 points. The mean score for the total sample was 14 ($\bar{x} = 14$), the mode was 12, and the median was 13 ($Mdn = 13$). The standard deviation for originality was six ($sd = 6$).

In subsample A (n_A = 16), the scores for originality ranged between two and 24 points (24 - 2 = 22); none of the subjects scored in the top two bands between 31 and 50 points. Four of the subjects (25%) scored between one and 10 points in originality. Ten subjects (62.5%) scored between 11 and 20 points, and two subjects (12.5%) scored between 21 and 30 points. The mean score for responses in subsample A was 13 ($\bar{x}$ = 13). The mode and median scores were both 12 (*Mdn* = 12). The standard deviation for originality was 5.74 (*sd* = 5.74).

The scores for originality for the 12 subjects in subsample B (n_B = 12) had a range between 11 and 32 points (32 - 11 = 21). None of the subjects scored between one and 10 or between 41 and 50, eliminating both the top and bottom frequency classes. Eight subjects (67%) in subsample B scored between 11 and 20 points on originality. In the frequency class of 21 to 30 points, three subjects (25%) were scored. Finally, one subject (8%) in subsample B scored between 31 and 40 on originality. The mean score for subsample B was 19 ($\bar{x}$ = 9). The median for this subsample was 17 (*Mdn* = 17); however, the most frequently-appearing score for originality was 13. The standard deviation for this subsample was seven (*sd* = 7).

The third subsample, C, was comprised of 13 subjects (n_C = 13) with scores ranging from six to 25 points (25 - 6 = 19). Five subjects (38%) scored in the frequency class of one to 10. Six subjects (46%) scored between 11 and 20 points, and two subjects (15%) scored between 31 and 40 points. None of the subjects in subsample C scored in the highest frequency class between 41 and 50. The median for originality in subsample C was 11 (*Mdn* = 11), and the mean was 12 ($\bar{x}$ = 12). The mode for subsample C was four. The standard deviation for this subsample was seven (*sd* = 7).

Finally, subsample D had 10 subjects ($n_D = 10$) who scored between nine and 23 points for originality (23 - 9 = 14). Four subjects (40%) scored between one and 10. Five subjects (50%) scored between 11 and 20 points. Only one subject of subsample D (10%) scored between 21 and 30 points. None of the subjects scored between 31 and 50 points, eliminating the top two frequency classes for this subsample. The mean for subsample D was 13 ($\bar{x} = 19.29$), and the median was 12 ($Mdn = 12$). The mode was nine. Subsample D had a standard deviation of four ($sd = 4$).

The highest number of subjects was in the frequency class between 11 and 20 points for originality. The highest number of subjects remained consistent across all the subsamples. With the exception of subsample B, all of the other subsamples (A, C, D) had 0% of the subjects scoring in the top two frequency classes. Subsample B scores were shifted up one frequency class. Subjects of subsample B had 0% of the subjects falling in the top and bottom classes and 100% of the subjects in the middle three ranges between 11 and 40 points.

The histogram (see Figure 3) represents the frequency of originality for the total sample (*N)* and each of the subsamples (A, B, C, D) in the sample. The use of the histogram supports the first research question, because originality represents one measure from the whole creativity index score. The shape of the lines on the histogram creates a bell curve line skewed to the right for the total sample (*N*) and each of the subsamples (A, B, C, and D) with the highest frequency in the 11-20 frequency class.

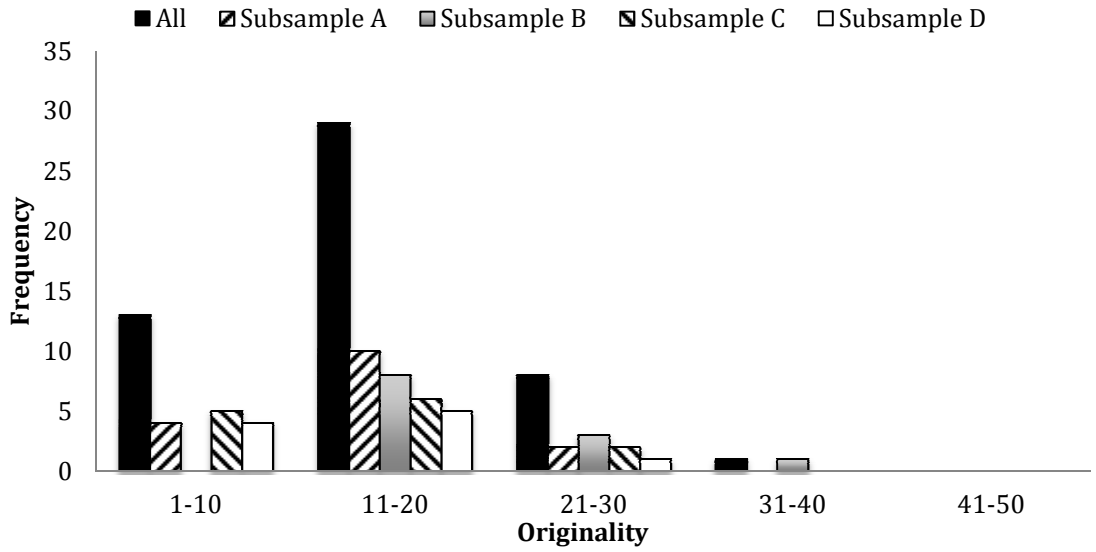


Figure 3. Histogram of originality raw scores.

Torrance et al. (2008) provided the norm-referenced standard scores for originality by age and grade. The standard score range was between 40 and 160 (160 - 40 = 120), according to the *Norm-Technical Manual* (Torrance et al., 2008). The standard scores of subjects in the study had a range from 44 through 141 by grade (141 - 44 = 97) and between 46 and 141 by age (141 - 46 = 95).

The standard score by age had a mean of 98.71 (= 98.71), a mode of 90, and a median of 95 (*Mdn* = 95). The standard deviation for the standard score by age was 20.44 (*sd* = 20.44). As for the standard score by grade, the mean was 98.1 (= 98.1), the mode was 90, and the median was 93 (*Mdn* = 93). The standard deviation was 21.47 (*sd* = 21.47), indicating a wide range of scores from the mean (Bluman, 2010). A table that lists the analysis of frequency counts for the norm-referenced standard scores for the measure of originality is available in Appendix E.

Elaboration. Elaboration, according to Torrance et al. (2008), "reflects the subject's ability to develop, embroider, embellish, carry out, or otherwise elaborate

details" (p. 3). Elaboration is "the 'flesh' that rounds out the 'skeleton' of an idea," according to Millar (2010, p. 380). The scorer was allowed to estimate the number of elaborative details per acceptable response (Torrance et al., 2008). The number of elaborations per three activities was added and then scored using six sets of normative data per activity (Torrance et al., 2008). The subject could receive no more than 18 points for the measure of elaboration (Torrance et al., 2008).

The 51 subjects in the total sample ($N = 51$) had a range of scores from three points to 12 points (12 - 3 = 9). Two subjects (4%) scored between one and three elaboration points. Twenty-one subjects (41%) scored between four and six points, and 23 subjects (45%) scored between seven and nine points. The remaining five subjects (10%) scored between 10 and 12 points for elaboration. None of the subjects scored above the 10 to 12 range. The mean and median for the elaboration scores were seven ($\bar{x} = 7$ and $Mdn = 7$). The mode and standard deviation were both six ($sd = 6$).

The data from subsample A ($n_A = 16$) had a mode and median of eight ($Mdn = 8$). The mean was seven, and the standard deviation was two ($\bar{x} = 7$ and $sd = 2$). The elaboration scores for subsample A had a range from three to nine (9 - 3 = 6). One subject (6.25%) scored between one and three points for elaboration. Six subjects (37.5%) scored between four and six points, and nine subjects (56.25%) scored between seven and nine points. None of the subjects of subsample A scored in the top two frequency classes.

The range of subsample B ($n_B = 12$) was between six and 11 (11 - 6 = 5). The mode, median, and mean were all nine ($\bar{x} = 9$ and $Mdn = 9$), and the standard deviation was two ($sd = 2$). None of the subjects in the subsample were within the first frequency class of one to three points or the last frequency class of 13 and 15 points. Two subjects

(17%) scored between four and six elaboration points. In the next frequency class, seven subjects (58%) scored between seven and nine elaboration points. Finally, three subjects (25%) scored between 10 and 12 points in the elaboration measure on the TTCT.

The subjects of subsample C (n_C = 13) had scores for elaboration that ranged between three and 12 points (12 - 3 = 9). The mean for subsample C was six ($\bar{x}$ = 6), the median was five (*Mdn* = 5), and the mode was four. The standard deviation was three (*sd* = 3). One subject (8%) scored between one and three points in elaboration. Eight subjects (62%) scored between four and six points. Both the seven to nine frequency class and the 10 to 12 frequency class contained two subjects (15%) each.

The subjects of subsample D (n_D = 10) had elaboration scores that ranged between five and nine points (9 - 5 = 4). The median and mean for the elaboration measure was seven ($\bar{x}$ = 7 and *Mdn* = 7), and the mode was six. The standard deviation was one (*sd* = 1). The subsample was split evenly into two frequency classes of five subjects (50%) each. The two classes were from four to six and from seven to nine elaboration points.

The frequency class with the highest number of subjects for all of the subsamples was between seven and nine points for elaboration, with the exception of subsample C. The seven to nine frequency class had 50% of the subjects or more in three of the four subsamples (A, B, D). Subsample C had the highest frequency (62%) in the four to six frequency class.

The histogram (see Figure 4) represents the frequency of elaboration for the total sample (*N*) and each of the subsamples (A, B, C, D). The use of the histogram supports the first research question, because elaboration represents one measure from the whole

creativity index score. The shape of the lines on the histogram has a bell curve line skewed to the right for the total sample (*N*) and each of the subsamples (A, B, C, D) with the highest frequency in the seven to nine frequency class.

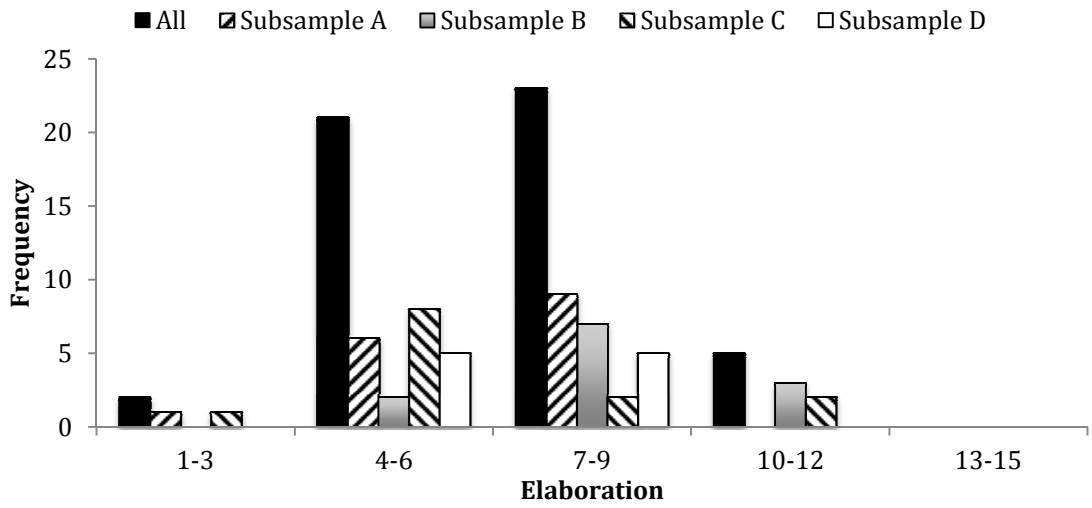


Figure 4. Histogram of elaboration raw scores.

The available norm-referenced standard scores for elaboration were provided with reference to age and grade. The standard score range was between 40 and 160 (*range* (40, 160) = 120) from the TTCT *Norms-Technical Manual* (Torrance et al., 2008). The standard scores for elaboration of subjects in the study had a range from 62 through 147 for both grade and age (147 - 62 = 85).

The standard score by age had a mean of 105.9 (= 105.9), a mode of 98, and a median of 109 (*Mdn* = 109). The standard deviation for the standard score by age was 20.98 (*sd* = 20.98). As for the standard score for elaboration by grade, the mean was 104.8 (= 104.8), the mode was 96, and the median was 108 (*Mdn* = 108). The standard deviation was 21.52 (*sd* = 21.52). A table that lists the data from the analysis of standard scores for elaboration is available in the appendix (See Appendix E).

Abstractness of titles. Added to the *Streamlined Scoring Guide* in 1983, abstractness of titles is "based on the ideas that creativity requires one to sense the essence of a problem, to know what is truly essential, and that this is reflected in the level of abstraction given to the title of the pictures drawn" (Torrance et al., 2008, p. 3). Millar (2010) explained the strength of abstractness of titles is about "getting to the heart of the matter" (p. 390). The scores for abstraction of titles were given in four categories.

Torrance et al. (2008) indicated, "Each point on the scale can be regarded as a different stage in the abstracting process or in capturing the essence of the picture" (p. 12). A subject scored zero points if the title reflected a factual account of what was drawn in the response, such as "cat," "leaf," or "boat" (Torrance et. al., 2008, p. 12). If the subject offered a simple but concrete descriptive title, such as "happy cat" or "dancing girl," the response received one point (Torrance et. al., 2008, p. 12). The third level of abstractness in titles, worth two points, was described as an "imaginative, descriptive title in which the modifier goes beyond a concrete, physical description" (Torrance et al., 2008, p. 12). Although the titles may be more descriptive, the titles in this stage may also have provided insight into the character's thoughts or the feelings of the person or object (Torrance et al., 2008).

The final stage was worth three points and was categorized as "abstract but appropriate" (Torrance et al., 2008, p. 12). The titles in this stage were more than descriptive and become a part of the whole story created in the figural response (Torrance et al., 2008). Examples of this stage included "sweetheart's quarrel" and "unwanted" (Torrance et al., 2008, p. 12). The score for abstractness of titles in the TTCT is only obtained from the first two activities, picture construction and picture completion, and

consists of 11 possible responses (Torrance et al., 2008). The highest score possible for abstractness of titles was three points times 11 responses, or 33 total points (Torrance et al., 2008).

The total sample ($N = 51$) had a range of one point to 20 points (20 - 1 = 19) in the abstractness of titles category. Twenty-one of the subjects (41%) had scores in the one to six frequency class, and 25 subjects (49%) scored between seven and 12 points. The next four subjects (8%) scored between 13 and 18 points. One of the subjects (2%) scored above 19 points but below 24 points. The mean for the total sample was 7.59, and the median was seven ($\bar{x} = 7.59$ and $Mdn = 7$). The mode was 10, and the standard deviation was 4.433 ($sd = 4.433$)

The 16 subjects in subsample A ($n_A = 16$) had scores for abstractness of titles that ranged between one and 12 (12 - 1 = 11), relegating all the subjects to the bottom two frequency classes. Five subjects (31%) scored between one and six points, and 11 (69%) scored between seven and 12 points. The median and mode for subsample A were both eight, and the mean was seven ($Mdn = 8$ and $\bar{x} = 7$). The standard deviation was 3.58 ($sd = 3.58$) for abstractness of titles for subsample A.

The subjects of subsample B ($n_B = 12$) had scores that ranged between one and 16 (16 - 1 = 15) in abstractness of titles. Six subjects (50%) scored between one and six points. Four subjects (33%) scored between seven and 12 points, while only two subjects (17%) scored between 13 and 18 points. The most frequently-occurring score for this subsample, the mode, was four. The mean was eight, and the median was seven ($\bar{x} = 8$ and $Mdn = 7$). The standard deviation was 4.54 ($sd = 4.54$) for subsample B in abstractness of titles.

The third group of subjects, subsample C (n_C = 13), had scores that ranged between five and 18 points (18 - 5 = 13) for abstractness of titles. In the lowest frequency class, five subjects (38%) scored between one and six points for abstractness of titles. Six subjects (46%) had scores in the next class ranging from seven to 12 points. One subject (8%) each was contained in two ranges, between 13 and 18 points and between 19 and 24 points. The median score for abstractness of titles was seven, and the mean score was eight (*Mdn* = 7 and $\bar{x}$ = 8). The mode was five. The standard deviation was 5.48 (*sd* = 5.48) for scores in subsample C.

The 10 subjects in subsample D (n_D = 10) had scores that ranged between two and 16 points (16 - 2 = 14) for abstractness of titles. Similar to subsamples C and A, subsample D had five subjects (50%) score between one and six points. Four subjects (40%) scored between seven and 12 points for abstractness of titles. Only one subject (10%) from subsample D scored between 13 and 18 points. The mean and mode scores for this subsample were seven ($\bar{x}$ = 7). The median score was six (*Mdn* = 6). The standard deviation was 4.64 (*sd* = 4.64) for subsample D.

Two of the subsamples, A and C, represent the students who were enrolled in fine arts courses. Both subsamples had the highest frequency in the seven to 12 frequency class. Although subsample A had 50% of the subjects within this frequency class, subsample C only had 38%, which does not constitute a majority of the subjects. Subsample C also had another 16% of the subjects in higher frequencies. Subsamples B and D, representing the students not enrolled in fine arts courses, had the highest frequency in the lowest frequency class. Although subsamples B and D did have 50% of

the students in the lowest frequency class, 50% of the subjects were also split between the next two frequency classes.

The histogram (see Figure 5) shows the frequency of abstractness of titles for the total sample (*N*) and each of the subsamples (A, B, C, D) in the sample. The use of the histogram supports the first research question, because abstractness of titles represents one measure from the whole creativity index score. The shape of the lines on the histogram was a bell curve line skewed to the right for the total sample and each of the subsamples with the highest frequency in the seven to 12 frequency class.

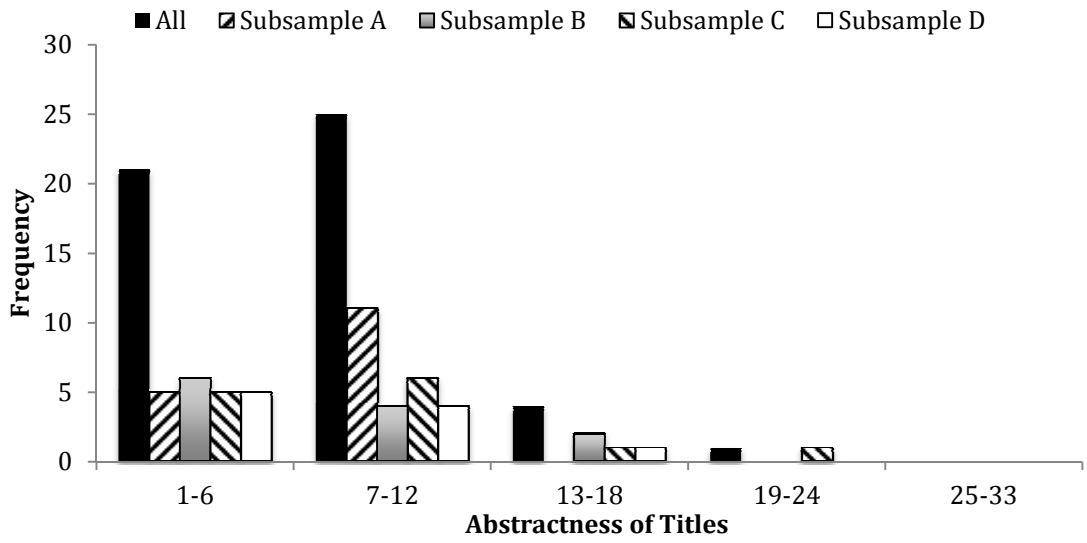


Figure 5. Histogram of abstractness of titles raw scores.

The available norm-referenced standard scores for abstractness of titles were referenced by age and by grade (Torrance, 2008). The norm-referenced standard score range was between 53 and 160 (160 - 53 = 107) for abstractness of titles (Torrance et al., 2008). The standard scores for abstractness of titles for the total sample (*N*) had a range from 53 through 147 (147 - 53 = 94) by both grade and age. The standard score by age had a mean of 92.94 (= 92.94), a mode of 98, and a median of 92 (*Mdn* = 92). The

standard deviation was 23.33 (*sd* = 23.33) for the standard score by age. As for the standard score for abstractness of titles by grade, the mean was 91.67 ($\bar{x}$ = 91.67), the mode was 96, and the median was 91 (*Mdn* = 91). The standard deviation was 23.34 (*sd* = 23.34) for the standard score by grade. A table, which details the frequency counts of the standard scores of abstractness of titles, is available in the appendix (see Appendix E).

Resistance to premature closure. The final of the five norm-referenced measures for the TTCT is resistance to premature closure (Torrance et al., 2008). Torrance et al. (2008) defined resistance to premature closure "as a scoring concept… based on the generally accepted conclusion that creative behavior requires a person to 'keep open' in processing information and to consider a variety of information" (p. 3). Millar (2010) suggested those demonstrating strength in this measure avoid "taking the easiest way out" of the problem (p. 390). This means the subject has considered and fully understands all sides of the problem before offering a solution, and as a result, avoids premature closure of the ideas (Millar, 2010).

The subjects in the TTCT are scored in this measure based on how quickly the stimulus lines of activity two (picture completion) are closed to create the figural response (Torrance et al., 2008). If the response was "closed by one of the quickest, easiest, most direct routes with a straight line, simple curved line, solid shading or coloring" (Torrance et al., 2008, p. 13), the subject received zero points for the response under the criteria for resistance to premature closure. If the response was closed by a direct closure, but the subject also elaborated outside of the closure or provided shading, the response was scored with one point (Torrance et al., 2008).

The response may have received two points if the figural response never closed the stimulus lines or if the closure was "competed with irregular lines, which form part of the picture" (Torrance et al., 2008, p. 13). Only the second activity of the TTCT, picture completion, is scored for resistance for premature closure (Torrance et al., 2008). As there were only 10 stimuli in this activity, a subject could receive a maximum of 20 points in this category if all figures were completed (Torrance et al., 2008).

The 51 subjects ($N = 51$) in the study had scores in the resistance to premature closure measure that ranged between two and 18 points (18 - 2 = 16). The mean score for the total sample (N) was 9.70 ($\bar{x} = 9.70$) for resistance to closure. The median score was seven ($Mdn = 7$), and the mode was eight. The standard deviation for the total sample was 3.89 ($sd = 3.89$). Seven subjects (14%) scored between one and five points. Twenty-six of the 51 subjects (51%) scored between six and 10 points, and 13 subjects (25%) scored between 11 and 15 points for resistance to closure. The final frequency class had five subjects (10%) score equal to or more than 16 points but fewer than 20 points in resistance to closure.

The 16 subjects of subsample A ($n_A = 16$) had a mean and a mode score of eight ($\bar{x} = 8$) and a median score of seven ($Mdn = 7$) for resistance of premature closure. The standard deviation was 3.32 ($sd = 3.32$) for subsample A. The subjects of subsample A had scores that ranged from two to 18 (18 - 2 = 16). One subject (6%) scored between one and five points. Eleven of the subjects (69%) scored between six and 11 points, and three subjects (19%) scored between 11 and 15 points. Finally, one subject of subsample A (6%) scored in the highest frequency class between 16 and 20 points.

Subsample B, comprised of 12 subjects (n_B = 12), had a range of scores from five to 15 (15 - 5 = 10). The mean, mode, and median scores for resistance to premature closure were all nine points for this subsample ($\bar{x}$ = 9 and *Mdn* = 9). The standard deviation was 3.08 (*sd* = 3.08) for subsample B. Two subjects (17%) scored between one and five points. Six subjects (50%) scored between six and 10 points. The final frequency class represented by four subjects (33%) of subsample B was between 11 and 15 points.

The subjects of the third subsample, C (n_C = 13), had scores for resistance to premature closure that ranged between two and 18 points (18 - 2 = 16). Three subjects (23%) scored between one and five points, four subjects (31%) scored between six and 10 points, and three subjects (23%) scored between 11 and 15 points. The final three subjects (23%) scored between 16 and 20 points for resistance to premature closure. The mean score for subsample C was 10 ($\bar{x}$ = 10). The mode was 17, and the median score was 10 (*Mdn* = 10). The standard deviation was 5.28 (*sd* = 5.28) for resistance to premature closure for subsample C.

The subjects of the final subsample, D (n_D = 10), had a range of scores from four to 17 points (17 - 4 = 13). The majority of subjects (50%) scored in the first frequency class between one and five points. Two subjects (20%) scored between six and 10 points. Two additional subjects (20%) scored between 11 and 15 points. The final subject in subsample D (10%) scored between 16 and 20 points for resistance to premature closure. The mean, mode, and median for subsample D were all 10 ($x\square$ = 10 and *Mdn* = 10) for resistance to premature closure. The standard deviation was 3.97 (*sd* = 3.97) for subsample D.

The common highest frequency class was between six and 10. The exception to this rule was subsample D. Fifty percent of the subjects of subsample D scored between one and five points on resistance to premature closure. The most balanced of the subsamples in resistance to premature closure was subsample C. The subjects of subsample C were split into three groups of three and one group of four across all four of the frequency classes.

A histogram (see Figure 6) was created to represent the frequency for resistance to premature closure for the total sample (*N*) and each of the subsamples (A, B, C, and D). The use of the histogram supports the first research question, because resistance to premature closure represents one measure from the whole creativity index score. The shape of the lines on the histogram is a bell curve line skewed to the right for the total sample (*N*) and each of the subsamples (A, B, C, D) with the highest frequency in the six to 10 frequency class.

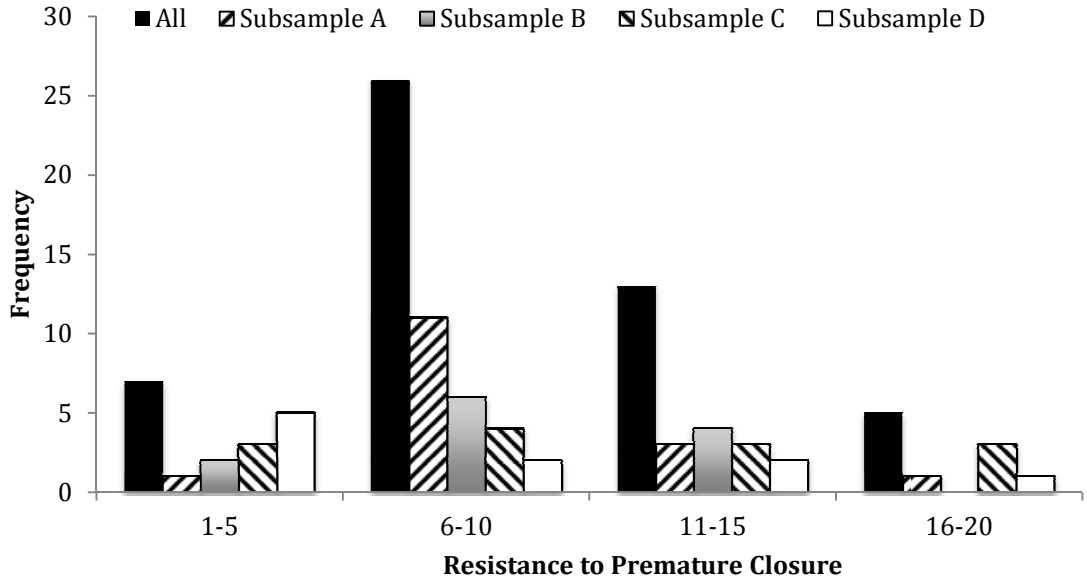


Figure 6. Histogram of resistance to premature closure raw scores.

The available norm-referenced standard scores for resistance to premature closure were referenced by age and by grade (Torrance, 2008). The norm-referenced standard score range was between 40 and 160 (160 - 40 = 120) in the *Norms-Technical Manual* (Torrance et al., 2008). The subjects in the total sample had standard scores for resistance to premature closure in a range from 46 through 130 by age (130 - 46 = 84) and a range of 46 through 128 by grade (128 - 46 = 82).

The standard score by age had a mean of 90 (= 90), a mode of 92, and a median of 87 (*Mdn* = 87). The standard deviation was 19.4 (*sd* = 19.4) for the standard score by age. As for the standard score for resistance for premature closure by grade, the mean was 88.84 (= 88.84), the mode was 91, and the median was 87 (*Mdn* = 87). The standard deviation was a 19.98 (*sd* = 19.98) for the standard score by grade. A table, which lists the frequency analysis of standard scores, is available in the appendix (see Appendix E).

Overall standard scores and national percentiles. Once the individual raw scores were computed and the normative standard scores and national percentiles were found in the tables for each measure by age and by grade in the *Torrance Test for Creative Thinking: Norms-Technical Manual* (Torrance, 2008), the average standard score was found by adding all the component scores (*fluency* + *originality* + *elaboration* + *abstractness of titles* + *resistance to premature closure*) and dividing by the number of components (*raw scores for norm-referenced measures* / 5). Next, the average was located in the table by grade or by age, and the national percentile was located in the adjacent column (Torrance, 2008). Later, when the checklist for creative strengths was scored, that number was added to the average standard score to become the creative index score for the subject (Torrance, 2008).

The total sample ($N = 51$) had an average standard score range from 62.6 to 124.6 by age (124. 6 - 62.6 = 62) and from 61.6 to 122.6 by grade (122.6 - 61.6 = 61). The normative sample used by Torrance (2008) had a range of 63 by age and a range of 64 by grade. The mean was 98.02 ($\bar{x} = 98.02$), the median was 99 ($Mdn = 99$), and the mode was 87.4 for the average standard score by age. The standard deviation of the average standard score by age was 14.17 ($sd = 14.17$).

The normative sample used by Torrance (2008) had similar results with a mean of 98.6 ($\bar{x} = 98.6$) and a standard deviation of 14.2 ($sd = 14.2$). By grade, the mean for the total sample was 97.17 ($\bar{x} = 97.17$), the median was 97.8 ($Mdn = 97.8$), and the mode was 86. The standard deviation by grade was 14.56 ($sd = 14.56$). The normative sample used by Torrance (2008) had a mean of 100 ($\bar{x} = 100$) and a standard deviation of 14.2 ($sd = 14.2$).

Norm-referenced by age, in the total sample of 51 subjects ($N = 51$), none of the subjects had a standard score between 40 and 51 by age or by grade. Only one subject (2%) had an average standard score between 52 and 63. Four subjects (8%) had an average standard score between 64 and 75. Two subjects had an average standard score between 76 and 87. The largest group of 19 subjects (37%) had an average standard score between 88 and 99. The frequency class of 100 to 111 average standard score had the second largest number of subjects totaling 17 subjects (33%). Seven subjects (14%) had an average standard score between 112 and 123. Finally, one subject (2%) had the top average standard score between 124 and 135. None of the subjects had an average standard score between 136 and 160.

The average standard score by grade had similar findings as those calculated by age for the first three frequency classes. In the fourth frequency class, the frequency numbers were more variable. Seven subjects (14%) had an average standard score between 76 and 87. Fifteen subjects (29%) had an average standard score between 88 and 99. Sixteen subjects (31%) had an average standard score between 100 and 111. The last class had eight subjects (16%) with an average standard score between 112 and 123. By grade, none of the subjects scored at or above 124 as an average standard score.

The histograms (see Figure 7 and Figure 8) show the frequency of average standard scores for the total sample (N) by age and by grade and each of the subsamples (A, B, C, D). The use of the histogram supports the first research question, because the average standard score is a component of the creativity index score. The shape of the lines on the histogram was a bell curve line for the total sample and each of the

subsamples with the highest frequency in the 88 to 99 frequency class by age and the 100 to 111 frequency class by grade.

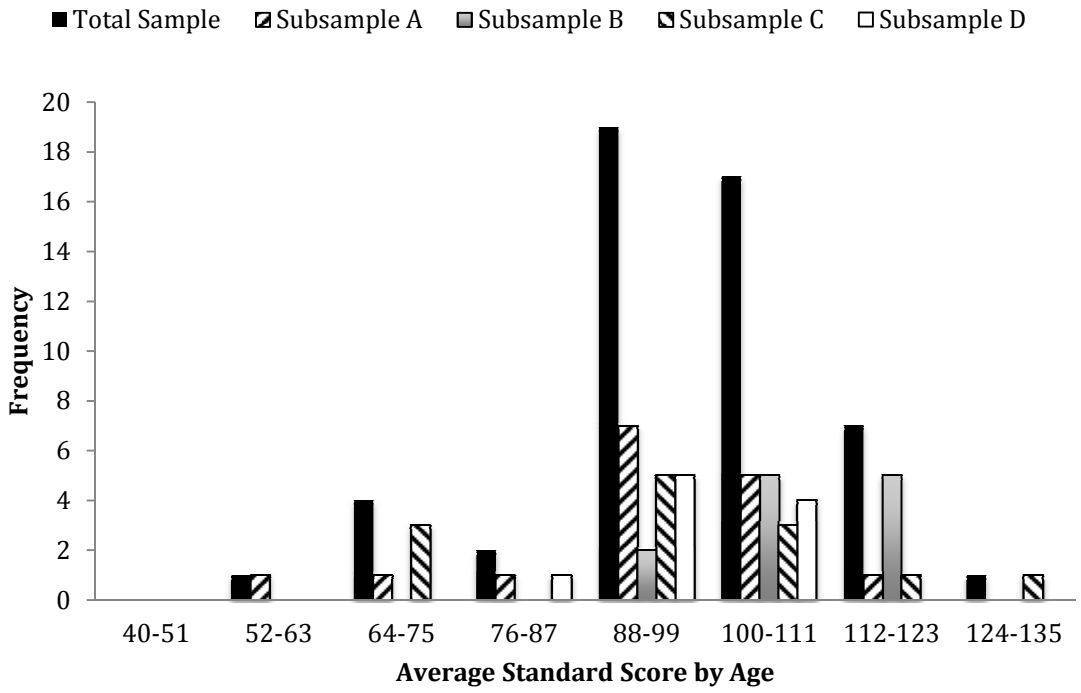


Figure 7. Histogram of average standard score by age.

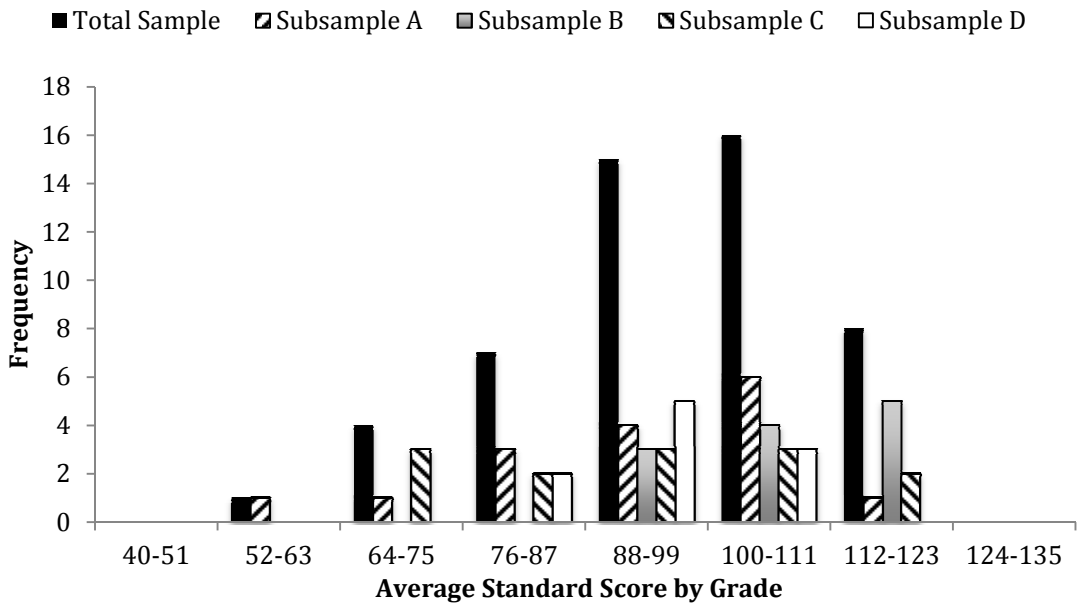


Figure 8. Histogram of average standard score by grade.

The national percentile for each average standard score was found in the adjacent column to the average standard score by age and by grade in the *Torrance Test of Creative Thinking: Norms-Technical Manual* (Torrance, 2008). This score was the overall percentile of the five norm-referenced measures of fluency, originality, elaboration, abstractness of titles, and resistance to premature closure (Torrance, 2008). It was not an average of the percentiles from each measure, but a norm-referenced percentile based on the average standard score for each subject (Torrance, 2008).

Thirteen criterion-referenced indicators. The *Torrance Test for Creative Thinking: Streamline Scoring Guide for Figural Forms A and B* (Torrance et al., 2008) provided guidelines for scoring the criterion-referenced measures indicating creative strengths of the subjects based on the responses in the TTCT. The responses were evaluated on emotional expressiveness, storytelling articulateness, movement or action, expressiveness of titles, synthesis of incomplete figures, usual visualization, internal

visualization, extending or breaking boundaries, humor, richness of imagery, colorfulness of imagery, and fantasy (Torrance et al., 2008).

In all categories except richness of imagery, subjects are awarded one plus (+) for demonstrating the criteria in one or two responses and two pluses (++) for demonstrating the criteria in three or more responses (Torrance et al., 2008). The exception to this instruction is in the criteria of richness of imagery, in which subjects receive one plus (+) for four to five responses and two pluses (++) for six or more responses demonstrating a legitimate presence of the criteria (Torrance et al., 2008). As two pluses (++) are the maximum score for any one criterion, each subject could receive up to 26 pluses for the total checklist (Torrance et al., 2008).

Torrance et al. (2008) reminded the scorers "not to make unwarranted conclusions on the basis of an absence of the indicators included in the checklist" (p. 15). The scores on the checklist by themselves were not intended for use individually, but as a whole (Torrance et al., 2008). When the checklist for creative strengths was added to the standard score by age or by grade, the creativity index score was created for the subject (Torrance et al., 2008). Torrance et al. (2008) reinforced the use of the presence of creative strengths in the population for the "development of appropriate curricula and instructional methods for a particular student" (p. 5).

Emotional expressiveness. Described by Torrance et al. (2008), emotional expressiveness includes the feelings and emotions communicated through both titles and figural responses to the stimuli. The ability to be aware of the emotions, according to Millar (2010), provides a connection to the problem. The answer results from the emotional response or "aha" moment (Millar, 2010, p. 390). In the scoring of the TTCT,

all three activities were scored for emotional expressiveness (Torrance et al., 2008). This strength is often found in the form of dialogue or speech bubbles, the titles used, or expressions found on faces of characters drawn in the figural response by the subject (Torrance et al., 2008). Torrance et al. (2008) provided examples of "common verbal cues [such as] sad, happy, joy, love, anger, hate, mean…etc." (p. 15). In addition, scorers were instructed to look carefully at "facial expressions, gestures with hands, body positions" for non-verbal cues to emotional expressiveness (Torrance et al., 2008, p. 15).

Storytelling articulateness. Defined by Millar (2010), storytelling articulateness is the context of the story within the environment created in the response. Torrance et al. (2008) observed in order "to be effective, the creative person must be able to communicate clearly and powerfully. There must be sufficient detail to put things in context and tell the story or communicate the idea" (p. 17). According to Torrance et al. (2008), this strength is most likely to appear in activities one and two of the TTCT, but could also appear in activity three. In order to be scored as storytelling articulateness, there has to be some "figural and/or verbal indicators of the object's history (story)" in the response (Torrance et al., 2008, p. 17).

Movement or action. As a result of Torrance's study of the Rorschach theory, movement or action was added as a strength appearing in the TTCT (Torrance et al., 2008). According to Torrance et al. (2008), "The perception of movement in the Rorschach Ink Blot technique has long been recognized as an indicator of imagination and a number of personality characteristics essential to creative functioning" (p. 19). Although movement or action may be indicated in speech bubbles or title descriptions, generally movement is present in the figural response itself (Torrance et al., 2008). The

scorer looked for common indicators of movement such as “running, flying, floating, dancing, diving skiing, fighting, throwing” (Torrance et al., 2008, p. 19).

Expressiveness of titles. Recognized as the respondent’s ability to get to the “heart” of the response, the strength of expressiveness of titles includes getting to the essence of the story with the word choice of the title (Millar, 2010, p. 124). Torrance et al. (2008) provided examples of expressiveness in titles in the *Torrance Test of Creative Thinking: Streamlined Scoring Guide*, which included “Lonely Old Lady” and “Canary’s Revenge” (Torrance et al., 2008, p. 21). Word choice is vital to the scoring of the category of expressiveness of titles, as the emotions have to be enhanced by the use of words and not necessarily apparent when the scorer views the graphic alone (Torrance et al., 2008).

Synthesis of incomplete figures and lines. The creative strength synthesis of incomplete figures was assessed only in activity two, and synthesis of incomplete lines was assessed only in activity three, because of the nature of the stimuli presented in each activity (Torrance et al., 2008). The synthesis of images was a similar concept in both activities. Participants were instructed prior to beginning each activity to try to create a story that was as complete as the subject could make it (Torrance et al., 2008). Most subjects created separate figural responses for each stimulus, but occasionally a subject combined stimuli in order to create one image spanning across the numbered stimuli (Torrance et al., 2008). Torrance et al. (2008) considered the resulting figural response “quite rare” (p. 21). In fact, according to Torrance et al. (2008), “When a person makes such a synthesis, it seems to represent a powerful type of thinking and possibly an ability to see relationships among rather diverse and otherwise unrelated elements” (p. 21).

The ability to make connections is also highly regarded by other creativity theorists, including Robinson (2011). Torrance et al. (2008) stated the exclusion of the permission to combine figures or lines in the instructions is by design. The authors of the *Torrance Test of Creative Thinking: Streamline Scoring Guide* asserted, "The rationale for this procedure is that the creative person sees possibilities that others assume have been closed, and under restrictive conditions is able to use whatever freedom is allowed" (Torrance et al., 2008, p. 23). The combined responses were scored to identify the presence of the strength of synthesis of incomplete figures or lines (Torrance et al., 2008).

Unusual and internal visualization. The two strengths of unusual visualization and internal visualization are used to reveal the subject's ability to see the stimuli from more than one perspective in order to create a figural response other than a typical head-on drawing (Torrance et al., 2008). Allen (2010) defined the skill of visualization as:

> The manner of thought in which images are generated or recalled in the mind. These images may be manipulated, rotated, increased or decreased in size, or even transformed from one image into another. Spatial ability, which is closely related to visualization, emphasizes three-dimensional space. The two-dimensional image transforms to a mass or empty volume, providing a sense of proportion, distance, balance. (pp. 242-243)

The creativity of visualization is evidenced, according to Torrance et al. (2008), as the ability to recognize a "commonplace object or situation and perceive it in different ways" (p. 25). Millar (2010) considered the strength of unusual visualization as "one of the single most effective predictors of adult creative achievement" (p. 382).

Examples of unusual visualization include turning a car sideways, creating a picture of a basketball court as viewed from above, or looking at the underside of a pig (Torrance et al., 2008). The subject demonstrates awareness of the inside of a figural response, on the other hand, by using internal visualization (Torrance et al., 2008). For example, the subject might draw roots of a tree under the ground, add ice to a glass of water, or place the figure of a man behind jail bars (Torrance et al., 2008). This strength is similar to unusual visualization, but Millar (2010) clarified, "This ability involves looking beyond exteriors to hidden possibilities" (p. 392).

Extending or breaking boundaries. The creative strength of extending or breaking boundaries was scored only in activity three where the subjects were given a series of straight lines as the stimulus (Torrance et al., 2008). In order to score this strength, Torrance et al. (2008) required the response to "somehow open up or extend the boundaries or limits of the…rectangle described by the parallel lines" (p. 29). Millar (2010) suggested in order to break the boundaries of the response, a respondent has to remove "barriers imposed by habit and tradition and reformulate the problems or solution" (p. 392). Scores were given to responses that lay outside the confines of the parallel lines (Torrance et al., 2008).

Humor. Described by Torrance et al. (2008), humor is "the quality of portraying something comical, funny, or amusing" (p. 31). Finding humor in a response goes beyond causing the scorer to laugh aloud (Torrance et al., 2008). Torrance et al. (2008) suggested the scorer consider what well-known comedians and humorists do in performance or writing. According to Torrance et al. (2008), humor is:

> Bringing together certain incongruities which arise naturally from a situation so as to illustrate some fundamental absurdity in human behavior or character; exaggeration; puns and word play ridicule; satire; opposites and hidden opposites; and caricature all involve some kind of perceptual or conceptual incongruity. (p. 31)

Millar (2010) stated the importance of a creative person's ability to be able to detach himself or herself from a situation in order to experience its humorous nature, which "is similar to the critical perspective necessary to look at problems and situations in a creative way" (p. 392).

Richness and colorfulness of imagery. The creative strength of richness of imagery is closely linked to elaboration in the five norm-referenced measures (Torrance et al., 2008). Nonetheless, the images "show variety, vividness, liveliness, and intensity" (Torrance et al., 2008, p. 33). Richness of imagery was the only strength that was scored with one plus (+) when four or five responses demonstrated evidence of richness and two pluses (++) when six or more responses demonstrated richness of imagery (Torrance et al., 2008). In contrast, colorfulness of imagery as a creative strength is evident when the figural response included a connection to one of the five senses: taste, smell, sight, touch, or hearing (Torrance et al., 2008). According to Torrance et al. (2008), the colorful response "might be flavor, earthiness, unreal, spooky, emotionally appealing, fantastic, etc." (p. 35).

Fantasy. The final creative strength identified in the TTCT is the use of fantasy (Torrance et al., 2008). Millar (2010) defined fantasy as "the ability to go beyond what is real into the realm of imagination. The ability to extend one's thoughts beyond concrete

reality and to, just for a while, believe the impossible possible is the essence of fantasy" (p. 391). Torrance et al. (2008) stated, "Some of the disciplined approaches to creative problem solving and invention make deliberate use of fantasy" (p. 37). Specific reference in the *Torrance Test of Creative Thinking: Streamlined Scoring Guide* was made to the 1961 theory of *synectics* by Gordon, which involved "imagining what it is like to be a drop of paint, an automobile tire, or some other object" (Torrance et al., 2008, p. 37). Similar examples were deemed acceptable under the strength of fantasy as were the inclusion of characters from fairy tales or science fiction (Torrance et al., 2008).

Scoring of checklist of creative strengths. Torrance et al. (2008) stated the presence or lack of presence of a particular creative strength should be used for the purposes of adjusting curriculum. In this study, the applied knowledge of the 13 criterion-referenced measures was used to provide insight into the creative strengths of the subjects tested. The addition of the scores from the checklist of creative strengths (CCS) and the average standard scores resulted in the final creativity index score.

In general, subjects scored at all levels of the creative strengths, with the exception of synthesis of incomplete figures. Similarly, the creative strength of synthesis of lines revealed only two subjects (3%) scored one plus (+), and one subject (2%) scored two pluses (++) for more than three examples. The presence of the low incidence in these two creative strengths was reinforcement of the contention made by Torrance et al. (2008). Torrance (2007) indicated the presence of these strengths is a rare occurrence, appearing in only 5% of the normative sample. In the table available in Appendix E, the frequency of one plus (+) and two pluses (++) for each of the creative strengths was

analyzed by the total sample ($N = 51$) and each of the subsamples (A, B, C, D). The creative strengths were not split by age and grade at this point of the scoring process.

The CCS includes 13-criterion referenced measures, and each of these measures received no more than two pluses (++) (Torrance et al., 2008). The total CCS score for the TTCT was a maximum of 26 points (Torrance et al., 2008). The total sample ($N = 51$) had a range from zero to 22 points (22 - 0 = 22) for the total CCS score. The mean was 11 ($x\square = 11$); the mode and median were both 12 ($Mdn = 12$). The standard deviation was four for the CCS ($sd = 4$). One subject (2%) had a CCS score between zero and four. Eighteen subjects (35%) scored in the second frequency class between five and nine. The third frequency class of CCS scores between 10 and 14 had 23 subjects (45%). Seven subjects (14%) had a CCS score between 15 and 19 points. The final frequency class had only two subjects (4%) score between 20 and 26 points.

Creativity index. The creativity index score is computed by adding the average standard score to the score from the CCS (Torrance, 2008). Torrance et al. (2008) outlined the range of the creativity index scores for the normative sample between 41 and 160 (160 - 41 = 119). The sample had creativity index scores that ranged between 67 and 138 by age (138 - 67 = 71) and 66 and 136 by grade (136 - 66 = 70). The mean creativity index score for the total sample was 109 by age and 108 by grade ($\bar{x}$ =109 and $\bar{x}$ =108, respectively). The mode score for creativity index was 97 by age and 100 by grade. The median score by age was 112 ($Mdn = 112$); the median score by grade was 111 ($Mdn = 111$). The standard deviation for the creativity index scores by age was 16.77, and the standard deviation by grade was 17.13 ($sd = 16.77$ and $sd = 17.13$, respectively).

The lowest two frequency classes had zero subjects in the range. The first frequency class with subjects counted, 64 to 75, had three subjects (59%) within it both by age and by grade. Two subjects (4%) scored between 76 and 87 in the creativity index by age and by grade. Eight subjects (16%) had creativity index scores between 88 and 99 by age and by grade. Eleven subjects (22%) had creativity index scores by age, and 12 subjects (24%) by grade between 100 and 111. The frequency class with the highest number of subjects had 17 subjects (33%) with a creativity index score by age and by grade between 112 and 123. Seven subjects (14%) had creativity index scores by age and by grade between 124 and 135. The final three subjects (6%) by age and two subjects (3%) by grade had creativity index scores between 136 and 147. The histograms (see Figures 11 and 12) are a visual reference of the creativity index score by age and by grade. The histograms have a traditional bell-shaped curve with a minor skew to the left.

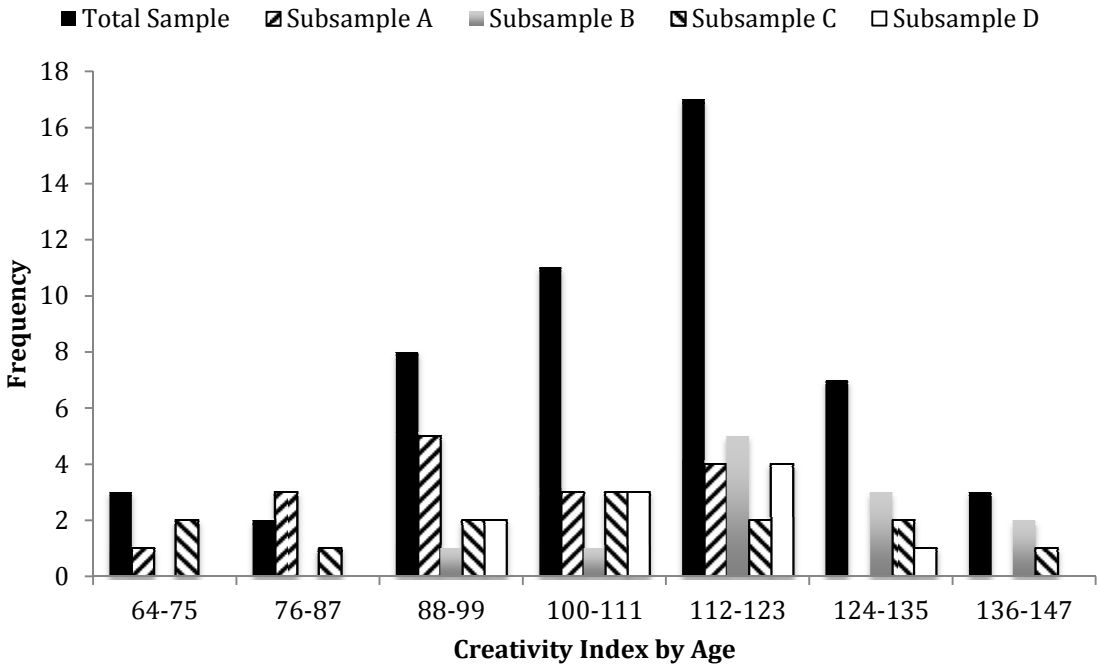


Figure 9. Histogram of creativity index score by age.

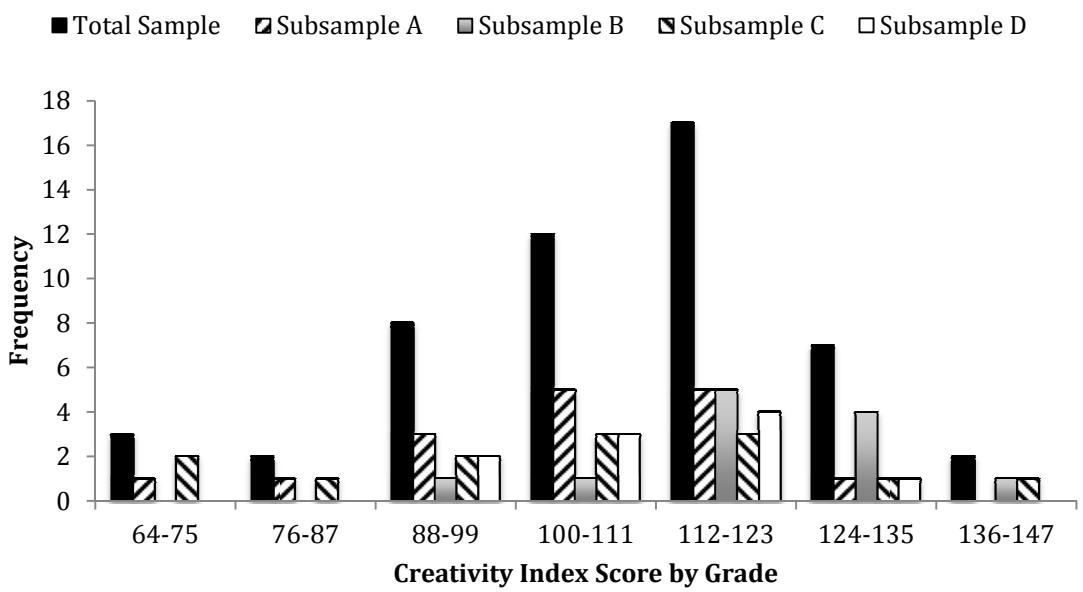


Figure 10. Histogram of creativity index score by grade.

In summary, Torrance et al. (2008) suggested analysis of the TTCT data through individual measures, average standard score, national percentiles, and the creativity index score. By analyzing the scoring data by each measure and by age and grade, the creative strengths and weaknesses of the sample were determined. Although the frequency counts of the data have differences in creativity index scores between the total sample ($N = 51$) and the subsamples (A, B, C, D), further analysis was conducted in Stage Two using a *t*-test for independent means and an ANOVA to compare the subsamples. These tests were selected in order to address research question one and to determine whether to reject or not reject the null hypothesis. In Stage Three the data were used to ascertain whether a relationship existed between the variables of creativity index scores and ACT or GPA. The statistical tests conducted addressed the second research questions in order to determine whether to reject or not reject the null hypothesis.

Stage Two: Statistical Tests Applied to Normative Creativity Index Scores

In Stage Two, the data from Stage One were subjected to statistical analysis using the Pearson Product moment coefficient (Pearson *r*), the *t*-test for independent means, and the analysis of variance (One-way ANOVA).

Pearson product moment coefficient (Pearson *r*). According to Bluman (2010), the Pearson *r* is used "to determine the strength of the linear relationship between two variables" (p. 533). When conducting the Pearson *r* on data, the results range:

> …from -1 to +1. If there is a strong positive linear relationship between the variables, the value of *r* will be close to +1. If there is a strong negative linear relationship between the variable, the value of *r* will be close -1. (Bluman, 2010, p. 533)

The variables included in this study were the enrollment in fine arts courses and IB DP curriculum and the individual subjects' creativity index scores. Fraenkel et al. (2012) stated, "When the data for both variables are expressed in terms of quantitative scores, the Pearson *r* is the appropriate correlation coefficient to use" (p. 208). Only one of the variables (course enrollment and creativity index score) was a numeric score; therefore, the Princeton University Library Data and Statistical Services (2007) suggested the solution of assigning the subsamples a dummy variable in order to calculate the correlation coefficient. Dummy variables are used because "social scientists often need to work with categorical variables in which the different values have no real numerical relationship with each other. Examples include variables for race, political affiliation, or marital status" (Princeton University Library Data and Statistical Services, 2007, para. 2)

As a result of the need for dummy variables, the subsamples were assigned a

number to represent their affiliation with a particular group. The largest subsample A was assigned zero. Subsample B was assigned the numerical value one, while subsamples C and D were assigned two and three, respectively. When the Pearson *r* was conducted on the data of subjects and the creativity index by age, an *r-value* of -.034 was calculated ($r = -.034$). This value alone was not enough to determine whether a strong linear relationship existed. In addition, the results from the Pearson *r* did not appear appropriate in this case for this study; therefore, no further action was taken with the Pearson *r* test.

The *t*-test for independent means. The *t*-test for independent means is "used to compare the mean scores of two different, or independent, groups" (Fraenkel et al., 2012, p. 234). Therefore, the *t*-test for independent means was conducted in this study. The *t*-value ($\alpha = .05$, one-tailed) was used to determine whether the means of two groups were statistically different from each other (Fraenkel et al., 2012). The data of the total sample ($N = 51$) were examined using the observations between creativity index scores and the enrollment in specific curriculum, including the fine arts courses and IB curriculum. The null hypothesis stated there was no statistically significant difference between the creativity index scores from the Torrance Test of Creative Thinking for students enrolled in fine arts courses and students not enrolled in fine arts courses. For the multiple *t*-tests conducted, the null hypothesis was adjusted to include a null hypothesis for each of the comparisons of the subsamples (Fraenkel et al., 2012). The six null hypotheses included (a) there was no statistically significant difference between the creativity index scores of subsample A and the creativity index scores of subsample B (H_0: $\mu_A \neq \mu_B$); (b) there was no statistically significant difference between the creativity index scores of subsample A and the creativity index scores of subsample C (H_0: $\mu_A \neq \mu_C$); (c) there was no statistically

significant difference between the creativity index scores of subsample A and the creativity index scores of subsample D (H_0: $\mu_A \neq \mu_D$); (d) there was no statistically significant difference between the creativity index scores of subsample B and the creativity index scores of subsample C (H_0: $\mu_B \neq \mu_C$); (e) there was no statistically significant difference between the creativity index scores of subsample B and the creativity index scores of subsample D (H_0: $\mu_B \neq \mu_D$); and (f) there was no relationship between the creativity index scores of subsample C and the creativity index scores of subsample D (H_0: $\mu_C \neq \mu_D$). Most importantly, a *t*-test for independent means was conducted on the combination of subsamples A and C, representing all subjects enrolled in fine arts courses, and subsamples B and D, representing all the subjects not enrolled in fine-arts courses (H_0: $\mu_{A+C} \neq \mu_{B+D}$).

When the *t*-test was completed, a *t*-value was calculated. According to Bluman (2010), the *t*-value was calculated by using the formula (p. 480),

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Once the *t*-value was calculated using the formula, a *p*-value was found using Table F from Bluman (2010). If the *p*-value was less than .05 ($p < .05$), indicating a statistically significant difference, then the null hypothesis was rejected (Bluman, 2010).

In the comparison of creativity index scores of subsample A, those enrolled in IB DP curriculum and fine arts courses, to subsample B, those enrolled in IB DP but not fine arts courses, by age in a *t*-test, the *t*-value was 2.549 ($t = 2.549$) and the *p*-value, .009 ($p = .009$). This result was found to be significant with $p < .05$. Comparing the same to subsamples by grade, the *t*-value was 2.516 ($t = 2.516$) and the *p*-value was .009 ($p =$

.009), which produced a statistically significant difference with $p < .05$. The null hypothesis for the comparison of IB/fine arts subjects and IB/non-fine arts students was rejected because the result was a statistically significant difference.

The comparison of creativity index scores by age of subsample A and subsample C, not enrolled in IB DP curriculum but enrolled in fine arts courses, was calculated using the *t*-test to determine the *t*-value was .318 ($t = .318$) and the *p*-value was .376 ($p = .376$). The test produced a result that is not a statistically significant difference at $p < .05$. The same two groups compared by grade had a *t*-value of .366 ($t = .366$) and a *p*-value of .359 ($p = .359$), again producing a result that was not a statistically significant difference at $p < .05$. The null hypothesis comparing IB/fine arts subjects with non-IB/fine arts subjects was not rejected because the results did not demonstrate a statistically significant difference.

The comparison of creativity index scores by age of subsample A and subsample D, not enrolled IB DP curriculum or fine arts courses, had a *t*-value of .535 ($t = .535$) and a *p*-value of .299 ($p = .299$). The result was not a statistically significant difference ($p < .05$). The same two groups compared by grade had a *t*-value of .388 ($t = .388$) and a *p*-value of .351 ($p = .351$). The result for the comparison by grade was also not a statistically significant difference ($p < .05$). The null hypothesis for the comparison of IB/fine arts subjects and non-IB/non-fine arts subjects was not rejected because the results did not demonstrate a statistically significant difference.

The comparison of creativity index scores by age of subsample B and subsample C had a *t*-value of 2.260 ($t = 2.260$) and a *p*-value of .017 ($p = .017$). The test had a result that was a statistically significant difference ($p < .05$). The same two groups compared by

grade had a *t*-value of 2.302 ($t = 2.302$) and a *p*-value of .015 ($p = .015$). The result of the comparison by grade was also a statistically significant difference at $p < .05$. The null hypothesis for the comparison of non-IB/non-fine arts subjects and non-IB/fine arts students was rejected because the result was a statistically significant difference.

The comparison of creativity index scores by age of subsample B and subsample D had a *t*-value of 2.176 ($t = 2.176$) and a *p*-value of .021 ($p = .021$). The produced result was a statistically significant difference ($p < .05$). The same two groups compared by grade had a *t*-value of 2.267 ($t = 2.267$) and a *p*-value of .017 ($p = .017$). The result of the comparison of subsample B and D by grade was a statistically significant difference at $p < .05$. The null hypothesis for the comparison of IB/non-fine arts subjects and non-IB/non-fine arts subjects was rejected because the result was a statistically significant difference.

The final comparison of creativity index scores by age for individual subsamples was between subsample C and subsample D. The *t*-value was .695 ($t = .695$) and the *p*-value was .247 ($p = .247$). The test results were not a statistically significant difference ($p < .05$). The same two subgroups compared by grade had a *t*-value of .632 ($t = .632$) and a *p*-value of .267 ($p = .267$). The results of the comparison of creativity index scores by grade were not a statistically significant difference ($p < .05$). The null hypothesis for the comparison of non-IB/fine arts and non-IB/non-fine arts was not rejected because the results did not indicate a statistically significant difference.

In order to answer the first research question and to compare the subsamples by affiliation to enrollment in fine arts courses, subsamples A and C ($n_{A+C} = 29$) were grouped together to represent those subjects enrolled in fine arts courses, and subsamples

B and D ($n_{B+D} = 22$) were grouped together to represent those subjects not enrolled in fine arts courses. The *t*-test for independent means between these combination subsamples had a *t*-value of 2.185 ($t = 2.185$) and a *p*-value of .0168 ($p = .0168$). The results were considered a statistically significant difference ($p < .05$). The null hypothesis for research question one was rejected, because according to the results from *t*-test for independent means a statistically significant difference was present.

In summary, statistically significant differences were present between several subsamples (see Table 1). The subsamples comprised of IB fine arts subjects compared to IB non-fine arts subjects had a statistically significant difference. This result also occurred when non-IB fine arts subjects were compared with IB non-fine arts students and when all fine arts students were compared with all non-fine arts students. In addition, there was a statistically significant difference between the subgroups of subjects who were not enrolled in fine arts courses. The comparisons of these subgroups using the *t*-test for independent means provided information concerning the differences, but not the direction of the differences.

Table 1

Results of the t-test

		n	*t*	*p*
Subsamples A & B	Age	28	2.549	.009
	Grade	28	2.516	.009
Subsamples A & C	Age	29	.318	.376
	Grade	29	.366	.359
Subsamples A & D	Age	26	.535	.299
	Grade	26	.388	.351
Subsamples B & C	Age	25	2.260	.017
	Grade	25	2.302	.015
Subsamples B & D	Age	22	2.176	.021
	Grade	22	2.267	.017
Subsamples C & D	Age	23	.695	.247
	Grade	23	.632	.267
Subsamples A + C	Age	51	2.185	.017
and B + D	Grade	51	2.113	.020

Note. n = number of subjects in a subsample, t = result from the t-test, p = probability value of getting a sample statistic in the direction of the alternative hypothesis ($p < .05$).

Analysis of variance (ANOVA). A wider margin of error can occur when conducting seven *t*-tests on the data to compare groups (Bluman, 2010). Furthermore, "the more *t*-tests that are conducted, the greater is the likelihood of getting significant

difference by chance alone" (Bluman, 2010, p. 602). Because four of the *t*-tests for independent means conducted had statistically significant results, an additional test was added to the analysis. The ANOVA uses an *F* test "to test a hypothesis concerning the means of three or more populations" (Bluman, 2010, p. 602). The ANOVA was conducted to compare the variance between means of subsamples, within means of subsamples, and for the total sample (Bluman, 2010). According to Bluman (2010), "Even though you are comparing three or more means in this use of the *F* test, variances are used in the test instead of means" (p. 603).

The use of the ANOVA test allowed the creativity indices of all four subsamples within the sample to be compared at one time (Bluman, 2010). The results of the ANOVA test were an *F*-value of 2.11 ($F = 2.11$) with confidence level of .05 ($\alpha = .05$). The degrees of freedom were 3 for the numerator ($d.f.N. = k - 1 = 3$) and 47 for the denominator ($d.f.D. = n - k = 47$). The *F*-value resulted in a *p*-value of .888 ($p\ (F \leq .888)$). The *p*-value was the probability of the score results being 2.11 or lower if there was no difference in the subsamples. The *p*-value of interest was the probability of a score of 2.11 or higher in order to reject the null hypothesis. The rules of probability were used to find $p\ (F \geq 2.11) = 1 - p\ (F \leq 2.11) = 1 - .8884128 = .1117$, which indicated there was an 11.17% chance of getting a test statistic of 2.11 or further from the null hypothesis concept if the null hypothesis was not rejected. A statistic of 11.17% was not a low enough percentage, so the null hypothesis would not be rejected.

Similarly, the ANOVA test was run on the creativity index scores by grade and revealed an *F*-score of 2.54 ($F = 2.54$) and a *p*-value of .93 ($p\ (F \leq .93)$). Again, the rules of probability were used to find $p\ (F \geq 2.54) = 1 - p\ (F \leq 2.54) = 1 - .93 = .07$, which

indicated there was a 7% chance of getting a test statistic of 2.54 or further from the null hypothesis if the null hypothesis was not rejected. As 7% was even lower than the percentage for creativity index by age, the null hypothesis would again not be rejected.

The ANOVA test and the *t*-test for independent means did not support the same conclusion; however, the tests were used to compare the sample in different ways. The ANOVA compared the subsamples within the total sample at the same time, and the *t*-test was used to target specific combinations of subsamples. The *t*-test results were used to support the decision to reject the null hypothesis of the first research question.

Stage Three: Additional Achievement Scores Compared to Creativity Index Scores

Stage three of research involved an analysis of data in order to determine whether a relationship existed between the creativity index scores of the students and additional academic measures of grade point average (GPA) and ACT scores (Lai & Viering, 2012; Rosen & Tager, 2013). Both ACT and GPA were compared to the creativity index score and analyzed using the Pearson *r*. The Pearson *r* was the appropriate test, in this case, because it "measures the strength and direction of a linear relationship between two variables" (Bluman, 2010, p. 533). The two variables were the creativity index score from the TTCT and the subject's ACT or GPA.

Grade point average. In the school from which the sample was recruited, students in the IB DP were generally graded on a 5.00 GPA, whereas students who were not enrolled in IB DP could take a variety of courses with a weighted grade point average of 5.00 and with a non-weighted grade point average of a 4.00. The subjects in the total sample ($N = 51$) had a GPA range of 1.76 to 5.00 (5.00 - 1.76 = 3.24). The mean GPA of

the sample was 3.92 ($\bar{x}$ = 3.92). The mode was 4.98 for the sample, and the median GPA was 4.05 (*Mdn* = 4.05). The standard deviation for the sample was .92 (*sd* = .92).

The GPA data were analyzed in relationship to the subsamples. The first group, subsample A (n_A = 16), had a GPA range from 3.02 to 5.00 (5.00 - 3.02 = 1.98). The mean GPA for subsample A was 4.41 ($\bar{x}$ = 4.41). The most frequently-counted GPA was 4.98, and the median GPA was 4.61 (*Mdn* = 4.61). The standard deviation was .66 for subsample A (*sd* = .66).

Subsample B (n_B = 12) had a GPA range from 3.89 to 5.00 (5.00 - 3.89 = 1.11). The mean for subsample B was 4.66 ($\bar{x}$ = 4.66). The most frequently-counted GPA was 5.00, and the median was 4.87 (*Mdn* = 4.87). The standard deviation was .41 for this subsample (*sd* = .41).

Subsample C (n_C = 13) had a GPA range from 1.76 to 4.16 (4.16 - 1.76 = 2.38). The mean for subsample C was 3.22 ($\bar{x}$ = 3.22). There was no GPA that appeared more than once in subsample C. The median was a 3.28 GPA (*Mdn* = 3.28). The standard deviation was .59 for this subsample (*sd* = .59).

The final subsample, D (n_D = 10), had a GPA range from 2.19 to 4.64 (4.64 - 2.19 = 2.45). The mean for subsample D was 3.13 ($\bar{x}$ = 3.13). No mode was counted in subsample D. The median was a 3.11 GPA (*Mdn* = 3.11), and the standard deviation was .84 for this subsample (*sd* = .84).

Using the Pearson *r*, the GPA and creativity index scores of the subjects were analyzed to discover whether a relationship existed, and if so, the strength of the relationship between the variables (Bluman, 2010; Fraenkel et al., 2012). Both creativity

index scores by age and by grade were used in the analysis of data. There were minor differences between the results by age and by grade.

When comparing the GPA and the creativity index score by age, the total sample ($N = 51$) had a positive relationship ($r = .280$); however, the relationship was determined to be weak as the relationship moved closer to zero (Stangroom, 2014). The p-value of .047 ($p = .047$) was determined to be statistically significant at $p < .05$. Similarly, the r-value of the total sample by grade was determined to have a positive relationship ($r = .284$). The relationship was again determined to be weak, because the nearer r was to zero, the weaker the relationship (Stangroom, 2014). The p-value ($p = .043$) indicated the results were statistically significant at $p < .05$.

The total sample ($N = 51$) had a positive relationship ($r = .284$) for creativity index score by grade and grade point average; however, the relationship was determined to be weak because the closer to zero, the weaker the relationship (Stangroom, 2014). The p-value of .0433 ($p = .0433$) was determined to be statistically significant ($p < .05$). Similarly, the r-value of the total sample by grade was determined to have a positive relationship ($r = .284$). The relationship was determined to be a weak relationship because the nearer r was to zero, the weaker the relationship became (Stangroom, 2014). The p-value ($p = .043$) indicated the results were statistically significant ($p < .05$). The results were contrasted with those produced in the Rosen and Tager (2013) study, which determined there was a strong negative relationship among GPA, English Language Arts scores, and creativity index score.

The following scatter plots (see Figures 11 and 12) were created to demonstrate visually the strength of the relationship between the creativity index score and GPA. If

the relationship was a positive linear relationship, the scatter plot created by age and by grade should have resulted in rising creativity index scores as the GPA also rose (Bluman, 2010). Neither scatter plot displayed a strong linear relationship between the variables.

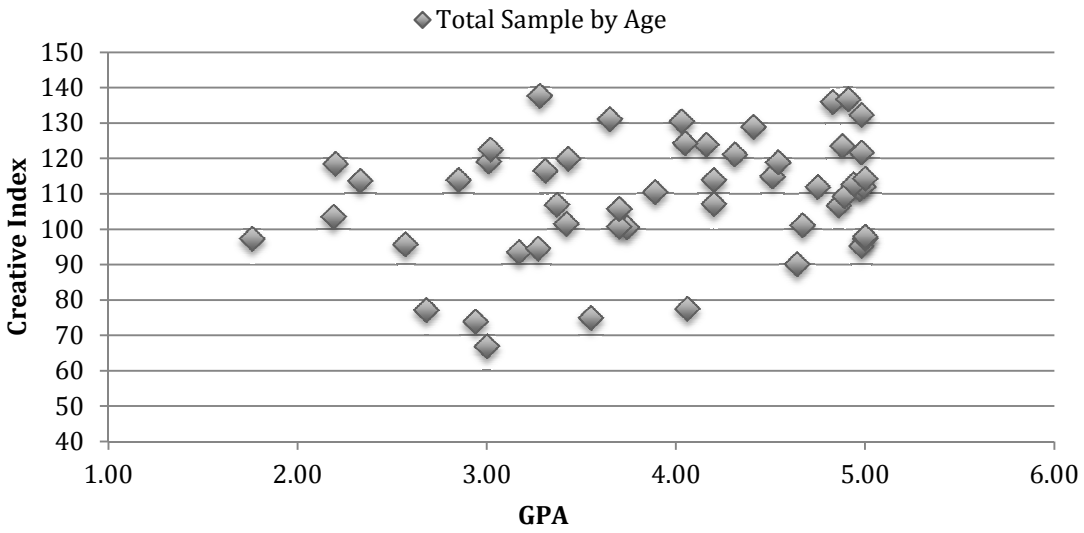


Figure 11. Scatter plot of total sample: Creativity index score by age & GPA.

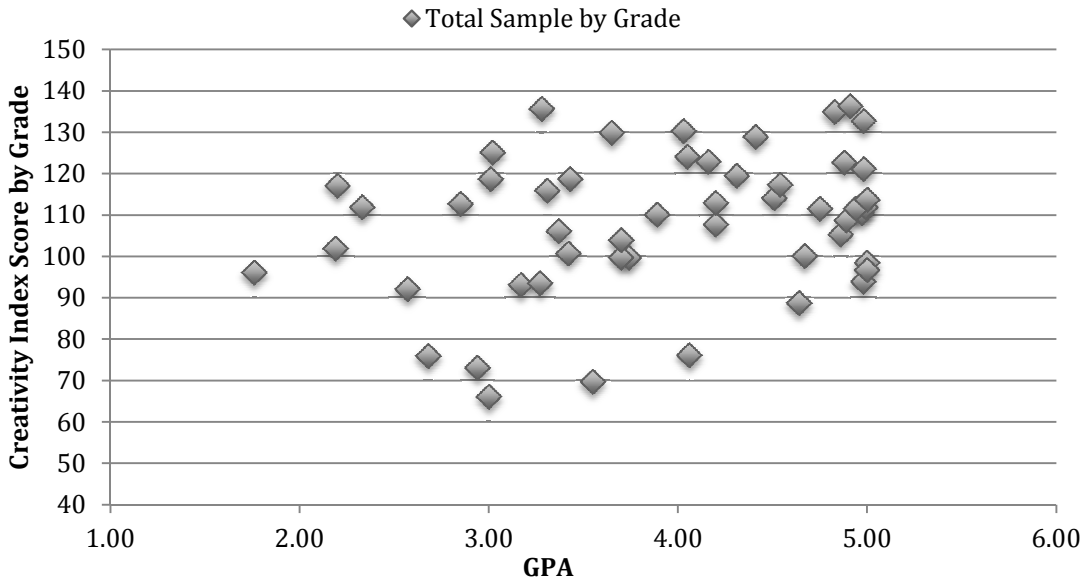


Figure 12. Scatter plot of total sample: Creativity index score by grade & GPA.

Subsample A ($n_A = 16$) had a positive relationship ($r = .282$) for creativity index score by age and GPA; however, the relationship was determined to be weak as the *r*-value was closer to zero, indicating a weaker relationship (Stangroom, 2014). The *p*-value of .290 ($p = .290$) was determined not to be statistically significant at $p < .05$. Similarly, the *r*-value of subsample A using creativity index by grade was determined to have a positive relationship ($r = .243$). The relationship was again determined to be weak between the variables because of how near *r* was to zero (Stangroom, 2014). The *p*-value ($p = .364$) was not statistically significant ($p < .05$).

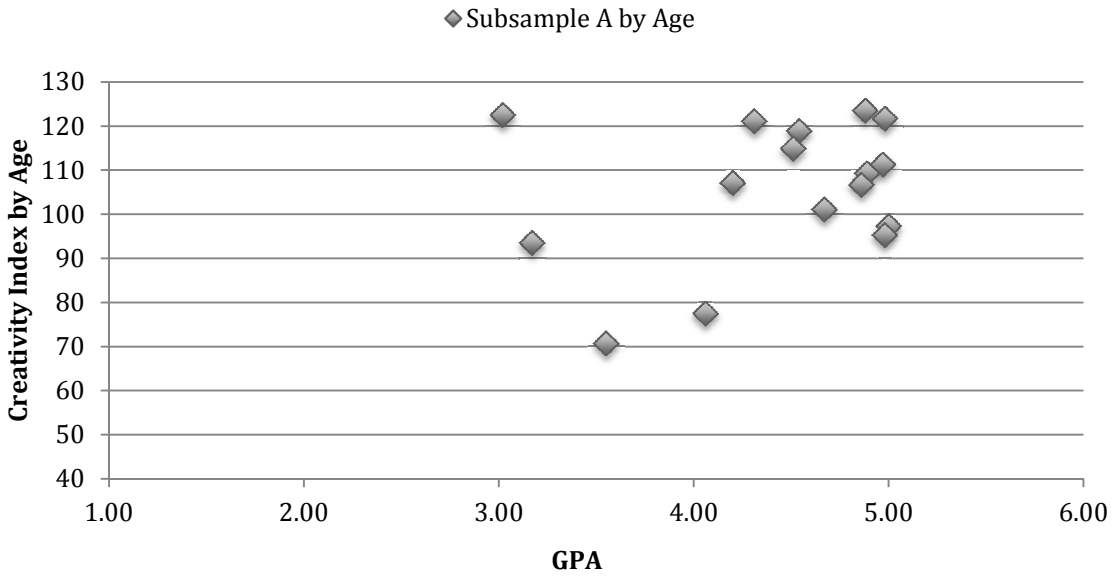


Figure 13. Scatter plot of subsample A: Creativity index score by age & GPA.

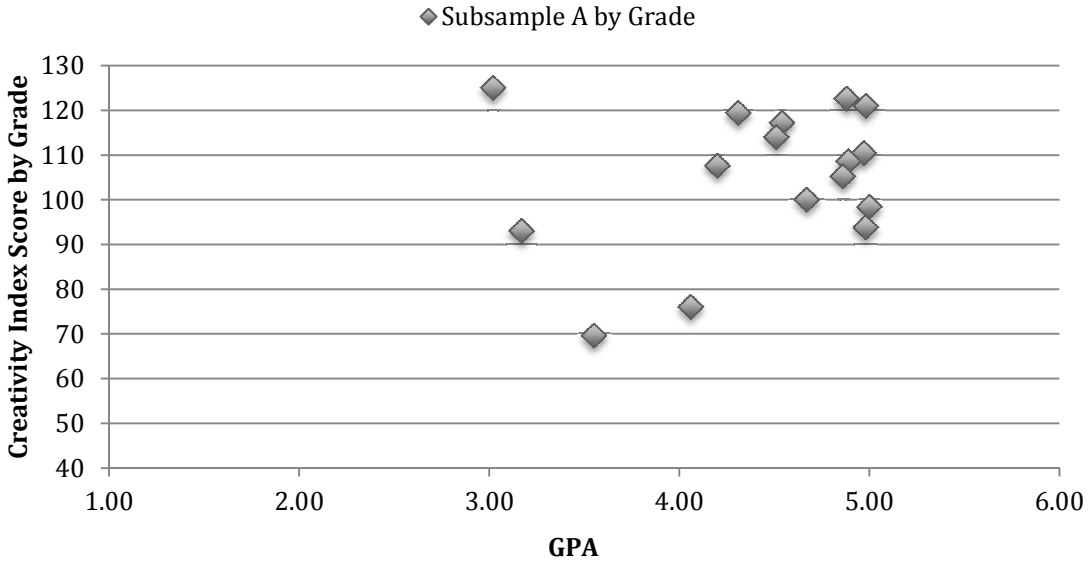


Figure 14. Scatter plot of subsample A: Creativity index score by grade & GPA.

Subsample B (n_B = 12) had a negative relationship (r = -.037) for creativity index score by age and GPA; however, the relationship was determined to be weak as the r-value was close to zero (Stangroom, 2014). The p-value of .904 (p = .904) was determined not to be statistically significant ($p < .05$). Similarly, the r-value of subsample

B, using creativity index by grade, was determined to have a negative relationship (r = -.048). The relationship was determined to be weak between the variables because the nearer r was to zero, the weaker the relationship (Stangroom, 2014). The p-value (p = .879) was not statistically significant at $p < .05$.

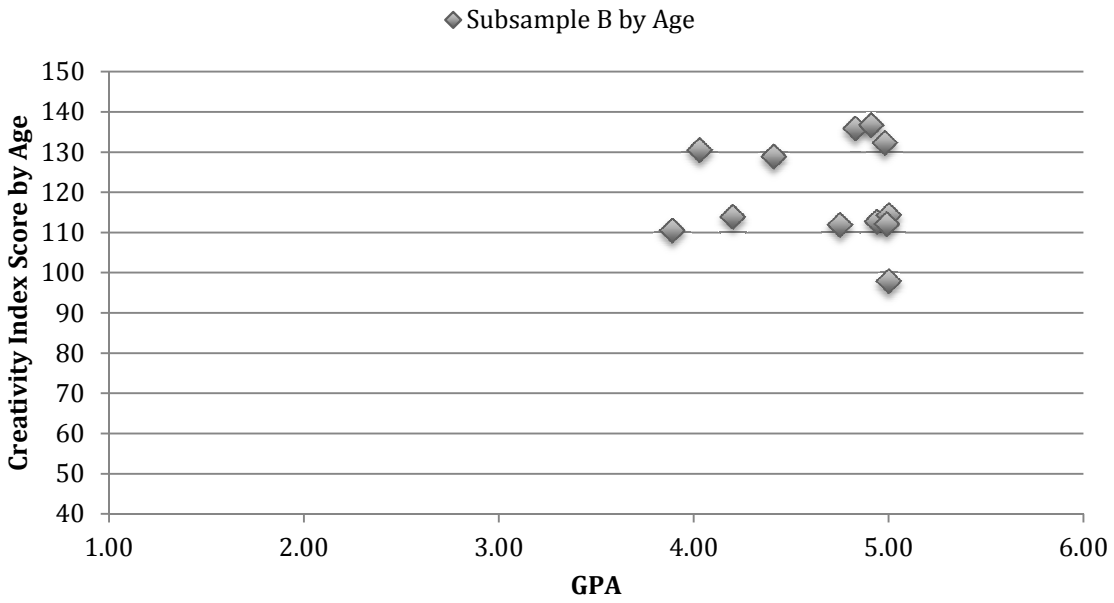


Figure 15. Scatter plot of subsample B: Creativity index score by age & GPA.

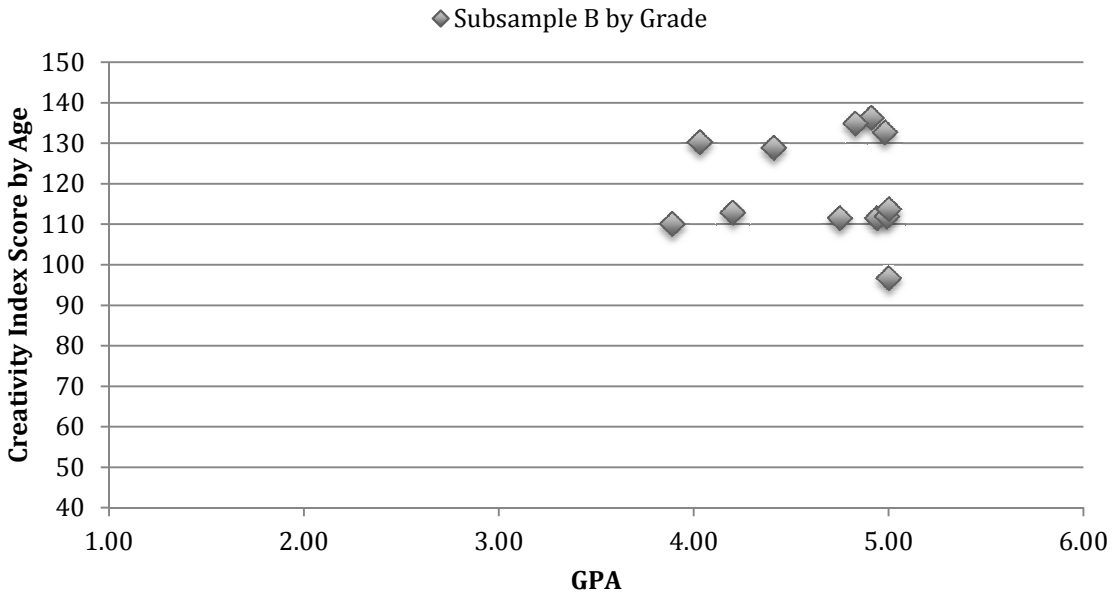


Figure 16. Scatter plot of subsample B: Creativity index score by grade & GPA.

Subsample C (n_C = 13) had a positive relationship (r = .432) for creativity index score by age and grade point average; however, the relationship was determined weak as the r-value was close to zero (Stangroom, 2014). The p-value of .285 (p = .285) was determined not to be statistically significant ($p < .05$). Similarly, the r-value of subsample C, using the creativity index by grade, was determined to have a positive relationship (r = .445). The relationship was determined to be a weak relationship between the variables because the nearer r was to zero, the weaker the relationship (Stangroom, 2014). The p-value (p = .128) was not statistically significant at $p < .05$.

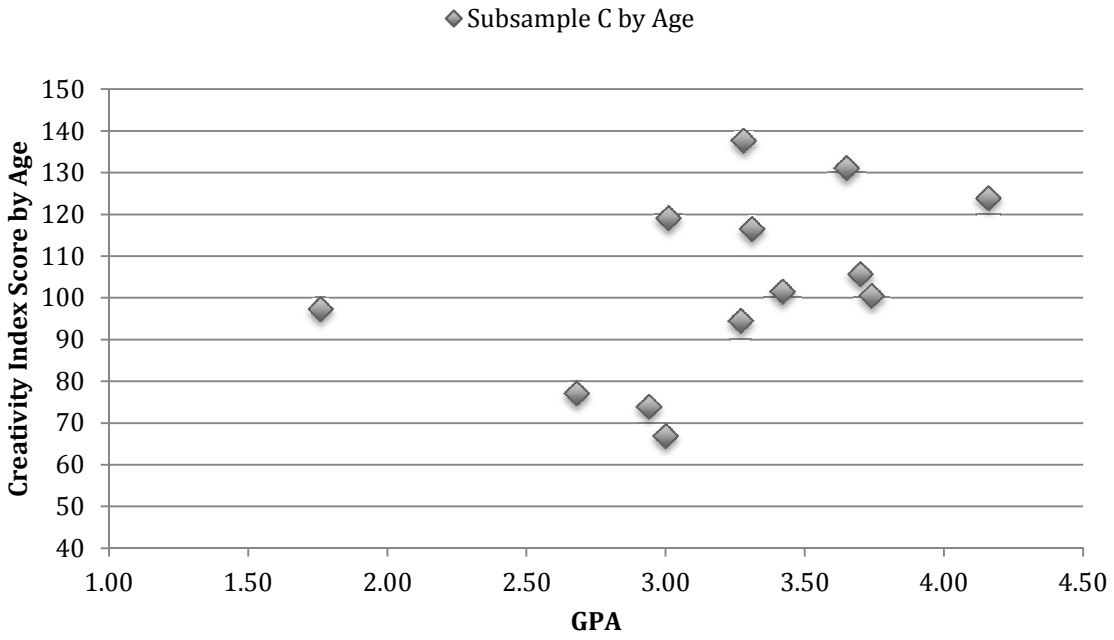


Figure 17. Scatter plot of subsample C: Creativity index score by age & GPA.

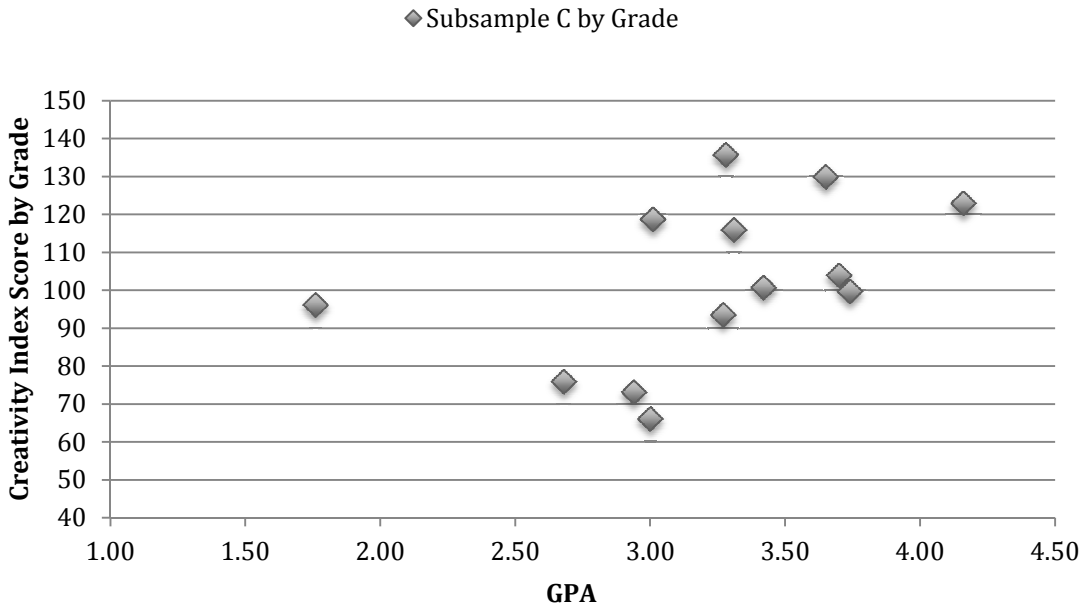


Figure 18. Scatter plot of subsample C: Creativity index score by grade & GPA.

Subsample D (n_D = 10) had a negative relationship (r = -.208) for the creativity index score by age and grade point average; however, the relationship was determined to

be weak (Stangroom, 2014). The *p*-value of .566 ($p = .566$) was determined not to be statistically significant ($p < .05$). Similarly, the *r*-value of subsample D using creativity index by grade was determined to have a negative relationship ($r = -.160$). The relationship was determined to be a weak relationship between the variables, because the nearer *r* was to zero, the weaker the relationship (Stangroom, 2014). The *p*-value ($p = .661$) was not statistically significant at $p < .05$.

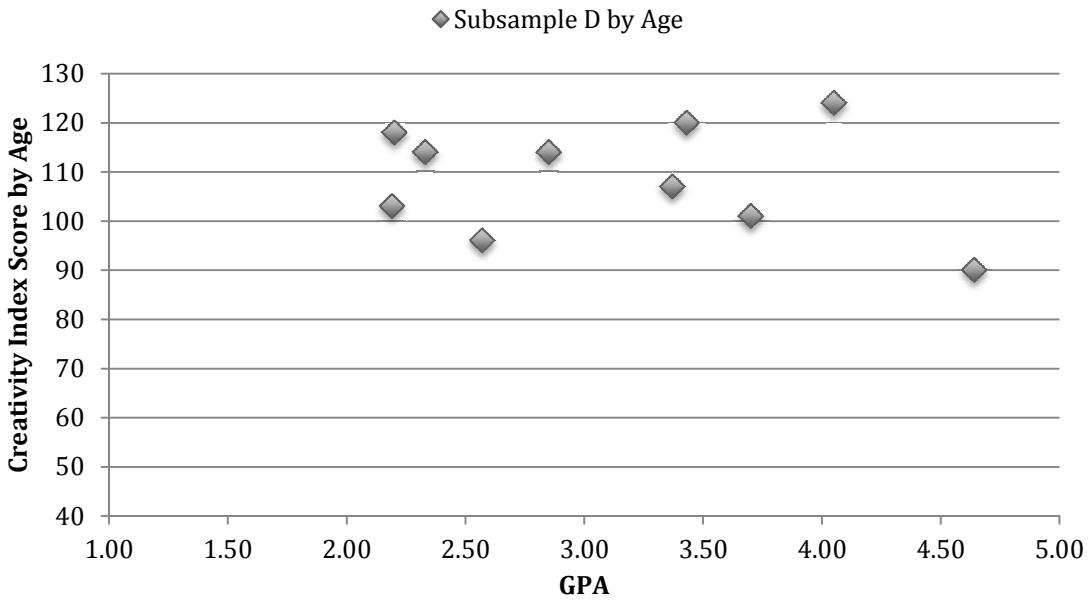


Figure 19. Scatter plot of subsample D: Creativity index score by age & GPA.

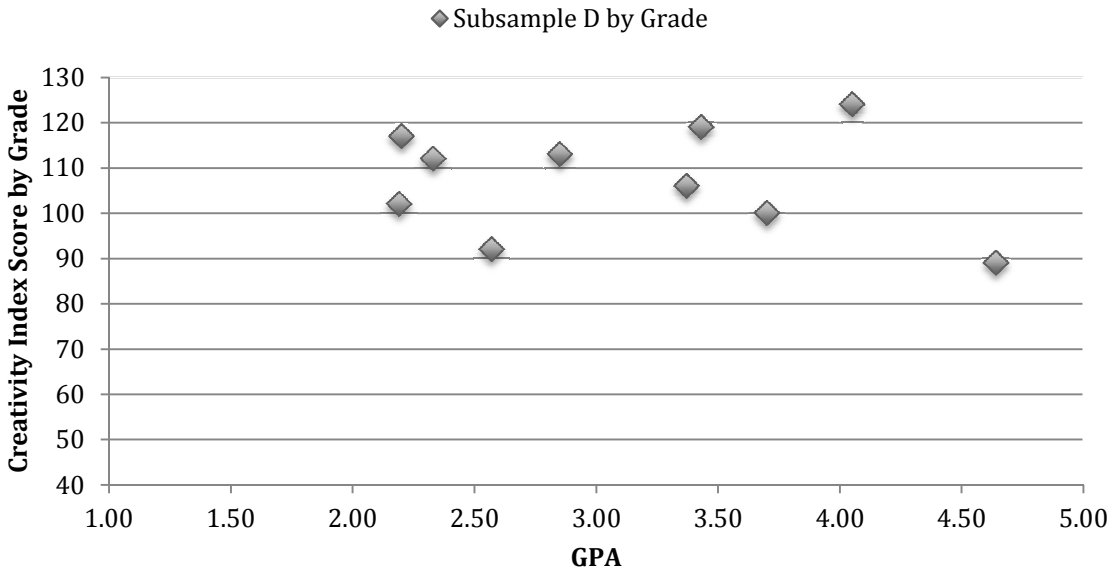


Figure 20. Scatter plot of subsample D: Creativity index score by grade & GPA.

The purpose of breaking the data into the subsamples was to allow analysis to be conducted on multiple variables. In order to address the second research question about the relationship between achievement data (ACT and GPA) and the creativity index scores from the Torrance Test of Creative Thinking, the subsamples were also combined by using subjects enrolled in fine arts courses. The first combination included subsample A and subsample C, representing the subjects currently enrolled in fine arts courses. The second combination was comprised of subsample B and subsample D, representing the subjects not currently enrolled in fine arts courses.

Subsamples A and C ($n_{A+C} = 29$) had a weak positive relationship between the variables of the creativity index score by age and GPA ($r = .296$). The p-value was .119 ($p = .119$). The results were not statistically significant at $p < .05$ (Stangroom, 2014). Similarly, a weak positive relationship was found between the variables of creativity index score by grade and GPA ($r = .2462$). The p-value for this relationship was .198 ($p =$

.198), which indicated the results were not statistically significant at $p < .05$ (Stangroom, 2014).

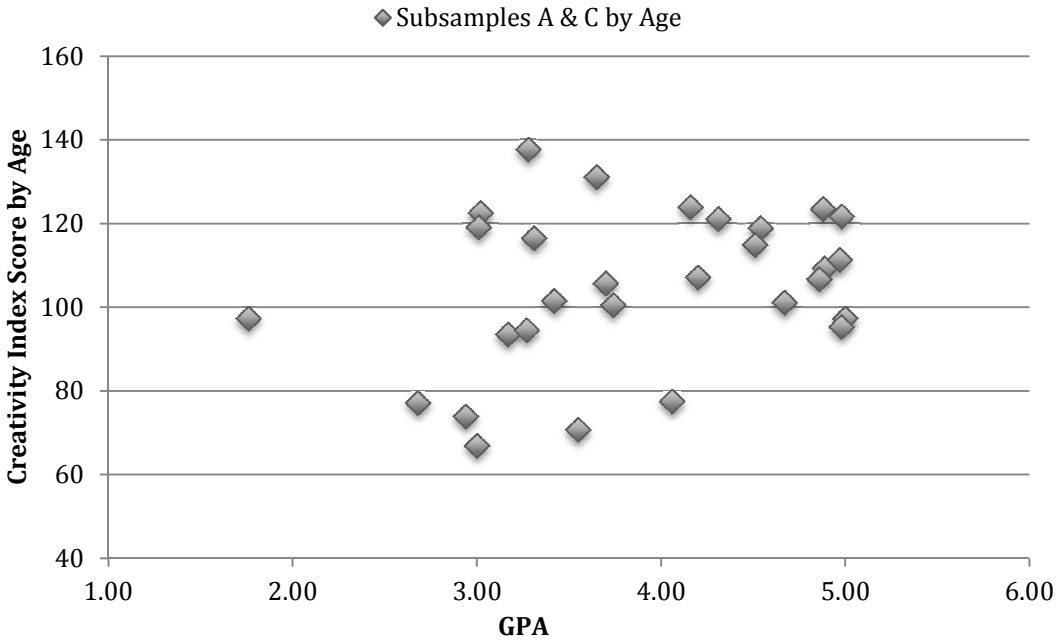


Figure 21. Scatter plot of subsamples A & C: Creativity index score by age & GPA.

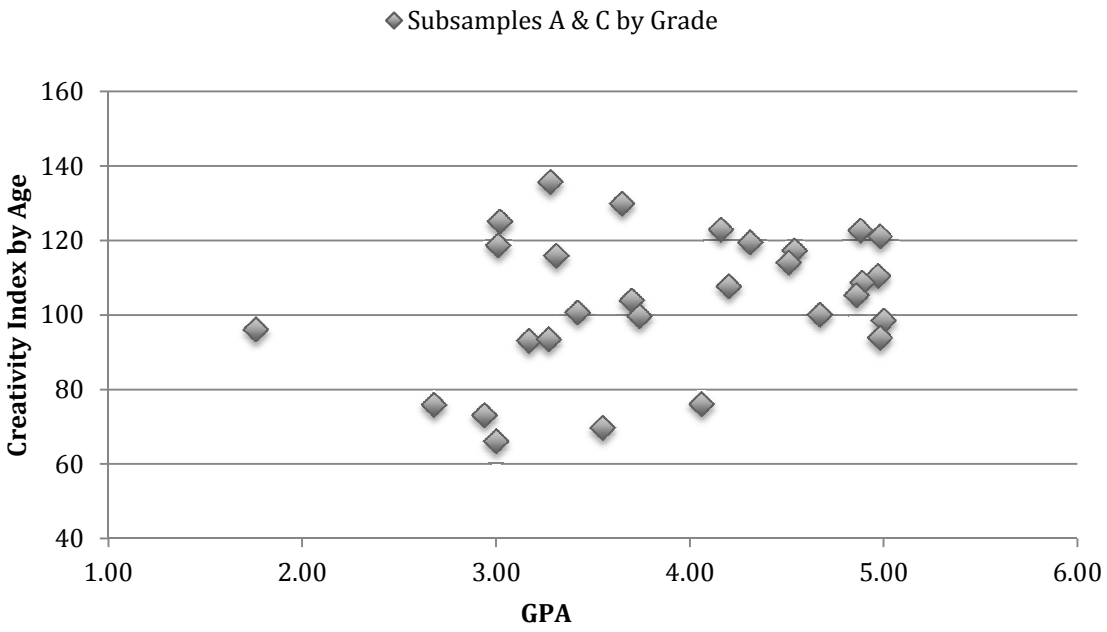


Figure 22. Scatter plot of subsamples A & C: Creativity index score by grade & GPA.

Subsamples B and D (n_{B+D} = 22) had a weak positive relationship between the variables of the creativity index score by age and GPA (r = .268). The p-value was .227 (p = .227). The results were not statistically significant at p < .05. Similarly, a weak positive relationship was found between the variables of creativity index score by grade and GPA (r = .355). The p-value for this relationship was .105 (p = .105). The results were not statistically significant at p < .05 (Stangroom, 2014).

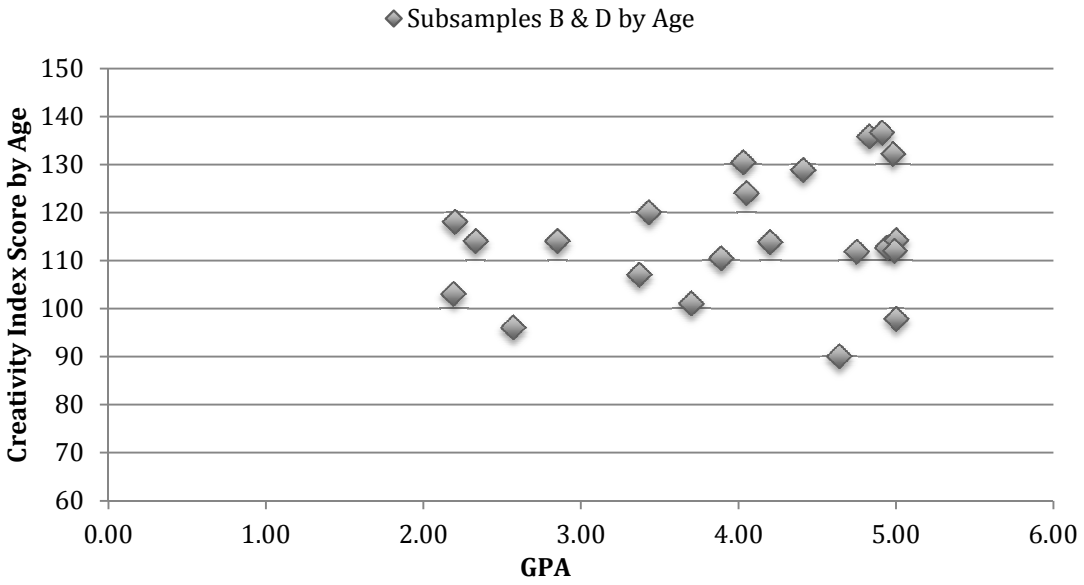


Figure 23. Scatter plot of subsamples B & D: Creativity index score by age & GPA.

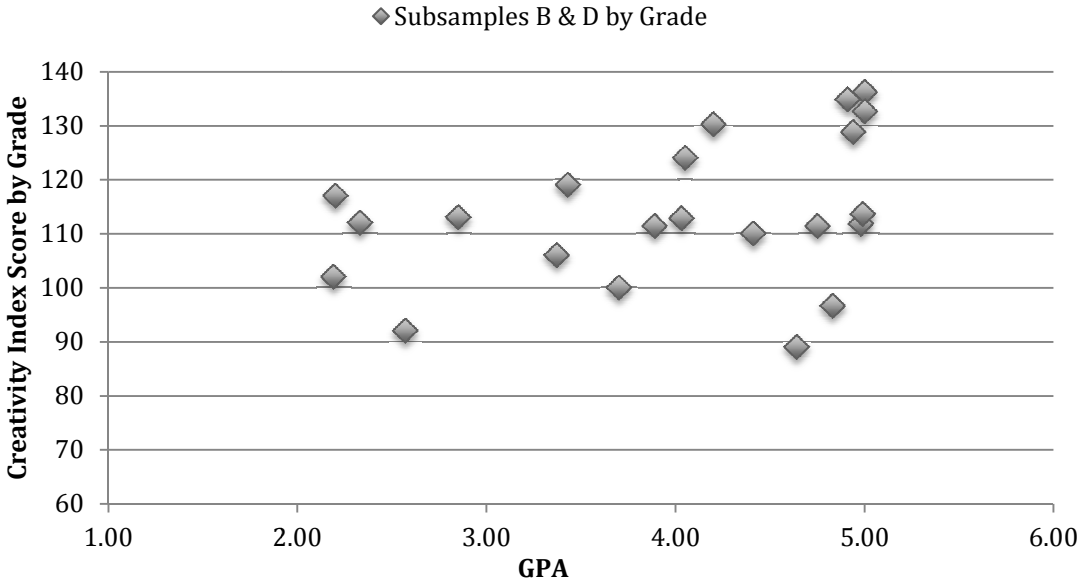


Figure 24. Scatter plot of subsamples B & D: Creativity index score by grade & GPA.

In the table (see Table 2), the findings from the Pearson *r* and the relationships between the variables of the creativity index score and GPA are summarized. The *r*-value is the sample correlation coefficient (Bluman, 2010). The r^2 value is the coefficient of determination (Bluman, 2010). The *p*-value is the probability value (Bluman, 2010). The

probability value is a resource for calculating the probability of getting a sample statistic in the direction of the alternative hypothesis (Stangroom, 2014).

Table 2

Pearson r Results between Creativity Index Score and GPA

		n	*r*	r^2	*p*-value
Total Sample	Age	51	.280	.078	.047
	Grade	51	.284	.081	.043
Subsample A	Age	16	.282	.079	.290
	Grade	16	.243	.059	.364
Subsample B	Age	12	-.037	.001	.904
	Grade	12	-.048	.002	.879
Subsample C	Age	13	.443	.187	.285
	Grade	13	.445	.198	.128
Subsample D	Age	10	-.208	.043	.566
	Grade	10	-.1596	.026	.661
Fine arts (A & C)	Age	29	.296	.088	.119
	Grade	29	.246	.084	.198
Non-fine arts (B & D)	Age	22	.268	.072	.227
	Grade	22	.355	.126	.105

Note. n = number of subjects in the sample or subsample, r = correlation coefficient, r^2 = the coefficient of determination, and p = the probability value.

Although the results of the statistical tests showed a positive relationship between the variables in most cases, the relationship was weak in all cases except the relationship between GPA and the total sample. The subjects enrolled in fine arts courses had a weak positive relationship between GPA and creativity index scores regardless of the enrollment in IB courses. The subjects not enrolled in fine arts courses had a weak negative relationship between GPA and creativity index scores regardless of the enrollment in IB courses; however, when students from these two subsamples (B and D) were combined together, the results indicated a weak positive relationship. Although the total sample had a statistically significant positive relationship between the variables, the null hypothesis proposed by the second research question to address the relationship between GPA and creativity index scores cannot be rejected because the subsamples did not have statistically significant results.

ACT Scores. According to ACT, Inc. (2007), the "ACT program is a comprehensive system of data collection, processing, and reporting designed to help high school students develop postsecondary educational plans and to help postsecondary educational institutions meet the needs of their students" (p. 13). The ACT is used to provide standardized scores of academic achievement (ACT, Inc., 2007). In addition, the ACT is used as a measure for millions of students across the nation (ACT, Inc., 2007). Kim (2006) suggested the appropriateness of using multiple measures of achievement, such as the ACT, in addition to the creativity index score generated by the TTCT when measuring creativity. Rosen and Tager (2013) proposed "adding the creative measures to other measures of analytical and practical measures roughly doubled the predictive value of the SAT for the sample in predicting grades for first-year college students" (pp. 7-8).

Since the SAT is another standardized achievement test similar in nature to the ACT, the data from the ACT was substituted as an achievement test for this study. The second research question of the study was developed to determine if similar results would occur with the ACT as reported the Rosen and Tager (2013) study, which originally cited the use of the SAT.

To answer the second research question, additional academic achievement data were compared to the creativity index scores of the TTCT to determine whether a relationship existed between the variables. Data in this area were limited due to several factors. Not all subjects in the study had participated in the ACT during their junior or senior years, because the students were either a) not on a college path after high school or b) the student was in 11th grade and would be tested after the study was concluded. Subsample D was limited in this area, because only two subjects had participated in the ACT prior to the completion of this study.

As a total sample, 34 subjects out of 51 (N - *17* = 34) took the ACT and received a score prior to the completion of the study. In subsample A, 13 out of 16 subjects had taken the ACT (n_A - *3* = 13). In subsample B, 11 out of 12 subjects had taken the ACT (n_B - *1* = 11). In subsample C, seven out of 13 subjects (n_C - *6* = 7) had taken the ACT. Finally, in subsample D, only two out of 10 subjects (n_D - *8* = 2) had taken the ACT. Those in the total sample (N - *17* = 34) who had taken the ACT had a range of scores from 14 to 34 (34 - 14 = 20). The mean score for the total sample was 27.12 ($\bar{x}$ = 27). The mode score was 29, and the median score was 28 (*Mdn* = 28). The standard deviation for the sample was 4.91 *(sd* = 4.91).

The 13 subjects in subsample A (n_A - *3* = 13) who took the ACT had a range of scores between 23 and 33 (33 - 23 = 10). The mean ACT score for subsample A was 29 (x□ = 29). The mode was 31, and the median score was 30 (*Mdn* = 30). The standard deviation for subsample A was 3.48 (*sd* = 3.48).

The 11 subjects in subsample B (n_B - *1* = 11) who took the ACT had a range of scores between 21 and 34 (34 - 21 = 13). The mean score for subsample B was 29.45 ($\bar{x}$ = 29.45). The mode was 27, and the median score was 29 (*Mdn* = 29). The standard deviation for subsample B was 3.78 (*sd* = 3.78).

The seven subjects in subsample C (n_C - *6* = 7) who took the ACT had a range of scores between 14 and 29 (29 - 14 = 15). The mean score for subsample C was 21.5 ($\bar{x}$ = 21.5). No mode score occurred in subsample C. The median score was 29 (*Mdn* = 29). The standard deviation for subsample C was 4.76 (*sd* = 4.76).

The final subsample, D, had two subjects (n_D - *8* = 2) who had taken the ACT. The scores ranged between 23 and 24 (24 - 23 = 1). There was no mode for this subsample. The mean and median were both 23.50 ($\bar{x}$ = 23.50 and *Mdn* = 23.50). The standard deviation was .71 (*sd* = .71).

Similar to the analysis of GPA, the Pearson *r* was used to compare ACT scores to the creativity index scores of the subjects. The resulting data were analyzed to determine whether a relationship existed and to ascertain the strength of the relationship between the variables (Bluman, 2010). The scores were analyzed both by age and by grade; however, minimal differences existed between the results by age and by grade.

When comparing the ACT scores and the creativity index scores by age, the total sample, minus those subjects who had not taken the ACT (*N* - 17 = 34), had a positive

relationship (r = .246). The relationship was determined to be weak, as the closer the r-value was to zero, the weaker the relationship (Stangroom, 2014). The p-value of .081 (p = .081) was determined not to be statistically significant at $p < .05$. Similarly, the r-value of the total sample creativity index score by grade, minus those subjects who had not taken the ACT, was determined to have a positive correlation (r = .252). The relationship was determined to be weak, because the nearer r was to zero, the weaker the relationship (Stangroom, 2014). The p-value (p = .074) was also not statistically significant at $p < .05$.

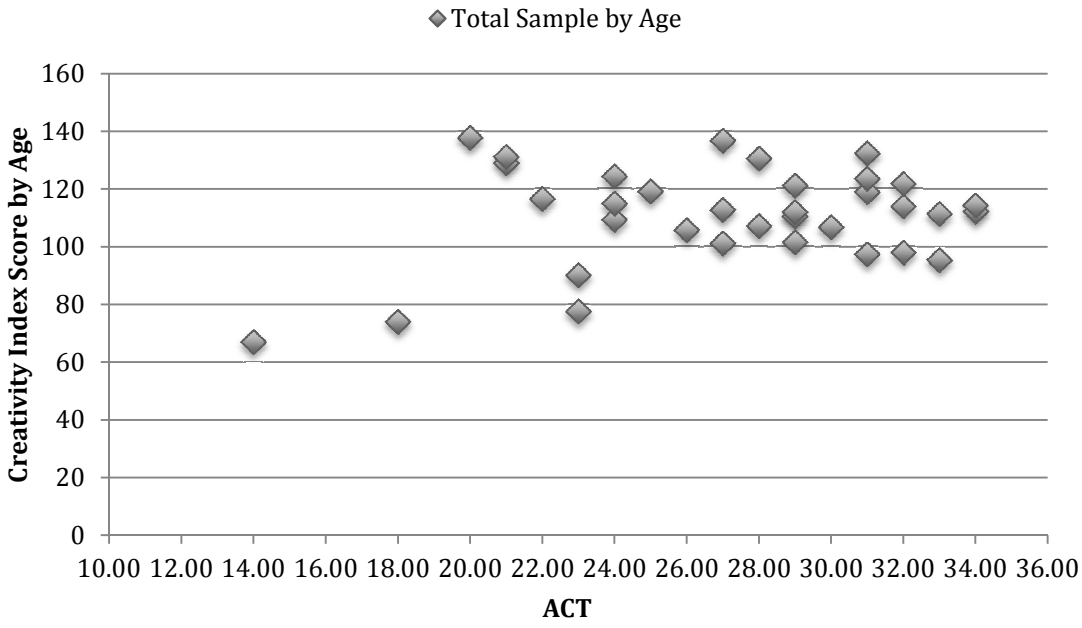


Figure 25. Scatter plot of total sample: Creativity index score by age & ACT.

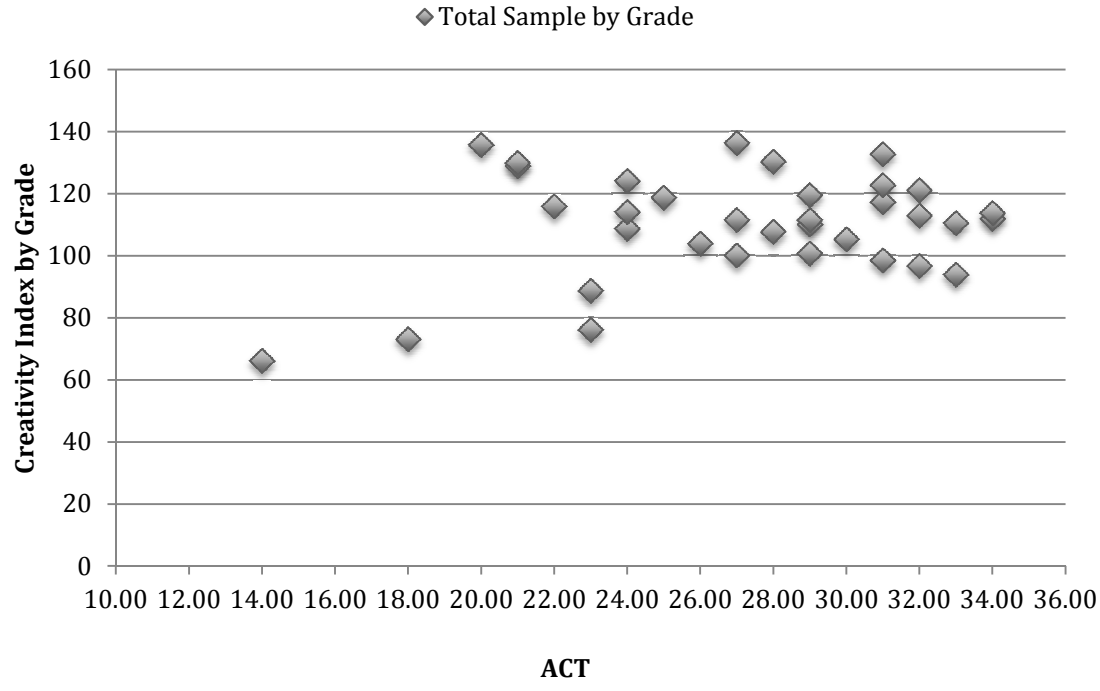


Figure 26. Scatter plot of total sample: Creativity index score by grade & ACT.

Subsample A (n_A - 3 = 13) had a positive relationship (r = .350) for creativity index scores by age and ACT. The relationship was determined to be weak (Stangroom, 2014). The p-value of .240 (p = .240) was determined not to be statistically significant (p < .05). Similarly, the r of subsample A using creativity index by grade was determined to have a positive relationship (r = .348). The relationship was a weak relationship because the nearer r was to zero, the weaker the relationship between the variables (Stangroom, 2014). The p-value (p = 0.244) was not statistically significant (p < .05).

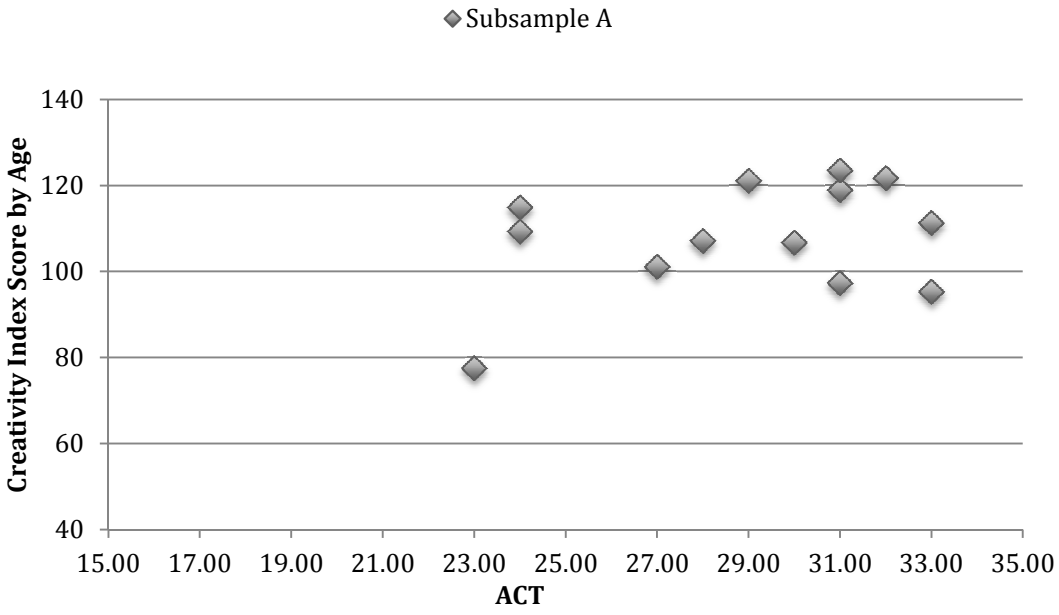


Figure 27. Scatter plot of subsample A: Creativity index score by age & ACT.

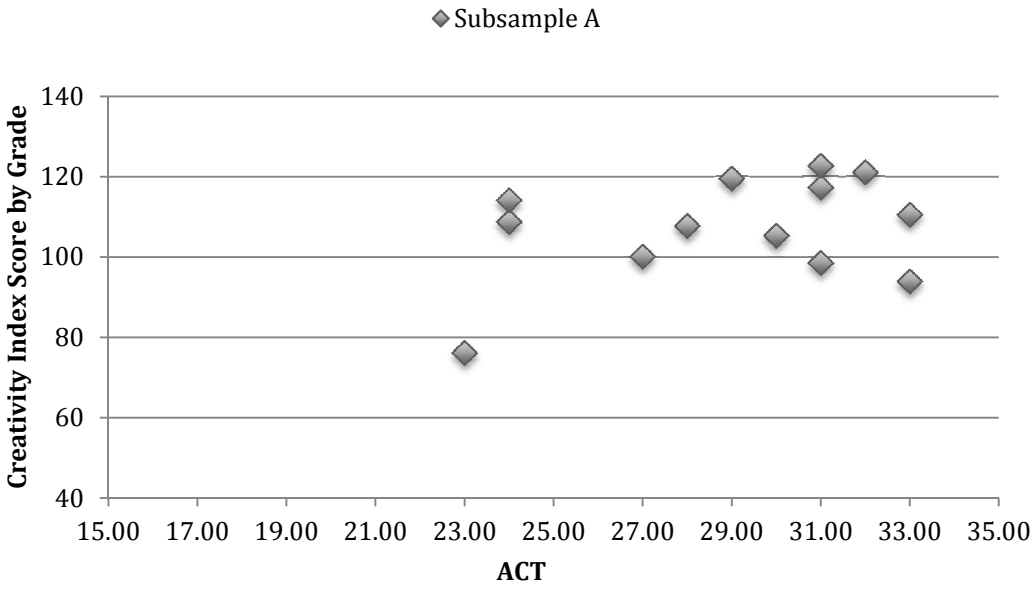


Figure 28. Scatter plot of subsample A: Creativity index score by grade & ACT.

Subsample B (n_B - 1 = 11) had a negative relationship (r = -.497) for creativity index scores by age and ACT; however, the relationship was determined to be weak, because the closer r was to zero, the weaker the relationship (Stangroom, 2014). The p-value of .100 (p = .100) was determined not to be statistically significant at $p < .05$. Similarly, the r of subsample B, using creativity index by grade, had a negative relationship (r = -.475). The relationship was weak, because the nearer r was to zero, the weaker the relationship between the variables (Stangroom, 2014). The p-value (p = .119) was not statistically significant ($p < .05$).

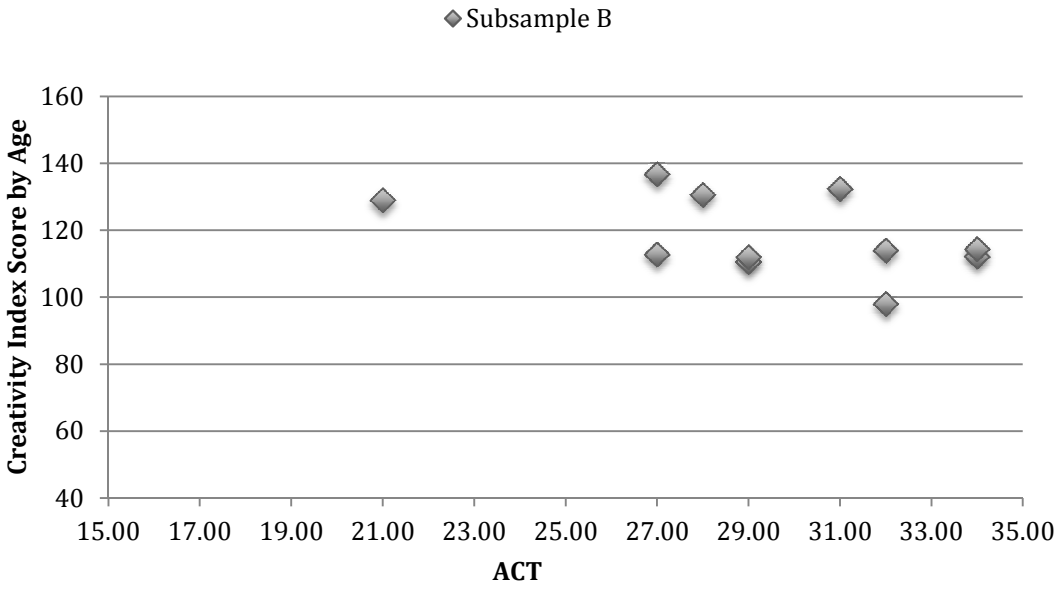


Figure 29. Scatter plot of subsample B: Creativity index score by age & ACT.

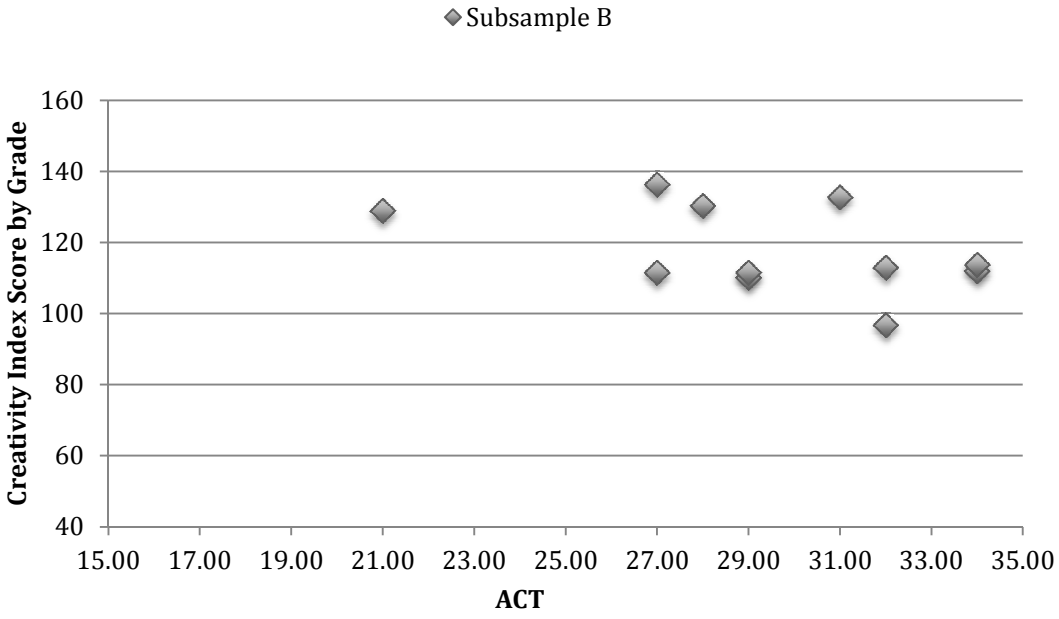


Figure 30. Scatter plot of subsample B: Creativity index score by grade & ACT.

Subsample C ($n_{C\text{-}6} = 7$) had a positive relationship ($r = .421$) for creativity index scores by age and ACT; however, the relationship was determined to be weak as the closer *r* was to zero, the weaker the relationship between the variables (Stangroom,

2014). The *p*-value of .299 (p = .299) was determined not to be statistically significant at $p < .05$. Similarly, the *r* of subsample C, using creativity index by grade, had a positive relationship ($r = .432$). The relationship was determined to be a weak relationship (Stangroom, 2014). The *p*-value ($p = .285$) was not statistically significant ($p < .05$). In the figures, the visual representation is used to identify an outlier, which may have affected the outcome of the data analysis.

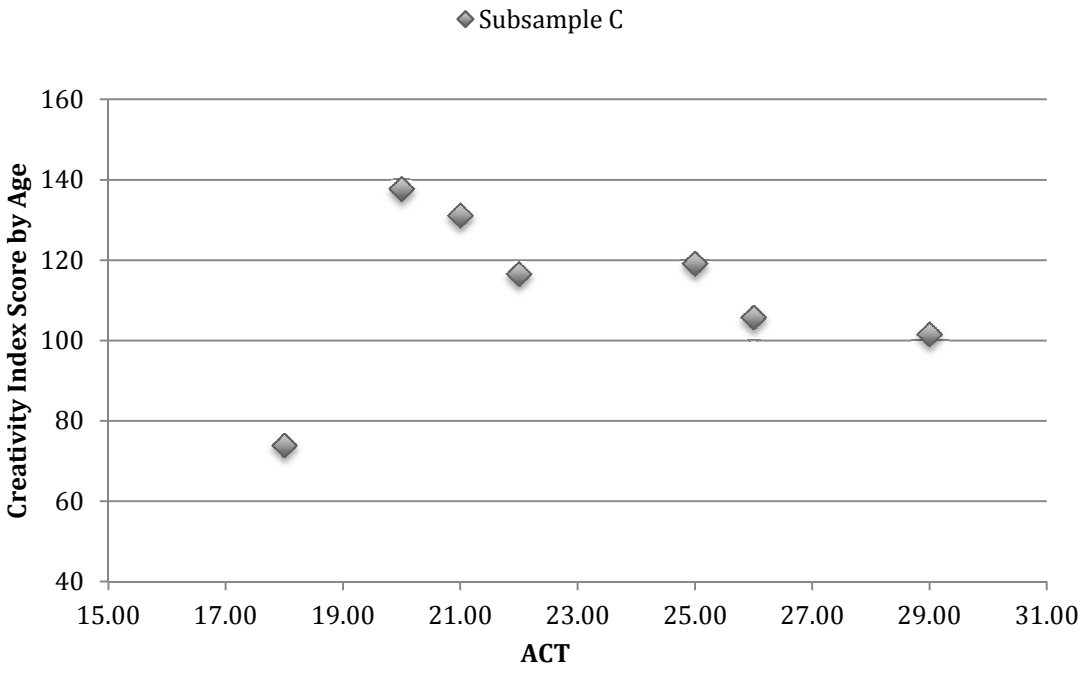


Figure 31. Scatter plot of subsample C: Creativity index score by age & ACT.

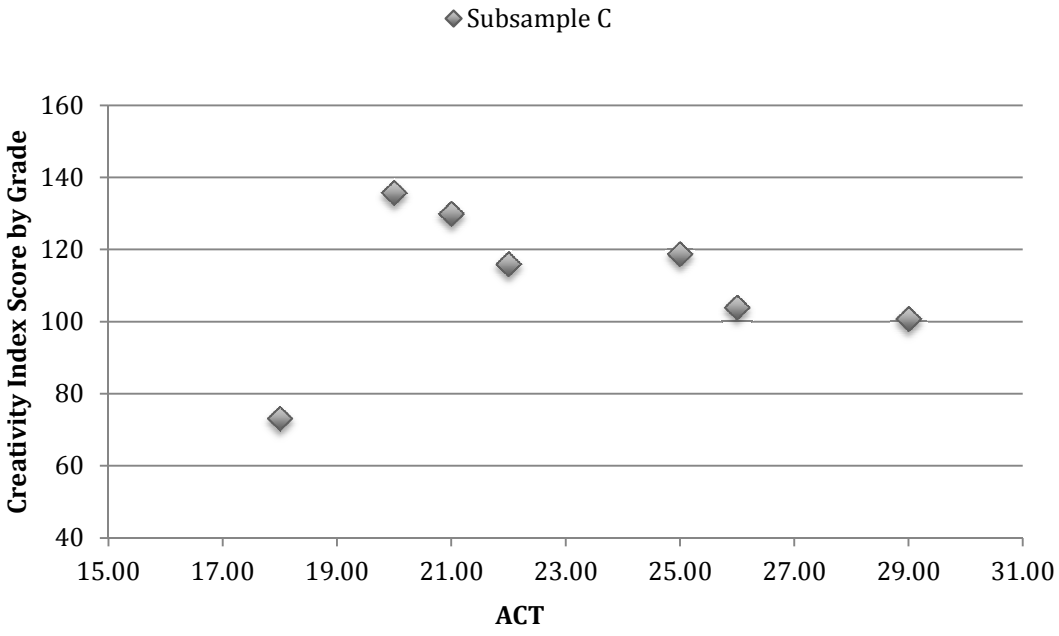


Figure 32. Scatter plot of subsample C: Creativity index score by grade & ACT.

Along with the data analysis of GPA, the data were represented by the subsamples, which allowed for analysis of individual subsamples. The second research question, what is the relationship between achievement data (ACT and GPA) and the creativity index scores from the Torrance Test of Creative Thinking, was addressed through the analysis of the subsamples combined using enrollment in fine arts courses and the variables of creativity index scores and ACT scores. The first combination was subsample A and subsample C, representing the 21 subjects (n_{A+C} - 8 = 21) who were enrolled in fine arts courses and who had also taken the ACT. The second combination was comprised of subsample B and subsample D, representing the 13 subjects (n_{B+D} - 9 = 13) who were not enrolled in fine arts courses, but who had an ACT score.

Subsamples A and C (n_{A+C} - 8 = 21) had a weak positive relationship between the variables of creativity index scores by age and ACT scores (r = .316). The p-value was .163 (p = .163). The result was not statistically significant at $p < .05$ (Stangroom, 2014).

Similarly, a weak positive relationship was found between the variables of creativity index score by grade and ACT score (r = .306). The p-value for this relationship was .177 (p = .177). The results were not statistically significant at $p < .05$ (Stangroom, 2014).

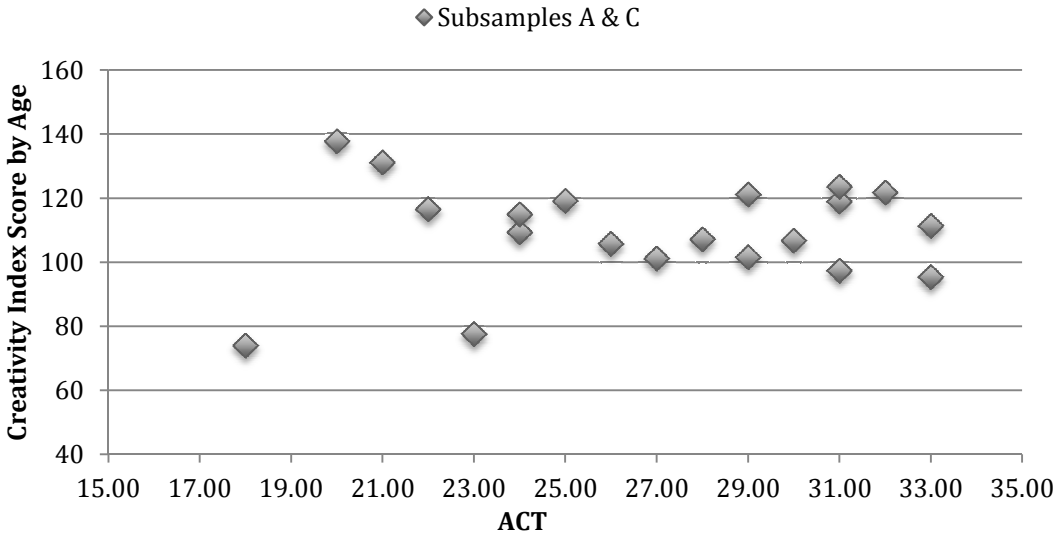


Figure 33. Scatter plot of subsamples A & C: Creativity index score by age & ACT.

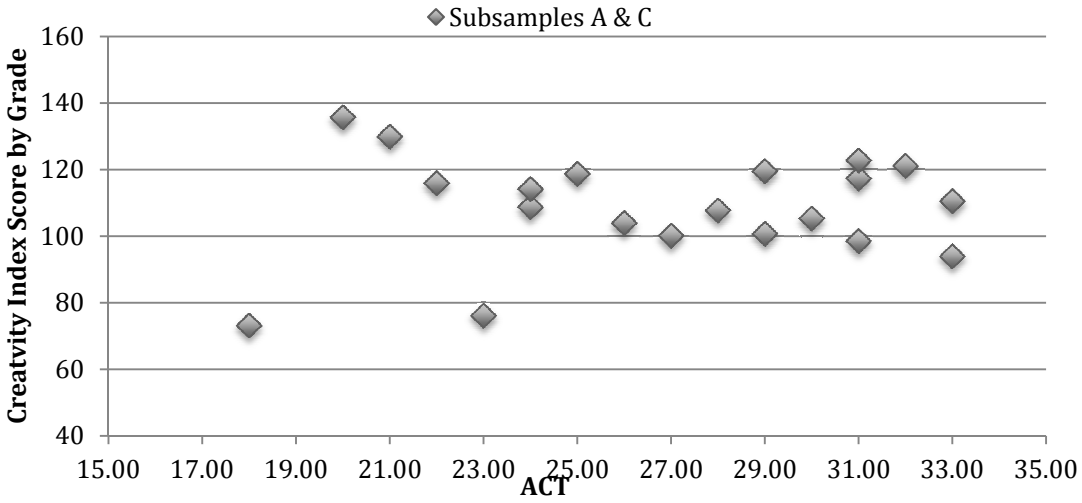


Figure 34. Scatter plot of subsamples A & C: Creativity index score by grade & ACT.

Subsamples B and D (n_{B+D} - 9 = 13) had a weak negative relationship between the variables of creativity index scores by age and ACT scores (r = -.139). The p-value was

.653 (p = .653). The result was not statistically significant (p < .05). Similarly, a weak negative relationship was found between the variables of creativity index score by grade and ACT score (r = -.135). The p-value for the relationship was .166 (p = .166). The results were not statistically significant at p < .05 (Stangroom, 2014).

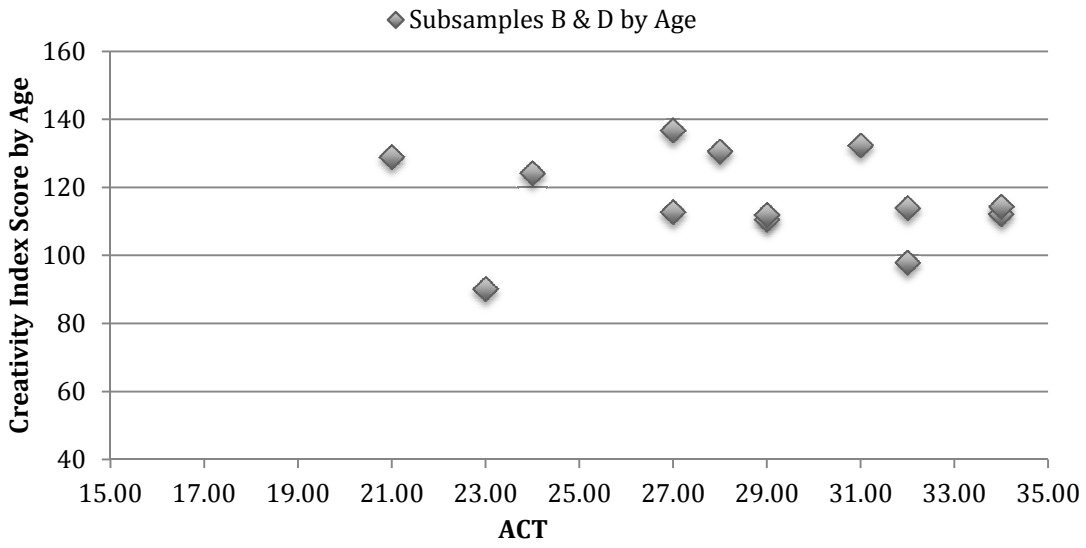


Figure 35. Scatter plot of subsamples B & D: Creativity index score by age & ACT.

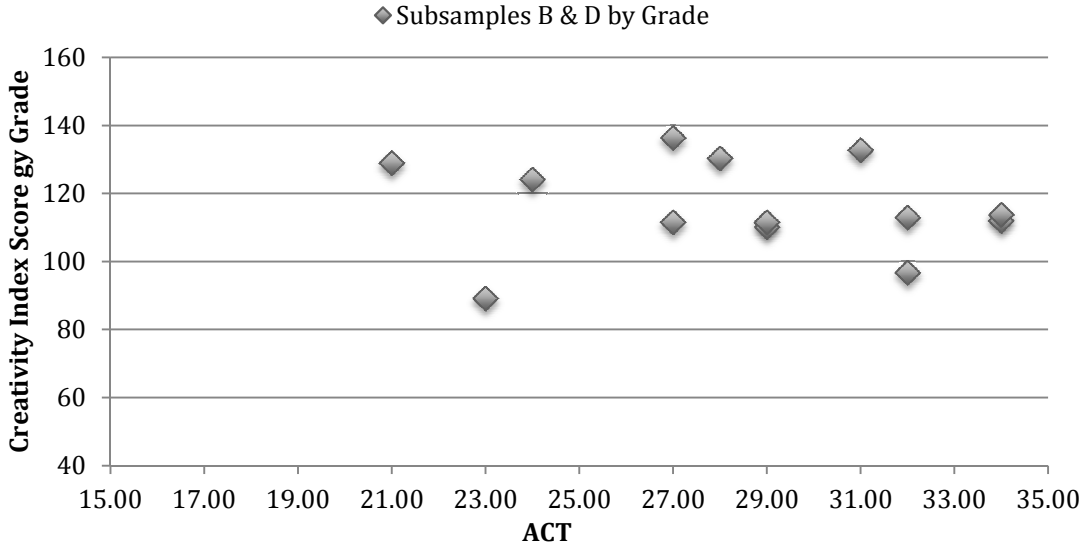


Figure 36. Scatter plot of subsamples B & D: Creativity index score by grade & ACT.

In Table 3, a summary of the findings from the Pearson *r* and the relationships between the variables of the creativity index scores and ACT scores is listed. The *r*-value is the sample correlation coefficient (Bluman, 2010). The r^2 value is the coefficient of determination (Bluman, 2010). The *p*-value is the probability value (Bluman, 2010). The probability value is the probability of getting a sample statistic in the direction of the alternative hypothesis (Stangroom, 2014).

Table 3

Pearson r Results between Creativity Index Score and ACT

		n	*r*	r^2	*p*
Total Sample	Age	34	.246	.061	.081
	Grade	34	.252	.064	.074
Subsample A	Age	13	.350	.123	.246
	Grade	13	.348	.121	.244
Subsample B	Age	11	-.497	.247	.100
	Grade	11	-.475	.225	.119
Subsample C	Age	8	.421	.177	.299
	Grade	8	.432	.187	.285
Subsample D	Age	2	n/a	n/a	n/a
	Grade	2	n/a	n/a	n/a
Fine arts (A & C)	Age	21	.316	.010	.163
	Grade	21	.306	.094	.177
Non-fine arts (B & D)	Age	13	-.139	.019	.653
	Grade	13	-.135	.018	.660

Note. n = number of subjects in the subsample; r = sample correlation coefficient; r^2 = coefficient of determination; p = probability value.

A positive relationship existed between the variables in most cases, with the exception of the negative relationship between variables in subsample B and the combination of subsamples B and D. The relationship between variables in all cases was

weak. The subsamples with subjects enrolled in fine arts course (A and C) consistently had a positive, albeit weak, relationship between the creativity index scores and ACT. Subsample B and D, which consisted of students not enrolled in fine arts courses, had a weak negative relationship between the variables. Although relationships were present, none of the relationships were strong or statistically significant; therefore, the null hypothesis proposed by the second research question was not rejected.

Summary

Data analysis was conducted in multiple stages. In the first stage, TTCT tests were scored. Frequency counts were made of each of the five norm-referenced measures and the 13 criterion-referenced measures, as well as the norm-referenced standard scores, the creativity index scores, and the national percentiles by age and by grade. Data were analyzed by the total sample (*N*) and by subsamples (A, B, C, D) defined by the course enrollment of the subjects.

In stage two, a *t*-test for independent means and an ANOVA test were conducted on the results of the TTCT. The results from the tests were used to determine whether a relationship existed between the variables of enrollment in IB DP curriculum or fine arts courses and the creativity index scores. Again, data were analyzed using the parameters of the total sample (*N*) and subsamples (A, B, C, D) defined by the course enrollment of the subjects. The hypothesis from the first research question was rejected.

In stage three, the creativity index scores were compared to the additional achievement data of the subjects. The Pearson *r* was performed on the data from the creativity index scores and GPA or ACT scores. The correlation coefficient was determined with the total sample (*N*) and subsamples (A, B, C, D) defined by the

enrollment of subjects in IB DP curricula or fine arts courses. In addition, the *r* for each test was evaluated to determine whether the score was statistically significant by calculating the *p* value. The hypothesis from the second research question was not rejected.

In Chapter Five, the purpose of the study is revisited through the summarization of findings. In addition, the limitations of findings are clarified and conclusions are drawn. Finally, the chapter concludes with a discussion of the implications for future studies and recommendations for further research.

Chapter Five: Summary and Conclusion

The purpose of the study was to determine if a significant statistical difference existed between the students enrolled in specific curricula offered at one high school and creativity index scores. The study was focused on two specific curricula choices at the school: the International Baccalaureate Diploma Programme (IB DP) and fine arts courses. The first population, enrollment in fine arts courses, established a connection between creative thinking, academic knowing, and the arts, and provided the relationship for study (Hope, 2010). The second targeted group of subjects was enrolled in IB DP, an academically rigorous and balanced curriculum for students 16 to 19 years old in grades 11 and 12 (IBO, 2007). In order to graduate with an IB diploma, the IB DP students are required to excel in the six core subjects of Language A (native language), Language B, history, experimental sciences, maths, and an elective course, which could be a fine arts class (IBO, 2007). The IB DP curriculum was designed with a focus on the *Learner Profile*, which provided guidelines for the characteristics expected from any IB student and were similar to the characteristics of a creative thinker presented in Chapter Two (IBO, 2009). In addition, International Baccalaureate Organization (IBO) (2011) cited a study conducted by the Programme for International Student Assessment (PISA), which determined a relationship existed between high scores in languages, maths, and sciences and excellence in creative subjects, such as the fine arts.

The theoretical framework of this study was guided by the research of Runco (2007). Runco (2007) provided a hierarchy for the study of creativity, specifically a branch of the hierarchy that focused on creative potential (person, process, and press). Torrance (2008) created the Torrance Test for Creative Thinking (TTCT) as an

assessment tool for the study of the creative potential of the subjects (Torrance, 2008). The creative person of the subjects was tested through the 13 criterion-referenced measures of the TTCT, creating the checklist for creative strengths (Torrance et al., 2008). The creative process was assessed through the five norm-referenced measures of the TTCT, which focused on fluency, originality, elaboration, abstractness of titles, and resistance to premature closure of the responses (Torrance et al., 2008). Finally, the hierarchical category of press was measured with the TTCT, because Torrance (2008) established time allotments and a playful testing environment be provided for each activity in the assessment.

A review of literature on several subjects regarding creativity was included in this study. The primary literature review was a discussion of the definitions of creativity within the academic and economic environments along with the importance of creativity to economic growth of the 21st century. The review of literature was also an investigation of how creativity is fostered in educational settings as a necessary component for college and career readiness.

Data collected for this study included (a) raw scores, norm-referenced standard scores, national percentiles, and creativity index scores from the TTCT, which were collected from the sample at one high school in a large accredited urban school district in southwest Missouri, and (b) secondary achievement data including ACT scores and grade point averages (GPA) of the subjects contained in the random sample. The data were analyzed to determine whether a statistically significant difference existed between the curricula choices made by the subjects and the creativity index scores from the TTCT. In addition, data were analyzed to determine if a relationship existed between the creativity

index scores and the secondary achievement data of the ACT and GPA. The following research questions guided this study:

1. Is there a statistically significant difference between the creativity index scores from the Torrance Test of Creative Thinking for students enrolled in fine arts courses and students who are not enrolled in fine arts courses?

2. What is the relationship between achievement data (ACT and GPA) and the creativity index scores from the Torrance Test of Creative Thinking?

In addition, two null hypotheses were offered to guide the analysis of data. The first null hypothesis ($H1_0$) suggested there is no statistically significant difference between the creativity index scores from the TTCT for students enrolled in fine arts courses and students who are not enrolled in fine arts courses. The corresponding alternative hypothesis ($H1_A$) proposed there is a statistically significant difference between the creativity index scores from the TTCT for students who were enrolled in fine arts courses and students who were not enrolled in fine arts courses. The second null hypothesis ($H2_0$) suggested there is no relationship between achievement data (ACT and GPA) and the creativity index scores from the Torrance Test of Creative Thinking. The corresponding alternative hypothesis ($H2_A$) proposed there is a relationship between achievement data (ACT and GPA) and the creativity index scores from the TTCT.

The subjects of this study were comprised of a random sample of 51 students ages 16 to 19 enrolled in grades 11 and 12 from one urban high school in a large school district in southwest Missouri. The total sample (N) represented four subsamples (A, B, C, D) of the current curricula at the school. Subsample A was comprised of 16 students enrolled in both IB DP courses and fine arts courses. The second subsample, B, was

comprised of 12 students enrolled in IB DP courses but not enrolled in fine arts courses. Subsample C was comprised of 13 students not enrolled in IB DP courses but enrolled in fine arts courses. The final subsample, D, was comprised of 10 students not enrolled in IB DP courses or fine arts courses. Participants completed the three activities of the TTCT, which was scored for five norm-referenced measures and 13 criterion-referenced measures and reported as a raw score, as a norm-referenced standard score, as a national percentile, and as a creativity index score.

Findings

The results of the TTCT and the secondary achievement data were analyzed in three stages. In stage one, the results of the TTCT included raw data, standard scores, and national percentiles. Using descriptive statistics, the data were reported and organized into frequency classes by the total sample (*N*) and subsamples (A, B, C, and D). In addition, a histogram of the data was produced.

In stage two of the analysis, the data from 51 students who participated in the TTCT were subjected to several statistical tests, including *t*-test for independent means and an ANOVA test. The *t*-test for independent means compares the means of two independent groups (Fraenkel et al., 2012). The ANOVA compares the variance of the independent groups to find statistically significant differences between the groups (Bluman, 2010).The statistical tests were conducted to compare the creativity index scores between the total sample (*N*) and subsamples (A, B, C, D).

During stage three, the analysis of the data from the 51 students who participated in the TTCT was continued. In this stage the variables were the creativity index score from the TTCT and additional achievement scores from the ACT test and GPA. The data

were subjected to the Pearson Product Moment Coefficient (Pearson *r*) statistical test in order to determine whether a linear relationship existed between the variables of the creativity index scores and additional achievement data. Again, the data were aggregated by total sample (*N*) and the subsamples (A, B, C, D).

Stage one: Descriptive statistics of TTCT results. The 51 subjects of the study responded to three timed activities from the TTCT. Each of the three activities was scored for the five norm-referenced measures: fluency, originality, elaboration, abstractness of titles, and resistance to premature closure (Torrance et al., 2008). These five measures represented the area of creative process under Runco's (2007) hierarchy of creativity. Once the five measures were scored for each subject, the scores were then compared to the norm-referenced standard scores and national percentiles provided by Torrance (2008). For each measure, the data were reported by frequency classes in order to determine if a pattern of scores existed within the total sample (*N*) and subsamples (A, B, C, D).

Fluency, the first measure scored, is represented by the number of responses in activities two and three (Torrance et al., 2008). The second measure, originality, was scored based on lists provided from the scoring guide for activities one, two, and three (Torrance et al., 2008). Responses matching those on the prescribed lists were statistically more likely to appear as a response and were, therefore, discounted as unoriginal (Torrance et al., 2008). Elaboration was scored in activities one, two, and three on the basis of how many additional details were added to the responses beyond what was necessary for the scorer to know what the figural response represented (Torrance et al., 2008). Abstractness of titles was scored using a hierarchy of abstractness provided in

the scoring guide (Torrance et al., 2008). A response could receive between zero and three points depending on the level of abstractness in the word choice for the titles (Torrance et al., 2008). The final norm-referenced measure was resistance to premature closure, which was scored only in the second activity. Responses were scored based on how quickly the stimulus was closed off; in other words, if the respondent closed the figure using a quick, direct line, the response was scored lower than a response closed by irregular lines or never closed at all (Millar, 2010; Torrance et al., 2008).

The 13 criterion-referenced measures comprising the checklist of creative strengths (CCS) were scored next. The CCS represents characteristics Runco (2007), Millar (2010), and Torrance (2008) identified as those possessed by a creative person. When scoring the measures of the CCS, one plus (+) was given when one or two responses indicated a genuine presence of the measure, or two pluses (+ +) were awarded when three or more responses demonstrated the presence of the measure (Torrance et al., 2008). This pattern was followed for all measures, with the exception of the richness of imagery measure (Torrance et al., 2008). When scoring richness of imagery, the scorer was allowed to give only one plus (+) when four or five responses had a genuine presence of the measure or two pluses (+ +) when six or more responses had elements of richness of imagery (Torrance et al., 2008). The score for the CCS was then added to the standard score for each subject to become the creativity index score (Torrance, 2008). According to Torrance (2008), the creativity index score is used as a predictor of creative potential in the subject.

Each measure had a range of scores. When compared by frequency class as a total sample (*N*) and by subsample (A, B, C, D), no single measure had the highest percentage

within a frequency class, which also had the highest percentage in all of the subsamples. In addition, the status of each subsample (IB DP/fine arts, non-IB DP/non-fine arts, etc.) did not have a consistently high or low score in the same ranges for each measure. The subjects were not predictable based on enrollment in specific curricula.

Stage two: Inferential statistics of TTCT scores by total sample and subsamples. Using the *t*-test for independent means and an ANOVA test, the creativity index scores of the 51 subjects representing the sample were analyzed. The data were aggregated by subsamples and the sample as a whole.

The *t*-test for independent means was conducted on the variables. In order to use the *t*-test for independent means, six null hypotheses were proposed. Each hypothesis was used to compare one subsample's mean creativity index score to another until all had been compared. In addition, a last null hypothesis was generated to determine whether a statistically significant difference existed between the subsamples representing subjects who were enrolled in fine arts courses (subsamples A and C) and subjects who were not enrolled in fine arts courses (subsamples B and D). These hypotheses were generated in order to ascertain the answer to the first research question: Is there a statistically significant difference between the creativity index scores from the Torrance Test of Creative Thinking for students enrolled in fine arts course and students who are not enrolled in fine arts courses?

The analysis of the *t*-test data generally had results of a statistically significant difference between the creativity index scores of IB/fine arts subjects and IB/non-fine arts subjects, non-IB/fine art subjects and IB/non-fine arts subjects, IB/non-fine arts subjects

and non-IB/non-fine arts students, and the combination of all fine arts students and all non-fine arts students.

When conducting multiple *t*-tests, Bluman (2010) stated it was more likely to get a measure of significance by chance. As a result, the ANOVA test was added to the study to analyze the data in an efficient manner. The ANOVA test is used to create a comparison among three or more variable means using the standard deviation (Bluman, 2010). The ANOVA was used to test the creativity index by age and then again by grade for all subsamples. The *F*-value of both tests had a *p*-value (p ($F \geq 2.11$) = .1117, by age; p ($F \geq 2.54$) = .07, by grade). The percentage was not a high enough percentage of probability (11.17 % by age; 7% by grade) to reject the null hypothesis, which stated that there was no statistically significant difference between the creativity index scores from the TTCT of students enrolled in fine arts courses and the creativity index scores from the TTCT of students not enrolled in fine arts courses. Although the results from the ANOVA did not reveal a statistically significant difference, the results of the comparisons of subsamples using the *t*-test did indicate a statistically significant difference enough to warrant the rejection of the null hypothesis associated with research question one.

Stage three: Inferential statistics of additional achievement assessments and creative index scores. In stage three, the creativity index scores from the TTCT were compared to additional achievement assessments from ACT scores and GPA in order to determine whether to reject or not reject the second null hypothesis. The hypothesis claimed that there was no relationship between the creativity index score from the TTCT and additional achievement assessments (ACT and GPA). The creativity index scores and

scores from ACT and GPA were used as variables in the Pearson *r* test. Again, the data were compared through the subsamples to determine whether a relationship existed between the variables within the constraints of curriculum choices, such as enrollment in IB DP and fine arts courses.

The Pearson *r* was deemed the appropriate method of comparison for both of the additional achievement variables and the creativity index scores, because the test compared independent means (Bluman, 2010). Although all of the relationships were deemed weak because of the proximity of the *r* to zero, subsamples A and C, subjects enrolled in fine arts courses, had a positive relationship between the creativity index scores and grade point averages ($r = .296$, by age and $r = .246$, by grade). Subsamples B and D, subjects not enrolled in fine arts courses, had a negative relationship between the creativity index scores and grade point averages ($r = -.037$ and $r = -.048$, by age and grade for subsample B, respectively; $r = -.208$ and $r = -.160$, by age and grade for subsample D, respectively). When subsample B and D were combined, a weak positive relationship was observed among the data points ($r = .268$ by age and $r = .355$ by grade). Unfortunately, none of the relationships were considered statistically significant. The exception to this finding was found in the total sample. The results, in this case, were a statistically significant positive relationship. The hypothesis was not rejected because the relationships between fine arts subjects and GPA were not statistically significant.

The relationship between creativity index scores and ACT scores was also tested using the Pearson *r*. All of the relationships between the variables were deemed weak because of the proximity of the *r* to zero. Subsamples A and C, as individual subsamples and as a combined subsample of all the students enrolled in fine arts courses, had a weak

positive relationship between creativity index scores and ACT scores of the subjects (r = .316 for subsamples A and C combined by age and r = .306 by grade). This meant a linear relationship was developed; as the creativity index scores went up, so did the ACT scores, but it was not a strong relationship. Subsamples B and D combined to establish a weak negative relationship between creativity index scores and ACT scores (r = -.139 by age and r = -.135 by grade). Furthermore, none of the results were considered significant because the p-values were greater than .05 ($p < .05$). After analyzing the results, the null hypothesis was not rejected because of the lack of strong statistical evidence to predict a relationship between the variables.

Limitations of Findings

The limitations of the study involved the sample for the research and the design of the study chosen by the researcher as listed below:

1. The study focused only on one high school in one school district.
2. A limited number of students participated in the study.
3. Although the sample was randomly selected, not all of the subsamples were represented equally.
4. Not all teachers of fine arts courses teach creativity in the same manner. With all the fine arts courses grouped together rather than separated by specialty (such as art, theatre, music), the results may not have given a clear representation of the place of creativity in the fine arts courses.
5. The fine arts students who represented their subsample were not evenly distributed among the fine arts options.
6. Only one creativity instrument, the TTCT, was used to assess the creativity of

the subjects.

7. The number of subjects completing the ACT prior to the beginning of this study was limited.

8. The scores from the TTCT were subject to the understanding of the components of the test and scoring in conjunction with training via the manual.

9. It was an assumption that respondents did their best work on the creativity assessment at the time the TTCT was conducted.

Conclusions

The conclusions are drawn within the context of the limitations of the study, the creativity index scores from the Torrance Test for Creative Thinking, and Runco's (2007) framework established for the study of creative potential:

Research question one. Is there a statistically significant difference between the creativity index scores from the Torrance Test of Creative Thinking for students enrolled in fine arts courses and students who are not enrolled in fine arts courses? Fifty-one students were tested for creativity using the Torrance Test for Creative Thinking (TTCT). The tests were scored and analyzed using multiple statistical measures including the *t*-test and the ANOVA. The results of the statistical tests of the TTCT using the *t*-test for independent means have indicated a statistically significant difference between the subjects enrolled in fine arts courses and those not enrolled in fine arts courses. The statistically significant difference comparing all four subsamples using the ANOVA had a smaller difference; however, the *t*-test results warranted the rejection of the null hypothesis that there is no statistically significant difference between the creativity index

scores from the Torrance Test of Creative Thinking for students enrolled in fine arts courses and students who are not enrolled in fine arts courses.

Research question two. What is the relationship between achievement data (ACT and GPA) and the creativity index scores from the Torrance Test of Creative Thinking? Comparing the creativity index scores to other achievement data such as the ACT and the student's GPA through the Pearson *r* was related to the second research question. Rosen and Tager (2013) examined the relationship between creativity index scores and SAT results. Rosen and Tager (2013) even went as far as to say, "Adding the creative measures to other measures of analytical and practical measures roughly doubled the predictive value of the SAT for the sample in predicting grades for first-year college students" (pp. 7-8). Achievement data such as the ACT were designed with the intention of predicting future academic achievement based on current achievement (ACT, Inc., 2007). The logical next step was to explore whether the relationship between creativity index scores would follow the same pattern of prediction as the ACT and GPA.

Creativity index scores and GPA and ACT of the sample were compared using the Pearson *r*. Although the results from the Pearson *r* test had a positive linear relationship, the relationship was considered weak and the *p*-value did not provide a high enough percentage in every case to justify the rejection of the null hypothesis that there is no relationship between achievement data (ACT and GPA) and the creativity index scores from the Torrance Test of Creative Thinking.

Implications for Practice

According to the results of this study, including descriptive statistics of raw data from the TTCT and inferential statistics, the following practices would improve

curriculum designs in order to continue the advancement of creativity s as a key component for future success in college and careers in the 21st century:

1. Curriculum developers, policy makers, educators, and students need to be aware of the need for creative thinking in the 21st century (IBM, 2010).

2. Educators need continued professional development on the definition of creativity, how to teach the creativity skills, how to respond to personality traits comprising creativity, and how to assess creative thinking (Gude, 2010).

3. Students can and should be taught to be creative through the implicit teaching and practice of the measures defined by Torrance (2008) as predictive of creative potential.

Recommendations for Further Research

Based on the results of this study, the following recommendations for further research are offered:

1. Expand the statistical analysis of the data collected for this study to determine the extent of the impact of creative thinking on learners in the IB DP and fine arts courses.

2. Explore the impact of fine arts on the 21st century skills of creative thinking, critical thinking, collaboration, and communication.

3. Define the differences among the fine arts (specifically theatre, visual arts, and music) in terms of teaching creative thinking and the expectation of creative behavior.

4. Conduct a survey of educator and student perception of creativity in the classroom and curriculum.

5. Measure the impact of rigorous academic programs, such as IB DP, Advanced Placement, and Dual Enrollment, on creative thinking.

6. Conduct similar research using multiple schools (high school, middle school, elementary) in a variety of districts (rural, urban, suburban) to compare the results.

7. Conduct a longitudinal study of the students from this study to discover if the TTCT was a better predictor of academic success than the ACT or GPA.

Summary

The purpose of this study was to determine if a statistically significant difference existed between curricula, IB DP and the fine arts, and creativity indices in one high school in one large accredited urban school district in southwest Missouri. Researchers from IBM (2010) established a need for business leaders to recruit and retain employees with creativity skills. The Partnership for 21st Century Skills (2009) defined necessary skills for a global society of the 21st century as creativity, collaboration, critical thinking, and communication. The goal of this study was to provide a foundation for future research within secondary schools concerning the current level of the creativity within their populations and curricula in order to prepare students to be competitive (Partnership for 21st Century Skills, 2009).

The statistical results of this study were varied. The results fluctuated between positive and negative relationships. The *t*-tests conducted on the creativity index scores had statistically significant results that lead to the rejection of the first null hypothesis. None of the tests conducted on the relationship between creativity index scores and additional achievement data provided results with significance enough to warrant the rejection of the second null hypothesis. As a result of the study of the relationship

between IB DP curricula and the fine arts courses and the creativity index scores from the TTCT, questions arose regarding the future of creativity research and the place of creativity within the curricula. With the growing need for creativity in a global society, the importance of teaching creativity skills to secondary students also grew exponentially. Future research into the impacts resulting from implicitly teaching creativity to secondary students and concerning the results of allowing secondary students to explore creative freedoms continues to be a priority in the 21st century.

Appendix A

Due to publisher restrictions regarding the reprinting of copyrighted material, the data from the instrument(s) are available from the author, and the original instrument is available from Scholastic Testing Service, Inc., Bensenville, IL 60106. USA.

Appendix B

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Gretchen Teague** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 03/14/2013

Certification Number: 1127719

Appendix C

LINDENWOOD

LINDENWOOD UNIVERSITY ST. CHARLES, MISSOURI

DATE: March 28, 2014

TO: Gretchen Teague
FROM: Lindenwood University Institutional Review Board

STUDY TITLE: [563623-2] Creativity Necessary for Student's Future Success: A Study of High School Student's Creativity Index Scores as a Predictor for Success Past High School

IRB REFERENCE #:
SUBMISSION TYPE: Amendment/Modification

ACTION: APPROVED
APPROVAL DATE: March 26, 2014
EXPIRATION DATE: March 28, 2015
REVIEW TYPE: Facilitated Review

Thank you for your submission of Amendment/Modification materials for this research project. Lindenwood University Institutional Review Board has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Facilitated Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to the IRB.

This project has been determined to be a Minimal Risk project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the completion/amendment form for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of March 28, 2015.

Please note that all research records must be retained for a minimum of three years.

If you have any questions, please contact Robyne Elder at [redacted] or relder@lindenwood.edu.

Please include your study title and reference number in all correspondence with this office. If you have any questions, please send them to IRB@lindenwood.edu . Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Lindenwood University Institutional Review Board's records.

Appendix D

INFORMED CONSENT FOR PARENTS TO SIGN FOR STUDENT PARTICIPATION IN RESEARCH ACTIVITIES

The Relationship between Creativity and Enrollment in Fine Arts or International Baccalaureate Diploma Programme Coursework

Principal Investigator: Gretchen Teague
Telephone: [redacted] E-mail: [redacted]@gmail[redacted]

Participant _____Parent Contact info _____

Dear Parent,

1. Your child is invited to participate in a research study conducted by Gretchen Teague under the guidance of Dr. Sherry DeVore, Dr. Lisa Christiansen, and Dr. Rebecca Bernard. The purpose of this research is to assess the creativity potential of the participants.

2. a) Your child's participation will involve:
   Answering three subsets of the Torrance Test for Creative Thinking in a pencil and paper assessment. The test consists of tasks such as picture completion, picture construction, and parallel lines. The participant will use their imagination and life experiences to draw pictures, explain in words, write questions, and reason solutions. The tasks have been designed by Dr. E. Paul Torrance and are used to assess creativity through fluency, originality, elaboration, abstraction of titles, and resistance to premature closure.

   Additionally, your child's ACT scores and GPA will be compared to the creative index score in order to determine if a relationship exists between the two variables.

   Approximately 80 students may be involved in this research.

   b) The amount of time involved in your child's participation will be a one-time assessment lasting approximately 45-minutes.

3. There are no anticipated risks to your child associated with this research.

4. There are no direct benefits for your child's participation in this study. However, your child's participation will contribute to the knowledge about creativity and may help the school district as new curriculum is designed to enhance 21st Century Skills, including creativity.

5. Your child's participation is voluntary, and you may choose not to let your child participate in this research study or to withdraw your consent for your child's

participation at any time. Your child may choose not to answer any questions that he or she does not want to answer. You and your child will NOT be penalized in any way should you choose not to let your child participate or to withdraw your child.

6. We will do everything we can to protect your child's privacy. As part of this effort, your child's identity will not be revealed in any publication or presentation that may result from this study.

7. If you have any questions or concerns regarding this study, or if any problems arise, you may call the Investigator, Gretchen Teague at [redacted] or the Supervising Faculty, Dr. Lisa Christiansen at [redacted]. You may also ask questions of or state concerns regarding your participation to the Lindenwood Institutional Review Board (IRB) through contacting Dr. Jann Weitzel, Vice President for Academic Affairs, at [redacted].

I have read this consent form and have been given the opportunity to ask questions. I will also be given a copy of this consent form for my records. I consent to my child's participation in the research described above.

Parent's/Guardian's Signature	Date	Parent's/Guardian's Printed Name	
Child's Signature	Date	Child's Printed Name	
Signature of Investigator	Date	Investigator Printed Name	

Appendix E

Table 4

Fluency Score Raw Data

Raw	Total *N*		n_A		n_B		n_C		n_D	
Score	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
1-10	6	12	2	13	0	0	2	15	2	20
11-20	26	51	10	60	4	33.3	7	54	5	50
21-30	15	29	4	27	4	33.3	4	31	3	30
31-40	4	8	0	0	4	33.3	0	0	0	0
Total	51	100	16	100	12	99.9	13	100	10	100

Note. *f* = the number of the subjects whose scores were within the class of scores; % = the percent of the subjects who scored within the frequency class; *N* = total sample; n_A = subsample A, enrolled in both IB DP and fine arts courses; n_B = enrolled in IB DP and not fine arts courses; n_C = not enrolled in IB DP, but enrolled in fine arts courses; n_D = neither enrolled in IB DP nor fine arts courses.

Table 5

Norm-Referenced Standard Score for Fluency

Standard	Total N		n_A		n_B		n_C		n_D	
Score	Age	Grade	Age	Grade	Age	Grade	Age	Grade	Age	Grade
40-51	0	0	0	0	0	0	0	0	0	0
52-63	3	3	1	1	0	0	2	2	0	0
64-75	3	3	1	1	0	0	0	0	2	2
76-87	5	4	3	2	0	0	1	1	1	1
88-99	8	12	5	7	1	1	2	3	0	1
100-111	13	12	2	2	3	4	4	3	4	3
112-123	12	9	3	1	4	3	2	2	3	3
124-135	5	6	1	2	2	2	2	2	0	0
136-147	2	2	0	0	2	2	0	0	0	0
148-160	0	0	0	0	0	0	0	0	0	0
Total	51	51	16	16	12	12	13	13	10	10

Note. N = total sample; n_A = subsample A, enrolled in both IB DP and fine arts courses; n_B = enrolled in IB DP and not fine arts courses; n_C = not enrolled in IB DP, but enrolled in fine arts courses; n_D = neither enrolled in IB DP nor fine arts courses.

Table 6

Originality Score Raw Data

Raw	Total *N*		n_A		n_B		n_C		n_D	
Score	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
1-10	13	25	4	25	0	0	5	39	4	40
11-20	29	57	10	62.5	8	67	6	46	5	50
21-30	8	16	2	12.5	3	25	2	15	1	10
31-40	1	2	0	0	1	8	0	0	0	0
41-50	0	0	0	0	0	0	0	0	0	0
Total	51	100	16	100	12	100	13	100	10	100

Note. f = the number of the subjects whose scores were within the class of scores; % = the percent of the subjects who scored within the frequency class; *N* = total sample; n_A = subsample A, enrolled in both IB DP and fine arts courses; n_B = enrolled in IB DP and not fine arts courses; n_C = not enrolled in IB DP, but enrolled in fine arts courses; n_D = neither enrolled in IB DP nor fine arts courses.

Table 7

Norm-Referenced Standard Score for Originality

Standard	Total *N*		n_A		n_B		n_C		n_D	
Score	Age	Grade	Age	Grade	Age	Grade	Age	Grade	Age	Grade
40-51	1	1	1	1	0	0	0	0	0	0
52-63	1	1	1	1	0	0	0	0	0	0
64-75	4	4	0	0	0	0	4	4	0	0
76-87	7	7	2	2	0	0	1	1	4	4
88-99	17	18	7	7	3	3	4	4	3	4
100-111	9	8	2	2	4	4	1	1	2	1
112-123	3	3	1	1	1	1	1	1	0	0
124-135	8	8	2	2	3	3	2	2	1	1
136-147	1	1	0	0	1	1	0	0	0	0
148-160	0	0	0	0	0	0	0	0	0	0
Total	51	51	16	16	12	12	13	13	10	10

Note. N = total sample; n_A = subsample A, enrolled in both IB DP and fine arts courses; n_B = enrolled in IB DP and not fine arts courses; n_C = not enrolled in IB DP, but enrolled in fine arts courses; n_D = neither enrolled in IB DP nor fine arts courses.

Table 8

Elaboration Score Raw Data

Raw	Total *N*		n_A		n_B		n_C		n_D	
Score	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
1-3	2	4	1	6.25	0	0	1	8	0	0
4-6	21	41	6	37.5	2	17	8	62	5	50
7-9	23	45	9	56.25	7	58	2	15	5	50
10-12	5	10	0	0	3	25	2	15	0	0
13-15	0	0	0	0	0	0	0	0	0	0
Total	51	100	16	100	12	100	13	100	10	100

Note. *f* = the number of the subjects whose scores were within the class of scores; % = the percent of the subjects who scored within the range; *N* = total sample; n_A = subsample A, enrolled in both IB DP and fine arts courses; n_B = enrolled in IB DP and not fine arts courses; n_C = not enrolled in IB DP, but enrolled in fine arts courses; n_D = neither enrolled in IB DP nor fine arts courses.

Table 9

Norm-Referenced Standard Score for Elaboration

Standard	Total N		n_A		n_B		n_C		n_D	
Score	Age	Grade	Age	Grade	Age	Grade	Age	Grade	Age	Grade
40-51	0	0	0	0	0	0	0	0	0	0
52-63	2	2	1	1	0	0	1	1	0	0
64-75	6	6	1	1	0	0	5	5	0	0
76-87	5	5	2	2	0	0	1	1	2	2
88-99	10	10	3	3	2	2	2	2	3	3
100-111	5	5	1	1	1	1	1	1	2	2
112-123	10	10	6	6	2	2	1	1	1	1
124-135	11	11	2	2	6	6	1	1	2	2
136-147	2	2	0	0	1	1	1	1	0	0
148-160	0	0	0	0	0	0	0	0	0	0
Total	51	51	16	16	12	12	13	13	10	10

Note. N = total sample; n_A = subsample A, enrolled in both IB DP and fine arts courses; n_B = enrolled in IB DP and not fine arts courses; n_C = not enrolled in IB DP, but enrolled in fine arts courses; n_D = neither enrolled in IB DP nor fine arts courses.

Table 10

Abstractness of Titles Raw Data

Raw	Total *N*		n_A		n_B		n_C		n_D	
Score	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
1-6	21	41	5	31	6	50	5	38	5	50
7-12	25	49	11	69	4	33	6	46	4	40
13-18	4	8	0	0	2	17	1	8	1	10
19-24	1	2	0	0	0	0	1	8	0	0
25-33	0	0	0	0	0	0	0	0	0	0
Total	51	100	16	100	12	100	13	100	10	100

Note. *f* = the number of subjects whose scores were within the class of scores; % = the percent of subjects who scored within the range; *N* = total sample; n_A = subsample A, enrolled in both IB DP and fine arts courses; n_B = enrolled in IB DP and not fine arts courses; n_C = not enrolled in IB DP, but enrolled in fine arts courses; n_D = neither enrolled in IB DP nor fine arts courses.

Table 11

Norm-Referenced Standard Score for Abstractness of Titles

Standard	Total *N*		n_A		n_B		n_C		n_D	
Score	Age	Grade	Age	Grade	Age	Grade	Age	Grade	Age	Grade
40-51	0	0	0	0	0	0	0	0	0	0
52-63	8	8	3	3	1	1	2	2	2	2
64-75	5	5	0	0	3	3	0	0	2	2
76-87	8	8	2	2	2	2	3	3	1	1
88-99	13	13	6	6	1	1	4	4	2	2
100-111	5	5	2	2	1	1	2	2	0	0
112-123	7	7	3	3	2	2	0	0	2	2
124-135	3	3	0	0	2	2	0	0	1	1
136-147	2	2	0	0	0	0	2	2	0	0
148-160	0	0	0	0	0	0	0	0	0	0
Total	51	51	16	16	12	12	13	13	10	10

Note. N = total sample; n_A = subsample A, enrolled in both IB DP and fine arts courses; n_B = enrolled in IB DP and not fine arts courses; n_C = not enrolled in IB DP, but enrolled in fine arts courses; n_D = neither enrolled in IB DP nor fine arts courses.

Table 12

Resistance to Premature Closure Score Raw Data

Raw	Total *N*		n_A		n_B		n_C		n_D	
Score	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
1-5	7	14	1	6	2	17	3	23	5	50
6-10	26	51	11	69	6	50	4	31	2	20
11-15	13	25	3	19	4	33	3	23	2	20
16-20	5	10	1	6	0	0	3	23	1	10
Total	51	100	16	100	12	100	13	100	10	100

Note. *f* = the number of subjects whose scores were within the class of scores; % = the percent of subjects who scored within the range; *N* = total sample; n_A = subsample A, enrolled in both IB DP and fine arts courses; n_B = enrolled in IB DP and not fine arts courses; n_C = not enrolled in IB DP, but enrolled in fine arts courses; n_D = neither enrolled in IB DP nor fine arts courses.

Table 13

Norm-Referenced Standard Score for Resistance to Premature Closure

Standard	Total *N*		n_A		n_B		n_C		n_D	
Score	Age	Grade	Age	Grade	Age	Grade	Age	Grade	Age	Grade
40-51	1	1	0	0	0	0	1	1	0	0
52-63	3	3	1	1	0	0	1	1	1	1
64-75	6	6	1	1	2	2	2	2	1	1
76-87	16	16	8	8	5	5	2	2	1	1
88-99	10	14	3	3	2	3	2	3	3	5
100-111	8	3	2	1	2	1	2	1	2	0
112-123	2	6	0	1	1	1	0	2	1	2
124-135	5	2	1	1	0	0	3	1	1	0
136-147	0	0	0	0	0	0	0	0	0	0
148-160	0	0	0	0	0	0	0	0	0	0
Total	51	51	16	16	12	12	13	13	10	10

Note. N = total sample; n_A = subsample A, enrolled in both IB DP and fine arts courses; n_B = enrolled in IB DP and not fine arts courses; n_C = not enrolled in IB DP, but enrolled in fine arts courses; n_D = neither enrolled in IB DP nor fine arts courses.

Table 14

Average Standard Score

Average Standard Score	Total *N*		n_A		n_B		n_C		n_D	
	Age	Grade	Age	Grade	Age	Grade	Age	Grade	Age	Grade
40-51	0	0	0	0	0	0	0	0	0	0
52-63	1	1	1	1	0	0	0	0	0	0
64-75	4	4	1	1	0	0	3	3	0	0
76-87	2	7	1	3	0	0	0	2	1	2
88-99	19	15	7	4	2	3	5	3	5	5
100-111	17	16	5	6	5	4	3	3	4	3
112-123	7	8	1	1	5	5	1	2	0	0
124-135	1	0	0	0	0	0	1	0	0	0
136-147	0	0	0	0	0	0	0	0	0	0
148-160	0	0	0	0	0	0	0	0	0	0
Total	51	51	16	16	12	12	13	13	10	10

Note. N = total sample; n_A = subsample A, enrolled in both IB DP and fine arts courses; n_B = enrolled in IB DP and not fine arts courses; n_C = not enrolled in IB DP, but enrolled in fine arts courses; n_D = neither enrolled in IB DP nor fine arts courses.

Table 15

Checklist of Creative Strengths for Total Sample and Subsamples

	Total N			n_A			n_B			n_C			n_D		
	0	+	++	0	+	++	0	+	++	0	+	++	0	+	++
Emotional Expressiveness	10	13	28	3	5	8	1	3	8	5	2	6	1	3	6
Storytelling Articulateness	11	20	20	3	10	3	1	4	7	5	3	5	2	3	5
Movement or Action	7	14	30	4	5	7	0	4	8	3	4	6	0	1	9
Expressiveness of Titles	13	22	16	3	8	5	3	4	5	4	5	4	3	5	2
Synthesis of Incomplete Figures	51	0	0	16	0	0	12	0	0	13	0	0	10	0	0
Synthesis of Lines	48	2	1	15	0	1	11	1	0	12	1	0	10	0	0
Unusual Visualization	7	20	24	2	8	5	0	4	8	4	4	5	0	4	6
Internal Visualization	31	15	5	11	3	2	8	3	1	7	5	1	5	4	1
Extending/ Breaking Boundaries	24	17	10	6	8	2	3	5	4	9	3	1	6	1	3
Humor	24	15	12	8	5	3	5	5	2	7	3	3	4	2	4
Richness	26	9	16	5	3	8	5	3	4	9	1	3	7	2	1
Colorfulness	23	19	9	8	3	5	4	5	3	7	6	0	4	5	1
Fantasy	11	29	11	3	11	2	2	8	2	5	4	4	1	6	3

Note. N = total sample; n_A = subsample A, enrolled in both IB DP and fine arts courses; n_B = enrolled in IB DP and not fine arts courses; n_C = not enrolled in IB DP, but enrolled in fine arts courses; n_D = neither enrolled in IB DP nor fine arts courses; 0 = the number of subjects who had zero indication of the creative strength; + = the number of subjects who had one to two responses indicate the e creative strength; ++ = the number of subjects who had three or more responses indicate the creative strength.

Table 16

Total Checklist of Creative Strengths

	Total *N*		n_A		n_B		n_C		n_D	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
0-4	1	2	0	0	0	0	1	8	0	0
5-9	18	35	6	37.5	2	17	6	46	2	20
10-14	23	45	7	43.75	7	58	4	31	7	70
15-19	7	14	3	18.75	2	17	2	15	0	0
20-26	2	4	0	0	1	8	0	0	1	10
Total	51	100	16	100	12	100	13	100	10	100

Note. *f* = the frequency of subjects whose scores were within the frequency class of scores; % = the percent of subjects who scored within the frequency class; *N* = total sample; n_A = subsample A, enrolled in both IB DP and fine arts courses; n_B = enrolled in IB DP and not fine arts courses; n_C = not enrolled in IB DP, but enrolled in fine arts courses; n_D = neither enrolled in IB DP nor fine arts courses.

References

ACT, Inc. (2007). *ACT Technical Manual*. Retrieved from http://www.act.org/aap/pdf/ACT_Technical_Manual.pdf

ACT, Inc. (2013). *What is WorkKeys®?* Retrieved from http://www.keytrain.com/wrk_over.asp

Allen, A. D. (2010). Complex spatial skills: The link between visualization and creativity. *Creativity Research Journal*, *22*(3), 241–249. doi:10.1080/10400419.2010.503530

Amazon.com. (2013). *Training specialist - Amazon web services*. Retrieved from http://www.amazon.com/gp/jobs/229027/ref=j_sr_21_t?ie=UTF8&category=Leadership%20Development%20%26%20Training&jobSearchKeywords=&location=*&page=2

Amabile, T. (1996). *Creativity in context: Update to the social psychology of creativity*. Boulder, CO: West View Press.

American Psychological Association. (2010). *Publication manual of the American Psychological Association* (6th ed.). Washington, DC: Author.

Anderson, L. W., & Krathwohl, D. R. (2010). Merlin C. Wittrock and the revision of Bloom's taxonomy. *Educational Psychologist*, *45*(1), 64-65. doi: 10.1080/00461520903433562

Anstead, A. (2011). Inner sparks. *Scientific American*, *304*(5), 84.

Apple Inc. (2013). *Jobs at Apple.* Retrieved from http://www.apple.com/jobs/us/index.html

Baer, J., & McKool, S. S. (2009). Assessing Creativity Using the Consensual Assessment

Technique. In C. Schreiner (Ed.), *Handbook of Research on Assessment Technologies, Methods, and Applications in Higher Education* (pp. 65-77). Hershey, PA: Information Science Reference. doi:10.4018/978-1-60566-667-9.ch004

Barbot, B., Besançon, M., & Lubart, T. (2011). Assessing creativity in the classroom. *The Open Education Journal*, *4*, 58-66. Retrieved from http://benthamscience.com/open/toeduj/articles/V004/SI0034TOEDUJ/58TOEDUJ.pdf

Beghetto, R. A., & Kaufman, J. C. (2013). Fundamentals of creativity. *Educational Leadership*, *70*(5), 10-15.

Bluman, A. G. (2010). *Elementary statistics: A step by step approach* (7th ed.). Boston, MA: McGraw-Hill Higher Education.

Brenner, M. Y. (2010). *Arts-based learning and leadership development: A case study* (Doctoral dissertation). Retrieved from http://pqdtopen.proquest.com/#viewpdf?dispub=3436229

Brinkman, D. J. (2010). Teaching creatively and teaching for creativity. *Arts Education Policy Review*, *111*, 48-50. doi:10.1080/10632910903455785

Brookhart, S. M. (2013). Assessing creativity. *Educational Leadership*, *70*(5), 28-34.

Bruton, D. (2011). Learning creativity and design for innovation. *International Journal of Technology and Design Education*, *21*(3), 321–333. doi:10.1007/s10798-010-9122-8

Bryant, C. (2010). 21st-century art room: The remix of creativity and technology. *Art Education*, *63*(2), 43-48.

Bushaw, W. J., & Lopez, S. J. (2013). The 45th annual PDK/Gallup poll of the public's perceptions toward the public schools. *Kappan*, *95*(1), 9-25. Retrieved from http://pdkintl.org/noindex/2013_PDKGallup.pdf

Cable News Network. (2013). *Fortune 500 2013: Annual ranking of America's largest corporations from Fortune Magazine*. Retrieved from http://money.cnn.com/magazines/fortune/fortune500/

Chrysikou, E. G. (2012). Your creative brain at work. *Scientific American Mind*, *23*(3), 24.

Conference Board. (2014). *About us*. Retrieved from https://www.conference-board.org/about/

Constantino, T., Kellam, N., Cramond, B., & Crowder, I. (2010). An interdisciplinary design studio: How can art and engineering collaborate to increase students' creativity? *Arts Education*, *63*(2), 49-53.

Craft, A. (2003). The limits to creativity in education: Dilemmas for the educator. *British Journal of Educational Studies*, *51*(2), 13-127. Retrieved from http://dx.doi.org/10.1111/1467-8527.t01-1-00229

Dacey, J. (2013). *Creativity and the standards*. Huntington Beach, CA: Shell Education.

Dhingra, R., & Sharma, N. (2012). Assessment of divergent thinking ability of school children. *International Journal of Academic Research*, *4*(2), 155-162.

Duncan, A. (2011). Forge a commitment to authentic professional learning. *Journal of Staff Development*, *32*(4), 70-72.

Dr. Pepper Snapple Group. (2013). *Careers*. Retrieved from https://secure.drpeppersnapplegroup.com/careers/

Eyster, L. (2010). Encouraging creativity in the science lab. *The Science Teacher*, *77*(6), 32-35.

Exxon Mobil Corporation. (2013). *Careers*. Retrieved from corporate.exxonmobil.com/en/company/careers

Fleith, D. D. (2000). Teacher and student perceptions of creativity in the classroom environment. *Roeper Review*, *22*(3), 48-53. doi:10.1080/02783190009554022

Fraenkel, J., Wallen, N. E., & Hyun, H. (2012). *How to design and evaluate research in education.* New York: McGraw-Hill Humanities/Social Sciences/Languages.

Geddes, L. (2010). Slow thinking may nurture creativity. *New Scientist*, *205*(2753), 12.

Gibson, H. (2005). What creativity isn't: The presumptions of instrumental and individual justifications for creativity in education. *British Journal of Educational Studies*, *53*(2), 148-167. Retrieved from http://www.jstor.org/stable/1555982

Grierson, E. (2011). Art and creativity in the global economies of education. *Educational Philosophy and Theory*, *43*(4), 336-350. doi:10.1111/j.1469-5812.2009.00550.x

Gude, O. (2010). Playing, creativity, possibility. *Arts Education*, *63*(2), 31-37.

Guilford, J.P. (1950). Creativity. *American Psychology*. *5*(9), 444-454. doi: 10.1037/h0063487

Hanna, G., Patterson, M., Rollins, J., & Sherman., A. (2011). *The arts and human development: Framing a national research agenda for the arts, lifelong learning, and individual well-being*. Washington, D.C.: National Endowment for the Arts in partnership with the U.S. Department of Health and Human Services.

Harris, C., Collins, M., & Cheek, D. (2013). *America's creative economy: A study of recent conceptions, definitions, and approaches, to measurement across the USA*.

Retrieved from http://nationalcreativitynetwork.org/wp-content/uploads/2010/11/AmericasCreativeEconomyFULLREPORT.pdf

Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning*. London: Routledge.

Hélie, S., & Sun, R. (2010). Incubation, insight, and creative problem solving: A unified theory and a connectionist model. *Psychological Review*, *117*(3), 94–1024. doi:10.1037/a0019532

Henshon, S. (2010). Explorations in creativity: An interview with Mark Runco. *Roeper Review*, *32*(1), 2-4. doi:10.1080/02783190903386215

Hope, S. (2010). Creativity, content, and policy. *Arts Education Policy Review*, 111, 39-47. doi: 10.1080/10632910903455736

IBM. (2010). *Capitalizing on complexity: Insights from the global chief executive officer study.* Ottawa: The Conference Board of Canada.

International Baccalaureate Organization. (2007). *Diploma programme theatre guide*. Cardiff, Wales, United Kingdom: Antony Rowe Ltd.

International Baccalaureate Organization. (2009). *IB learner profile packet*. Cardiff, Wales, United Kingdom: Antony Rowe Ltd. Retrieved from http://www.ibo.org/programmes/profile/documents/Learnerprofileguide.pdf

International Baccalaureate Organization. (2011). Creativity: It's not what you know.... *IB World*. Retrieved from http://www.ibo.org/ibworld/may2011/leadfeaturecreativity.cfm

International Baccalaureate Organization. (2014a). *The IB middle years programme*. Retrieved from www.ibo.org/myp/index.cfm

International Baccalaureate Organization. (2014b). *What are IB world schools*. Retrieved from www.ibo.org/who/slidee.cfm

Jaffer, S. (2013). *Harnessing innovation in the 21st century: The impact of leadership styles.* (Doctoral Dissertation). Retrieved from http://pqdtopen.proquest.com/#viewpdf?dispub=3557412

Jeffrey, B., & Craft, A. (2010). Teaching creatively and teaching for creativity: Distinctions and relationships. *Educational Studies*, *30*(1), 77-87. Retrieved from http://dx.doi.org/10.1080/0305569032000159750

Kennedy Center. (2014). *ARTSEDGE: Growing from STEM to STEAM*. Retrieved from https://artsedge.kennedy-center.org/educators/how-to/growing-from-stem-to-steam

Kim, K. (2006). Can we trust creativity tests: A review of the Torrance Test for Creative Thinking (TTCT). *Creativity Research Journal, 18*(1), 3-14.

Kim, T., Hon, A. H., & Lee, D. (2010). Proactive personality and employee creativity: The effects of job creativity requirement and supervisor support for creativity. *Creativity Research Journal*, *22*(1), 37-45. doi:10.1080/10400410903579536

Kirschenbaum, R. J. (1998). The creativity classification system: An assessment theory. *Roeper Review*, *21*(1), 20-26.

Lai, E. & Viering, M. (2012). *Assessing 21st century skills: Integrating research findings.* National Council on Measurement in Education. Vancouver, BC: Pearson, 1-66.

Lapeniene, D., & Bruneckiene, J. (2010). Teachers' creativity in the domain of professional activity. Analysis of individual factors. *Economics and Management*, 642-649.

LEGO Group. (2013). *Jobs working at the LEGO group*. Retrieved from

http://jobs.lego.com/en-us/workingatthelegogrouppage

LEGO Systems, Inc. (2007). *Lego survey reports: Creativity is critical for new recruits*. Retrieved from http://www.prnewswire.com/news-releases/legor-survey-reports-creativity-is-critical-for-new-recruits-office-politics-are-stifling-my-creativity-58292332.html

Lichtenberg, J., Woock, C., & Wright, M. (2008). *Ready to innovate: Are educators and executives aligned on the creative readiness of the U.S. workforce?* New York, NY: Conference Board.

Livingston, L. (2010). Teaching creativity in higher education. *Arts Education Policy Review*, *111*(2), 59-62. doi:10.1080/10632910903455884

Marshall, J. (2010). Thinking outside and on the box: Creativity and inquiry in art practice. *Arts Education*, *63*(2), 16-23.

Milbrandt, M., & Milbrandt, L. (2011). Creativity: What are we talking about? *Arts Education Journal*, *64*(1), 8-13.

Millar, G. W. (2010). *The power of creativity: Results of the 50-year follow-up to the Torrance Longitudinal Study of creative behavior*. Bensenville, IL: Scholastic Testing Service.

Mishra, P., & Henriksen, D. (2013). A NEW approach to defining and measuring creativity: Rethinking technology & creativity in the 21st century. *Techtrends: Linking Research & Practice to Improve Learning*, *57*(5), 10-13. doi:10.1007/s11528-013-0685-6

Missouri Department of Elementary and Secondary Education. (2013). *Missouri comprehensive data system - District info*. Retrieved from

http://mcds.dese.mo.gov/quickfacts/SitePages/DistrictInfo.aspx?ID=__bk81000300330093001300430013001300

Mrnarević, P. (2011). Creativity–vice or virtue?: A study of different visions of creativity. *Politička misao*, *48*(4), 7-25. doi:159.954:001

Mumford, M. D., Waples, E. P., Antes, A. L., Brown, R. P., Connelly, S., Murphy, S. T., & Devenport, L. D. (2010). Creativity and ethics: The relationship of creative and ethical problem-solving. *Creativity Research Journal*, *22*(1), 74-89. doi:10.1080/10400410903579619

National Art Education Association. (2014). *Arts education for America's students: Statement*. Retrieved from http://www.arteducators.org/advocacy/arts-education-for-americas-students

Newell, B. R., & Rakow, T. (2011). Revising beliefs about the merit of unconscious thought: Evidence in favor of the null hypothesis. *Social Cognition*, *29*(6), 711–726. doi:10.1521/soco.2011.29.6.711

Notar, C., & Padgett, S. (2010). Is think outside the box 21st century code for imagination, innovation, creativity, critical thinking and intuition? *College Student Journal*, *44*(2), 294-298.

Novotney, A. (2013). No such thing as 'right-brained' or 'left-brained,' new research finds. *Monitor on Psychology*, *44*(10), 10. Retrieved from http://www.apa.org/monitor/2013/11/right-brained.aspx

Oxford University Press. (2013). *Collaboration: Definition of collaboration in Oxford Dictionary.* Retrieved from http://oxforddictionaries.com/us/definition/american_english/collaboration

Palaniappan, A. K. (2012). Web-based creativity assessment system. *International Journal of Information and Education Technology*, *2*(3), 255-258. Retrieved from doi: 10.7763/IJIET.2012.V2.123

Partnership for 21st Century Skills (2009). *P21 framework definitions*. Retrieved from http://www.p21.org/storage/documents/P21_Framework_Definitions.pdf

Pérez-Peña, R. (2013, November 3). Robots or aliens as parents? Colleges gauge applicants' creativity. *New York Times*. Retrieved from http://http://www.nytimes.com/2013/11/03/education/robots-or-aliens-as-parents-colleges-gauge-applicants-creativity.html?src=xps

President's Committee on the Arts and the Humanities. (2011). *Reinvesting in arts education: Winning America's future through creative schools*. Retrieved from http://www.pcah.gov

Princeton University Library Data and Statistical Services. (2007). Working with dummy variables. Retrieved from http://dss.princeton.edu/online_help/analysis/dummy_variables.htm

Rhoades, M. (1987). An analysis of creativity. In S. G. Isaksen (Ed.), *Frontiers of creativity research: Beyond the basics* (pp. 216-222). Buffalo, NY: Bearly Ltd.

Robinson, K. (2011). *Out of our minds: Learning to be creative*. Oxford: Capstone.

Rosen, Y., & Tager, M. (2013). *Computer-based performance assessment of creativity skills: A pilot study*. Retrieved from http://researchnetwork.pearson.com/wp-content/uploads/creativityassessmentresearchreport.pdf

Rosing, K., Frese, M., & Bausch, A. (2011). Explaining the heterogeneity of the leadership-innovation relationship: Ambidextrous leadership. *The Leadership*

Quarterly, *22*, 956-974.

Runco, M. A. (2003). Education for creative potential. *Scandinavian Journal of Educational Research*, *47*(3), 317-324.

Runco, M. A. (2004). Creativity. *Annual Review of Psychology*, *55*, 657-87. doi: 10.1146/annurev.psych.55.090902.141502

Runco, M. A. (2007). A hierarchical framework for the study of creativity. *New Horizons in Education*, *55*(3), 1-9.

Scholastic Testing Service, Inc. (2013). *Gifted education: Torrance tests of creative thinking*. Retrieved from http://ststesting.com/2005giftttct.html

Shively, C. H. (2011). Grow creativity. *Learning & Leading with Technology*, *38*(7), 10-15.

Stangroom, J. (2014). Social science statistics home page. Retrieved from http://www.socscistatistics.com/

Sternberg, R. (2006). The nature of creativity. *Creativity Research Journal*, *18*(1), 87-98. Retrieved from http://dx.doi.org/10.1207/s15326934crj1801_10

Strand, T. (2011). Metaphors of creativity and workplace learning. *Scandinavian Journal of Educational Research*, *55*(4), 341-355. doi:10.1080/00313831.2011.587320

Torrance, E. P. (2007). *Torrance test of creative thinking: Directions manual figural forms A and B.* Bensenville, IL: Scholastic Testing Service, Inc.

Torrance, E. P. (2008). *Torrance test of creative thinking: Norms-technical manual, figural (streamlined) forms A & B*. Bensenville, IL: Scholastic Testing Service, Inc.

Torrance, E. P., Ball, O. E., & Safter, H. T. (2008). *Torrance test of creative thinking: Streamlined scoring guide for figural forms A and B*. Bensenville, IL: Scholastic Testing Service, Inc.

Wagner, T. (2012). *Creating innovators: The making of young people who will change the world.* New York, NY: Simon & Schuster, Inc.

Walmart Stores, Inc. (2013). *Career areas*. Retrieved from http://careers.walmart.com/career-areas/

Why creativity is like karaoke. (2013). *Inc*, *35*(8), 92.

Wong, Y., & Siu, K. (2012). A model of creative design process for fostering creativity of students in design education. *International Journal of Technology & Design Education*, *22*(4), 437-450. doi:10.1007/s10798-011-9162-8

Vita

Gretchen Teague teaches introductory and advanced theatre courses from the regular district curriculum and the International Baccalaureate Diploma Programme at Central High School in Springfield, Missouri. Teague has also served the Springfield R-12 District as a member of the Professional Learning Advisory Committee. In addition to teaching theatre, Teague has served as an IB Examiner for Theatre since 2010. Outside of secondary education, Teague has taught at Drury University Pre-College program, Drury Leadership Academy, and as a per-course instructor for Ozark Technical College and Missouri State University. Teague often facilitates professional learning opportunities through the Ozark Writing Project at Missouri State University, and Glass Classrooms and Persistence to Graduation (P2G) for Springfield Public Schools. She graduated with a Bachelor of Fine Arts in Theatre from Missouri State University in 1991. Teague returned to Missouri State University in 1998 to complete secondary certification in Speech and Theatre as well as English Language Arts. She graduated with a Masters in Secondary Education from Drury University in 2006.