TEACHERS' ATTITUDES AND FEATURES OF SUPPORT RELATED TO TEACHING FOR CREATIVITY AND MATHEMATICAL TALENT DEVELOPMENT IN THE UNITED STATES

By

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Abstract

This study further discusses creativity and mathematics gifted education, and synthesizes rational support of a proposed philosophy for teaching mathematics; Teaching for Creativity and Mathematical Talent development (TCMT). It also examined three variables related to teaching for creativity and mathematical talent development in the U.S.: teachers' attitudes, perceived support, and professional development. The major purpose is to contribute to understanding teachers' attitudes and enhancing school trends toward nurturing creativity for all students and meeting the needs of gifted/talented mathematics students utilizing broad conceptions of creativity and talent, and internalizing positive beliefs about student capability for success.

The participants in this study included 93 elementary mathematics teachers from several states in the United States of America. The findings indicate that teachers hold positive attitudes toward teaching for creativity and mathematical talent development (M=4.02, SD=.45). In regard to the extent of support, responses indicate that teachers are somewhat supported to teach for creativity and mathematical talent development; the mean of the overall perceived support was 3.04, SD = .84. The inferential analysis also revealed that overall perceived support did not contribute of a statistically significant proportion of unique variance in teachers' attitudes toward teaching for creativity and mathematical talent development (R^2 change < .0001, F change observed (1, 87) = .04, p = .85, α = .05). Professional development, however, was found to be the major variable accounting for a statistically significant proportion of unique variance (10%) in teachers' attitudes (R^2 change = .1, F change observed (1, 87) = 9.92, p = .002).

The implications of such support and professional development for teachers are discussed as significant factors on teaching effectiveness and student positive outcomes. Accordingly, recommendations for improving school environments and teaching quality are presented.

Dedication

This Work is Dedicated with Special Thanks to:

My parents for their sincere wishes of success, support, and for their patience with me being away for a long time of academic journey

My wife for the inspiration, support, sacrifice, and for understanding my busy schedule and the limited time I spend with our children

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CHAPTER 1: INTRODUCTION

Introduction

Maintaining a leadership position in the world in productivity and scientific development is a major aim that nations seek to attain. Youth are future leaders for any nation, and as such they should be exposed to educational experiences at early ages that help them become more independent, analytical, critical, creative, cooperative, and thus personally and socially successful in dealing with real life problems and needs. These significant skills should be developed in the general classroom for all students, with additional enrichment opportunities for those who express high academic abilities and potential talents.

Students at the elementary school age are in a critical developmental stage. At this level of education, essential and advanced skills can be developed to become life-long attributes, including creativity skills. Allowing youth to use their intellectual potential at early levels of education is recommended; as special efforts at university levels often are not effective with students who have experienced continued earlier boredom and frustration (Stanley, 1991). Literature also indicates that creativity as an attitude toward life and development is more obvious and easier to nurture in young children than it is in older children and adults who have been affected by environments that encourage intellectual conformity, suppress creativity, and overlook talent potential (e.g., Torrance, 1995; Beghetto & Kaufman, 2007; Sternberg, Kaufman, & Grigorenko, 2008).

Creativity has been viewed as an important multifaceted phenomenon that can be developed for all students in different areas toward different levels (Davis, 2004). As stated by Treffinger, Young, Selby, and Shepardson (2002), "Creativity can be expressed in a nearly infinite number of ways in human behavior and has its origins in several components of individual and social experience" (p. 5). Plucker, Beghetto, and Dow (2004) added that "creativity is an important component of problem-solving, healthy social and emotional well-being, and scholastic and adult success" (p. 83). Therefore, teachers should not only teach creatively, but also teach for creativity; in order to motivate students to think effectively and become continued creative learners who can make well informed critical decisions and choices in unexpected situations (Torrance, 1995; Brinkman, 2010; Sternberg, 2010; Sriraman, Yaftian, & Lee, 2011).

According to Sternberg and Kaufman (1998), children's multiple abilities would not be utilized if teaching and evaluation systems tend to undervalue creative and practical abilities. Teaching should not only be to help students learn facts and think critically about them; teaching should be for nurturing creative thinking, and facilitating overall development of students to become the mature adults they are capable of being (Sternberg, 2004). Sternberg (2006) explained that "teaching for creative as well as analytical and practical thinking combined enables children to capitalize on their strengths and to correct or to compensate for their weaknesses in order to be successfully intelligent individuals" (p. 94).

On the other hand, the National Council of Teachers of Mathematics NCTM (1980) stated that "outstanding mathematical ability is a precious societal resource, sorely needed to maintain leadership in a technological world" (p. 18). The United States of America is one of the most influential countries in the development of the current technological world. The quality research in both mathematics and mathematics education played important roles in the current advanced status of the United States in such a changing world (Karp, 2009). Maintaining this influential status and making consistent progress requires education that effectively nurtures creativity and further develops mathematical talent (Mann, 2005);

responding to the essential roles that mathematics plays in the development of sciences, technology, economics, and various branches of industry (Leikin, 2009).

The United States National Science Board NSB (2010) pointed out that "scientific and technological innovation, and improving the quality of life in the United States requires continued focus on excellence in science, technology, engineering, and mathematics (STEM) education and talent development" (p.5). The National Council of Supervisors of Mathematics NCSM (2012) released a position paper that also emphasizes the importance of providing productive learning environments that foster creativity and passion for all students, and expand talent development opportunities for mathematically promising students. Therefore, teaching for creativity and mathematical talent development should be adopted as a philosophy in schools beginning at early levels, in order to address multiple issues of education as a process of human development, and the education of mathematics as an important field in scientific development. This teaching philosophy should lead to a system of teaching methods that are significant not only for those who have potential talents but also significant for all students as the atmosphere of creativity enhances achievement for all.

Teaching for creativity enhances authentic learning and facilitates real achievement for all students (Sheffield, 2013; Bahar & Maker, 2011; Burleson, 2006); creativity here represents overall human development toward self-actualization. Self-actualization as a motive of creativity was defined by Maslow (1943) as "the desire for self-fulfillment and being everything that one is capable of becoming" (p.382). Teaching for mathematical talent development extends the efforts of developing creativity by further developing mathematical abilities, including mathematical creativity, for students who are academically high achieving/gifted; leading them to become talented and future mathematicians.

However, it seems that the support within the U.S. education system for nurturing creativity and mathematical talent is not at the desired level. Sternberg (2006) stated that “the systems in most schools strongly tend to favor children with strengths in memory and analytical abilities” (p. 93). Literature also reveals that the ambiguous nature of creativity and talent, and the great amount of time students spend in the general classroom are not considered; the enrichment programs still are provided exclusively under identification processes with inappropriate tools and inconsistent definitions of creativity and talent (e. g., Davis, 2004; Schroth & Heifer, 2008; Karp, 2009; Davis, Riman, & Seigle, 2011).

Furthermore, according to Kim (2011), U.S. children have become less creative since 1990. Using normative data of the Torrance Tests of Creativity Thinking (TTCT) from 1968 to 2008, Kim analyzed creativity skills of 272,599 kindergarten-through-grade12 students (K-12); this analysis showed that creative thinking scores remained static or decreased starting at sixth grade. Results also indicated that since 1990 creative thinking scores have significantly decreased, even as IQ scores have risen. The most significant decrease of creativity was found among kindergarten through third grade students. Although, it has been hypothesized that the high-stake standardized testing environment is a potential factor, causes of this decline in student creativity still need to be further investigated.

Gavin, Casa, Adelson, Carroll, and Sheffield (2009) added that current educational system in the United States does not serve the needs of students who have high potential; as well as, gifted students in mathematics still are one of the most neglected groups in general education schools. Mann (2006) also pointed out that mathematics is widely taught solely as a set of skills to master and rules to memorize with overemphasis on tests, single right answer, grades, and pacing which hinders creativity; the essential component involved in mathematics learning and mathematical talent development. Allen (2011) added that the current education system does not promote using thinking skills in constructing mathematics; as it focuses too much on standards and testing at the expense of democratic authentic learning. Furthermore, investigations into teachers instructional practices for developing student creativity and talent were not reported at the desired level (e.g., Brighton, Moon, Jarvis, & Hockett, 2007; Drain, 2008).

As stated by Milgram and Hong (2009), “societies that do not make every effort to assure that the potential talents of young people are utilized are losing their most valuable natural resource; human capital” (p. 161). This study aims to further investigate this issue by examining potentially influential factors in teachers’ practices toward nurturing creativity for all students and meeting the needs of gifted/talented mathematics students in general education schools; teachers’ attitudes, overall perceived support, and professional training (e.g., Brighton, Moon, Jarvis, & Hockett, 2007; Stemhagen, 2011). The major purpose is to contribute to enhancing school trends and understanding teachers’ attitudes toward teaching for creativity and mathematical talent development utilizing broad conceptions of creativity and talent, and internalizing positive beliefs about student capability for success.

This study is important not only because it is related to creativity and mathematical talent development in general school settings, but also because it was conducted in the United States as one of the most developed countries. Such implications of this study would be valuable for the United States as it seeks to maintain the leadership of the world scientific advancement, and for the world as it seeks new scientific innovations through the applications of mathematics. Furthermore, such research findings and development related to the U.S.

education system is transferable to other countries, as it is viewed as a model of an effective educational system.

Background

The National Council of Teachers of Mathematics NCTM (2000) pointed out that "in this changing world, those who understand and master mathematical abilities will have significantly enhanced opportunities and options for shaping a productive future" (p. 5). Providing students with an environment that nurtures creativity and develops their mathematical abilities should be a premier goal for educational systems that seek to create creative leaders of societies who can contribute in making life better. However, providing special enrichment programs only outside the classroom is not adequate; as these programs are hindered by identification procedures that might overlook some gifted students due to the ambiguous nature of creativity and talent. The importance of creativity as a factor of effective learning that should be developed for all students is another base for the idea that special out-of-classroom programs for certain identified students are not enough.

Creativity has a multifaceted and complex nature (Csikszentmihalyi, 1996; Davis, 2004). Philosophers, psychiatrists, and psychologists have attempted for many years to describe creativity which has resulted in not only different constructs of creativity, but also in different levels of creativity (Davis, Rimm, & Siegle, 2011). Literature also indicates that all individuals are capable of creativity, but they may function at different levels (e.g., Davis, 2004; Sternberg, 2006; Sternberg, 2010, Davis, Rimm, & Siegle, 2011). Sternberg, Kaufman, and Grigorenko (2008) pointed out that "research suggests that, to a large extent, people can become creative if they decide that is what they want to do" (p. 291).

Creativity has been defined in different ways; it was defined as a life style, as a factor of effective learning, as a component of giftedness, as a separate category of talent, and as original productivity. Plucker, Beghetto, and Dow (2005) described creativity as “the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context” (p. 90).

Broad theories of intelligence, on the other hand, viewed creativity as an aspect, as well as an outcome of intelligence, as they discussed intelligence as a modifiable multiple phenomenon (e.g., Gardner, 1983; Sternberg, 1985). Psychometric approaches of studying intelligence, however, have not provided a commonly accepted conclusion about its relationship with creativity (Jauk, Benedek, Dunst, & Neubauer, 2013). Kim (2005) concluded that “the negligible relationship between creativity and IQ scores indicates that even students with low IQ scores can be creative” (p. 65).

In mathematics and mathematics education domains, there is also no consensus on a clear definition of mathematical creativity. However, literature indicates that creativity is a feature of mathematical thinking (Sriraman, 2004), and a major element of mathematicians' accomplishments (Lee, Hwang, & Seo, 2003). Sriraman (2005) pointed out that students at the general education levels are capable of creativity. He explained that mathematical creativity in school settings can be defined as “the process that results in unusual or/ and insightful solutions to a given problem or analogy problems; or/ and the formulation of new questions or/and possibilities that allow an old problem to be regarded from a new angle requiring imagination which is similar to those for creativity in professional mathematics” (p. 24).

Creativity is included as a component in the prominent theories of giftedness and talent (Kaufman, Plucker, and Russell, 2011). Giftedness and talent, however, have been used interchangeably and defined in different ways with no one definition that is universally accepted. Davis, Riman, & Seigle (2011) pointed that “common usage of these two terms even by experts is ambiguous and inconsistent” (p. 17). Subotnik, Olszewski-Kubilius, and Worrell (2012) indicated that “giftedness can be viewed as developmental in the beginning stages in which potential is the key variable” (p. 176). Renzulli (2005) viewed giftedness as emerging from the interaction of three components; above average ability, creativity, and task commitment.

In turn, mathematical giftedness/talent can be demonstrated in a variety of ways. Although academic achievement in mathematics is a strong predictor of mathematical talent, the absence of academic achievement does not necessary mean the absence of potential. Students are different in terms of being stimulated to express their academic abilities, and “absence of evidence is not evidence of absence”. Sheffield (1994) stated that “the frequent narrow definition of gifted mathematics student is scoring above the 95th percentile on a test of mathematical achievement” (p. 3).

Miller (1990) mentioned that mathematical giftedness refers to “an unusually high ability to understand mathematical ideas and to reason mathematically, rather than just a high ability to do arithmetic computations or get top grades in mathematics” (p. 2). NCTM defines the group of students with high ability in mathematics as mathematically promising; the NCTM Task Force on Mathematically Promising Students identifies mathematical promise as “a function of ability, motivation, belief, and experience or opportunity with large range of abilities and a continuum of needs that should be met” (Sheffield et al., 1999, p. 310).

As a result of this ambiguity and overlap between academic achievement, giftedness, talent, intelligence, and creativity; it is difficult to achieve accuracy in the first critical process to provide gifted/talented students with special enrichment programs; the identification process. The identification process of gifted students for special educational services does not only lack of clear definitions of giftedness and talent, but also is affected by many other factors such as psychological and cultural factors. Therefore, the likelihood that some gifted students are excluded from special pull-out educational services does exist.

According to Davis, Rimm, & Siegle (2011), identification procedures of gifted students are usually conducted using intelligence and achievement tests, grades, and teacher nomination, which may lead to bias and inaccurate judgment of students' actual abilities. They added that even with using multiple criteria, "they are often added together in statistically unsound ways that product quantitative scores that obscure important indicators of high potential" (p. 60). Schroth and Heifer (2008) added that traditional programs for gifted and talented education use identification procedures that exclude many students who have promising potential. Mann (2006) pointed out that gifted students in mathematics can be overlooked especially that current practices in schools often reward only accuracy and speed. Kim, Cho, and Ahn (2003) confirmed that traditional tests used to identify the mathematically gifted do not identify or measure creativity.

Therefore, heterogeneous/general classrooms in many schools may include gifted students who are not identified as gifted and deprived from additional special services because of an inaccurate identification process, or because their schools do not offer special programs for gifted and talented students. Based upon that, and taking into account the importance of nurturing student creativity, and the importance of addressing the needs of gifted/talented students in general classrooms, teachers should internalize broad conceptions of creativity and talent, work to foster creativity skills for all students, and provide additional enrichment opportunities for those who have high abilities.

Burleson (2006) indicated that notable educators and psychologists agree that learning is enhanced when it is pursued as a creative and self-actualizing passion. Treffinger, Young, Selby, and Shepardson (2002) added that deliberate efforts to nurture creative thinking skills are important components of excellent educational programs. In the mathematics education field, creativity is considered the essence that should not be neglected in general classrooms in order to facilitate the development of talented young mathematicians (Mann, 2006; Leikin & Pitta-Pantazi, 2013).

Encouraging creativity in mathematics classes is important for all students to enjoy working in mathematics and to develop meaningful understanding of mathematical concepts. Creativity encouragement in mathematics is more important for students who have high abilities in order to develop their mathematical talent and to become more creative and future mathematicians. However, nurturing creativity and meeting the needs of gifted mathematics students in general education schools requires that teachers hold positive attitudes, and have facilities and support to teach for creativity and mathematical talent development.

Although previous studies indicated that most teachers recognize that gifted students have needs that should be met, these studies also revealed that teachers appeared to have ambivalence/ inconsistence views regarding their responsibility for nurturing creativity and developing talent in the general classroom, as well as teachers' instructional practices for talent development were not reported at the desired level (McCoach & Siegle, 2007; Aljughaiman & Mowrer-Reynolds, 2005; Brighton , Moon, Jarvis, & Hockett, 2007; Donerlson, 2008; Kim & Gentry, 2008; Drain, 2008; Ayebo, 2010; Dimitriadis, 2012; Cheung, 2012). McCoach &

Siegle (2007) indicated that the picture of teachers' attitudes toward gifted education is still not clear, as the results of previous studies have been mixed, and may not be generalizable to the general population of teachers. Furthermore, inconsistencies have been reported between teachers' stated beliefs and their classroom practices related to developing student creativity (Cheung, 2012).

Most of the relevant previous studies were related to teachers' perspectives, conceptions, or perceptions about giftedness and/or creativity in general, and few have been conducted related to teachers' attitudes toward creativity and talent in mathematics. Having knowledge and clear perceptions of creativity and giftedness should be aligned with positive attitudes and a professional supportive atmosphere related to creativity and talent development; creativity as a major feature of the effective classroom situation for all students; and talent development as the base of meeting the needs of gifted/talented students.

Moreover, none of the accessible studies analyzed the relationship between teachers' attitudes and the extent of support that they receive related to teaching for creativity and mathematical talent development. Cheung (2012) indicated that results from previous studies suggest that teacher practices can be a function of many factors, rather than just their beliefs. Therefore, it is important to conduct studies that examine teachers' attitudes in relation to overall available support, and the professional training in creativity and gifted education, as potential factors of teachers' attitudes and practices, in order to gain better insight about school environments in terms of nurturing creativity and talent development in each subject area; the current study intended to achieve this purpose in mathematics area.

In this study, the focus for examination is the relationship of teachers' attitudes toward teaching for creativity and mathematical talent development with the extent of overall support they perceive, and with the special professional development they receive in creativity and gifted mathematics education, after accounting for some demographic variables. Finding out key factors that shape teacher attitudes is useful in developing teacher professional development programs and school environments to achieve the aim of creativity enhancement for all students and mathematical talent development for those who are mathematically high achieving.

Problem Statement and Purpose

Literature indicates that there is a high probability that general classrooms include students who have high potential but they are not identified as gifted/talented students because of inaccurate identification processes or other obscuring factors (e.g., Davis, Rimm, & Siegle, 2011; Schroth & Heifer, 2008). Those students usually remain in regular educational settings without any additional fostering activities because they are not exposed to appropriate stimuli to express their abilities, overlooked and excluded from special developmental programs, or because their schools do not offer special programs for gifted education.

Providing special out-of-classroom enrichment programs is important, but it may not be affordable, as well as gifted/talented identification procedures might not be accurate. Therefore, teachers in general classrooms are to carry out this crucial commitment and develop their instructional practices with the belief that creativity skills are important to be nurtured for all students, and that there might be gifted students in their classrooms who need additional care to develop their talents and be more creative.

The problem of this study can be stated that there is likelihood that general classrooms include gifted students in mathematics, but those gifted students' needs may not be met.

According to the most recent administration of the Trends in International Mathematics and Science Study TIMSS (2011), as reported by National Center for Education Statistics, students at grade 4 of 8 in several countries, such as Singapore and Korea, had average mathematics scores above the U.S. students' average score. Although progress has been achieved, mathematical proficiency of the U.S students in comparison to some other eastern-Asian countries still raises questions about teaching mathematics for creativity as a factor of effective learning and real achievement. This problem is investigated partly in this study, by examining teachers' attitudes and the features of support related to teaching for creativity and mathematical talent development in general education elementary schools. The purpose is to extract implications that can be used to develop teachers' professional developmental programs, as well as improving school learning environments that fosters creativity and mathematical talent in general education settings.

Research Questions

The research questions that guide this study are:

1. What are elementary mathematics teachers' attitudes toward teaching for creativity and mathematical talent development?
2. What are features of support, related to teaching for creativity and mathematical talent development, that teachers feel are available?
3. Does the extent of overall perceived support contribute of a statistically significant proportion of unique variance (using an alpha level of .05) in teachers' attitudes toward teaching for creativity and mathematical talent development; after accounting for gender, academic degree, years of teaching experience, and professional development?
4. Does professional development contribute of a statistically significant proportion of unique variance (using an alpha level of .05) in teachers' attitudes toward teaching for creativity and mathematical talent development; after accounting for gender, academic degree, years of teaching experience, and overall perceived support?

Research Hypotheses

Based upon relevant literature, formal and informal discussions with teachers, as well as the researcher's experience in teaching elementary mathematics and working with pre-service mathematics teachers, the following hypotheses are proposed for examination in this study:

1. Mathematics teachers in U.S. general education elementary schools hold positive attitudes toward teaching for creativity and mathematical talent development.
2. Mathematics teachers do not have enough support to teach for creativity and mathematical talent development in general education settings.
3. There is a significant positive unique contribution of the extent of overall support that teachers perceive in their attitudes toward teaching for creativity and mathematical talent development.
4. There is a significant positive unique contribution of professional development that teachers receive in their attitudes toward teaching for creativity and mathematical talent development.

Definitions of Terms

The key-terms of this study can be defined theoretically and operationally in relation to the topic as follows:

Attitudes: Attitude is defined in Merriam-Webster dictionary (2014) as "a feeling or way of thinking that affects a person's behavior". In this study, attitudes are opinions and beliefs associated with feelings driven by one's values related to nurturing creativity and gifted education in general education schools.

Creativity: "Behaviors or actions that, while appropriate and relevant to the situation, reflect original, new or novel thought and flexible non-traditional approaches" (Griffith & Kowalski, 2010, p. 34). Creativity in this study is considered a multi-level ability that includes all types of thinking skills, and can be nurtured for all students; creativity also is a component of giftedness that should be considered as a major part of the mathematical talent development process.

Giftedness and Talent: Gagné (1995, 2004) proposed a distinction between giftedness and talent. Gagné (2004) indicated that:

> The term *giftedness* designates the possession and use of untrained and spontaneously expressed natural abilities (called outstanding aptitudes or gifts), in at least one ability domain, to a degree that places an individual at least among the top 10 percent of age peers. On the other hand, the term *talent* designates the outstanding mastery of systematically developed abilities (or skills) and knowledge in at least one field of human activity to a degree that places an individual at least among the top 10 percent of age peers who are or have been active in that field or fields.(p. 120)

The researcher proposes that the giftedness in mathematics is a combination of aptitudes, motivation, and attitudes toward mathematics that when nurtured in parallel with creativity skills may turn to be mathematical talent, and later with more effort and a supporting environment for creativity, mathematical genius may show up. However, the terms giftedness and talent are usually used interchangeably in the field of gifted and talented education, and are so used in this study.

Mathematical Talent: The researcher defines mathematical talent as clear demonstration of evolving abilities in mathematics including intuitive, inductive, divergent, analytical, critical, deductive, and abstract thinking. These abilities are interrelated, however, we can theoretically sate the last four abilities widely describe giftedness, and the former three abilities widely describe creativity; mathematical talent is the result of the development of creativity and giftedness as interrelated interactive constructs. Aptitudes, motivation, and attitudes toward mathematics (giftedness) are stand points to develop mathematical talent. Developing mathematical talent requires providing gifted students with learning environments that further develop their creativity and lead them from being gifted to become talented, with additional supportive atmosphere of creativity for being future mathematicians.

Features of Support: Features of the support that teachers need as essential components of the appropriate environment that facilitates effective teaching for creativity and mathematical talent development in general education schools including effective policy, resources, facilities, programs, professional development opportunities, and human support. The degree of availability of these features is used in this study as an indication of the level of support that teachers receive.

Significance

Research on creativity and talent development is inadequate in the mathematics education field (Leikin, 2009). Dimitriadis (2012) pointed out that there is still paucity in research that investigates aspects of provision for the gifted and talented in mathematics especially within elementary schools. Reform of teaching requires continued development in all aspects of the schooling process, including professional development of teachers. Robinson, Shire, and Enersen (2007) stated that "a recent focus of professional development is on the personal history and belief system of teachers" (p. 267).

Studies on teachers' attitudes and features of support related to teaching for creativity and talent development are recommended. For example, McCoach and Siegle (2007) recommended further investigations of the impact of professional training on teachers attitudes toward gifted education, as their study did not reveal a significant relationship between teachers' attitudes and the professional training they received in gifted education, which is "a troubling finding" (p. 254), as they stated. Moreover, Kampylis, Berki, and Saariluoma (2009) concluded that further research still is needed in order to understand teachers' conceptions of creativity and classify their needs to facilitate the creative potential of elementary school students.

Teachers' practices for developing student creativity and mathematical talent are influenced by their attitudes (e.g., Guilford, 1958; Stemhagen, 2011). Positive attitudes toward teaching for creativity and mathematical talent development are built upon positive beliefs that may lead to best practices that nurture creativity and meet the needs of gifted mathematics students. Positive beliefs, attitudes, along with sufficient environmental support and professional development may lead to efficient practices that develop creativity and mathematical talent in general educational settings, in order to nurture successful future leaders who can keep their communities productive and innovative.

Numerous studies have been conducted in relation to the perceptions and conceptions of creativity and/or giftedness, but little have been done related to teachers' attitudes that combine these two important concepts together in mathematics; creativity and talent. Successful implementation of such professional development programs related to teaching for creativity and talent development depends on understanding teachers' attitudes and the possible factors that shape them. The overall support that teachers perceive and the special professional development that they receive in creativity and gifted mathematics education are important variables that might have relationships with teachers' attitudes, but they have not been adequately investigated. Revealing the features of support that are available for teachers, as well as the professional development received related to creativity and mathematical talent development is needed for setting appropriate plans for future improvement of school environments and professional development programs.

The population of this study is elementary mathematics teachers in the United States which also makes this study important for several considerations. These considerations include the critical position of the elementary education level among other levels as a period of establishing life-long characteristics, the special status of mathematics among other subjects as a central field leading scientific development, and the advanced status of the U.S. educational system that is under ongoing development to maintain its advancement. Moreover, the implications of this study are transferable to other educational systems all over the world as they can be used to improve teacher professional development programs, and school environments for fostering creativity and mathematical talent in general education settings.

Chapter Summary

Elementary education level is critical in student skills development. Teaching for creativity and mathematical talent development in general education elementary schools is important not only for those who have potential talent but also for all students as teaching for creativity enhances authentic learning and leads to real achievement. However, literature indicates that current educational systems do not foster creativity, as well as that gifted students in mathematics is one of most neglected groups in general education schools.

Positive attitudes, environment support, and professional development are essential for teachers to have in order to teach for creativity and mathematical talent development as a way of promoting mastery learning of mathematics, as well as meeting the needs of those who are gifted, moving them to become talented and future mathematicians. Attitudes, as a component of the personal belief system, affect instructional practices and thus education outcomes. Examining teachers' attitudes is important because it may lead to discover factors that shape them, so teachers' professional development and plans for improving school environments can be directed in light of these factors. Previous studies on teachers' attitudes revealed that teachers generally have positive attitudes. However, studies about features of available support were few, indirect, and with negative conclusions about the extent of support that teachers receive.

This study aims to further investigate teachers' attitudes and features of support related to teaching for creativity and mathematical talent development in U.S. general education elementary schools. The major purpose is to extract implications for further development of teachers' professional programs as well as school environments that support creativity and mathematical talent development in general educational settings.

CHAPTER 2: LITERATURE REVIEW

Preface

Gifted and talented education is an important issue worldwide, but it is perceived and addressed differently from population to another. Creativity is an important, if not the most important, topic in the education of gifted and talented children (Davis et. al., 2011). Nations rely on talented individuals to utilize their skills at the highest level possible and contribute to improving all life aspects including solving problems creatively, developing genuine innovations, and leading communities to productivity.

Therefore, research has been focused on topics related to creativity and talent development in order to understand and develop teaching practices that meet, not only the needs of gifted students, but also foster creativity for all students. Talent in mathematics is a major focus for many researchers because of the importance of mathematics in scientific development and innovation. Creativity is considered not only as a major component of talent, but also as the essence of mathematics that should be fostered for all students, especially for gifted students as a part of mathematical talent development. Defining, identifying, and nurturing creativity and talent in mathematics are evolving topics in the field of mathematics talented education.

Creativity as a Human Phenomenon

There have been attempts for many years to describe the construct and the principles of creativity which has resulted not only in different constructs of creativity, but also to different levels of creativity (Davis, Rimm, & Siegle, 2011). Some of these different views are general and others overlap with other concepts such as giftedness, talent, and intelligence. The major four strands for inquiry on creativity were identified first by Rhodes (1961): the person, process, product, and the press (place/ environment); known collectively as "The 4Ps model". These strands have been the focus of the majority of creativity definitions with different types of interactions and weights.

Humanistic psychologists Maslow (1943,1968) and Rogers (1954) related creativity to self-actualization as a high level personal need that requires prior fulfillment of other basic needs including physiological, safety, social, and esteem needs. According to Maslow (1943) self-actualization refers to "the desire for self-fulfillment and being everything that one is capable of becoming" (p. 382). Rogers (1954) indicated that creativity emerges from the need of self-actualization that involves prerequisite personal and environmental conditions that support an internal locus of evaluation, feeling of worth, and freedom of expression. Maslow (1943) described that although creative behavior has multiple determinations, the products of creative people who are satisfied in their basic needs can be distinguished from the products of unsatisfied creative others.

Although it was not effectively utilized until decades later, the humanistic approach to understanding creativity has been prominent as the essence of broad contemporary conceptions of creativity. Davis (2004) pointed out the humanistic approach to creativity, through its relationship with self-actualization, provided the most influential concepts in the field of creativity; he summarized that Maslow and Rogers' theories of creativity indicate that the creative person is "a self-actualizing human being who is mentally healthy, self-accepting, democratic minded, fully functioning, and forward growing using all of his/her talents to become what he/she is capable of becoming" (p. 2).

Guilford (1950, 1966) discussed creativity with more emphasis on thinking processes especially divergent thinking in problem solving. According to Guilford (1950), creativity "represents patterns of primary abilities that can vary with different spheres of creative activity, and are based in multiple intellectual factors including sensitivity to problems, ideational fluency, flexibility of set, ideational novelty, synthesizing ability, analyzing ability, reorganizing or redefining ability, span of ideational structure, and evaluating ability"(p. 454). Guilford (1966) added that actual creative performance depends on multiple qualities and dimensions related to potentiality and on what the operating situation allows. The factor of creative potential was central in Guilford's view of creativity, as he (1966) indicated that it plays a significant role, and can be defined as "what an individual brings to a possible creative performance because of his personality structure" (p. 186).

Torrance (1962, 1993) also emphasized creative thinking process, he indicated that creativity is an important natural process that is based on human needs, and leads to effective learning and continued growth. He (1993) described creative thinking as "the process of sensing of difficulties, problems, gaps in information, missing elements, something askew; making guesses and formulating hypotheses about these deficiencies; evaluating and testing these guesses and hypotheses; possibly revising and retesting them; and, last, communicating the results " (p. 233). According to Torrance's view (1962, 1993), creativity is the essence of scientific discoveries and inventions, and it is also in the realm of everyday living; as it is not only reserved for ethereal achieved heights of creation.

Amabile (1982, 1983a, 2001) discussed creativity as a dynamic process influenced significantly by the social environment factor. According to Amabile (1982), creativity can be regarded as "the quality of response, process, or products judged to be creative by appropriate observers familiar with the domain in which the response was articulated, the process implemented, or the product created" (p. 1001). She (1983a, 2001) criticized theories of creativity that overemphasize personal talent as a premier source of individual creativity; and proposed her componential model that emphasizes hard work and passionate desire as factors that play central roles in creativity performance.

Amabile's componential model of creativity (1983a) includes three basic intra-individual components. The first component is domain-relevant skills/expertise, which represents competencies and talents applicable to the domain or domains in which the individual is working. The second component is creativity-relevant processes, which represent personality characteristics, cognitive styles, and work habits that promote creativity in any domain. The third component is the intrinsic task motivation, the internally driven involvement in the task at hand, which can be influenced significantly by the social environment as an extra individual factor of creativity and innovation. Amabile and her collogues (1996) added that innovation does not depend only on individual creative ideas, but also requires creative ideas generated and matured by work teams within organizations that support successful implementation. Schools as educational organizations represent environments within which student creative thinking should be nurtured and ideas for innovative products should be supported.

Treffinger (1988, 1991) proposed the COCO model of creativity in which he indicated that creative productivity arises from dynamic interactions among four essential components: characteristics, operations, context, and outcomes. Characteristics include generating ideas, thinking deeper for more ideas, openness and courage to explore ideas, and listening to one's inner voice. Operations involve the strategies and techniques people employ to generate and analyze ideas, solve problems, make decisions, and manage their thinking. Context includes the culture, climate, situational dynamics such as communication and collaboration, and the physical environment in which one is operating. Outcomes are the products and ideas that result from people's efforts.

Sternberg & Lubart (1991, 1996) analyzed creativity as an investment process; their Investment Theory of Creativity is a confluence theory according to which creative people are those who are willing and able to “buy low and sell high” in the realm of ideas. Sternberg (2006) described that “ buying low means pursuing ideas that are unknown or out of favor but that have growth potential; and, often, when these ideas are first presented, they encounter resistance; the creative individual persists in the face of this resistance and eventually sells high, moving on to the next new or unpopular idea” (p. 87). According to the Investment Theory of Creativity (Sternberg & Lubart, 1991, 1996), creativity requires a confluence of six distinct but interrelated resources: knowledge, intellectual abilities, styles of thinking, personality, motivation, and environment. Knowledge has been considered essential to produce original work and to go beyond what has been already known; it is also necessary because creativity can be domain specific. The intellectual abilities include synthetic, analytic, and practical abilities; using these three abilities, creative individuals can see connections, redefine problems, analyze ideas and judge their potential return, and present ideas in ways that show their values and get accepted for implementation. The styles of thinking represent the ways people prefer to use their intellectual abilities, such as the inventing legislative, implementing, and the evaluating style.

Sternberg, O'Hara, and Lubart (1997) indicated that everyone possesses every style to some degree, but individuals who want to be creative have to prefer and strengthen the inventing style of thinking which means doing things in novel ways. In addition to knowledge, ability, and style of thinking, individuals also need to have motivation for creativity in order to cope with difficulties faced and move forward with enjoyment. Creativity also requires a self-determined and risk-taking personality that persists for achievement, as well as an environment that supports the investment of ideas and spreads the risks.

Plucker, Beghetto, and Dow (2004) described creativity as "the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context" (p. 90). Beghetto and Kaufman (2007) highlighted the relationship between learning and creativity; they indicated that "the interpretive and transformative process of information is a creative endeavor" (p. 73). They also pointed out that researchers and educators should broaden their conceptions of creativity, and explore how to "best support a lifetime of creative learning and expression" (p. 78). Tanggaard (2013) added that creativity should be viewed as "an everyday phenomenon resulting in continual processes of making the world" (p. 20). Therefore, it can be summarized that creativity is a wide-range attribute that can be expressed through different life skills related to multiple aspects including the intellectual personal, environmental social, and innovative productivity aspect.

Davis, Rimm, and Siegle (2011) concluded also that there are many intellectual abilities that contribute to creative potential; they described the major abilities of creativity that have appeared in creativity literature, especially in Guilford (1967) and Torrance's (1988, 1995) work, as the following:

- **Fluency**: The ability to produce many ideas in response to an open-ended problem or question, either verbal or nonverbal ones.
- **Flexibility**: The ability to make different approaches to a problem, think of ideas in different categories, or view a situation from several perspectives.

- **Originality**: statistical rarity or uniqueness and nonconformity.
- **Elaboration**: The ability to add details, develop, and implement a given idea.

Davis, Rimm, and Siegle (2011) added that creativity is not limited to these common four abilities. They indicated that other important creative abilities include problem finding, problem sensitivity, problem defining , visualization, analogical thinking, evaluation, intuition, curiosity , independence, resisting premature closure, risk taking, logical thinking, seeing structure in chaos, discovering relationships, planning, prioritizing, and making good decisions. Literature also indicates that all individuals are capable of enjoying creative thoughts and production, but they may function at different levels of creativity; the following levels of creativity were adopted by Wilson (n.d.) from the work of A. Taylor (1959):

- **Intuitive level**: Creative expression for the intrinsic joy of creativity.
- **Academic and technical level**: Adding power to the creative expression by learning the techniques and skills related to the creative work.
- **Inventive level**: Going beyond skills and challenging the boundaries to practice untraditional experiments.
- **Innovative level**: Originality and out of the ordinary productions or ideas that have a guiding academic foundation.
- **Genius level**: The uniqueness of the ideas or the accomplishments that might have additional genetic aspects.

Creativity and Human Intelligence

Creativity has been discussed in relation to intelligence; however, literature indicates that "intelligence, as like as creativity, lacks a solid operational definitional foundation;

definitions of intelligence still range from a neural efficiency perspective to the ability to adapt the self to the environment" (Batey & Furnham, 2006, p. 364). Brody (2000) stated also that "contemporary theorists have not attained consensus about the definition of intelligence" (p. 30). Psychometric approaches of studying intelligence, in turn, have not provided a commonly accepted conclusion about its relationship with creativity (Jauk, Benedek, Dunst, & Neubauer, 2013).

Factor analysis of human intelligence provided different views of the quantity and quality of the factors accounting for its components. The view of the single general ability factor "g" that accounts for most human cognitive abilities has been presented earlier, criticized, utilized, and developed (e.g., Spearman, 1904, as cited in Brody, 2000). Guilford's (1956) multiple factors of intelligence and Cattell's (1963) theory of the fluid and crystallized intelligence provoked the field for more investigations and broader multi-aspect views and hierarchical modeling. The study of Flynn (1984) on intelligence development through generations added more complexity and new directions toward understanding and developing intelligence; as he proposed that the environment, Flynn's effect, positively affects human intelligence as it develops. Flynn (2007) concluded that intelligence should be conceptualized like "the atom with multiple components that are held/blended together by the general intelligence factor, and smashed/ splitted by the Flynn effect/environment effect on IQ gains over time" (p. 4).

In regard to creativity, broad theories of intelligence viewed creativity as an aspect and an outcome of intelligence; as they discussed intelligence to be a modifiable phenomenon with multiple factors (e.g., Guilford, 1956; Gardner, 1983; Sternberg, 1985). Guilford (1950) related creativity to divergent thinking process and included it as an aspect in his model of intelligence.

In his model of intelligence, the Structure of Intellect, Guilford (1956) criticized the view of the single "g" factor of intelligence, and discussed a system of multiple factors of human intellectual abilities that were categorized under general headings including cognition (discovery), production (convergent and divergent thinking), and evaluation. Guilford also contributed to directing research to view intelligence as a multi-aspect phenomenon, as he (1956) indicated that "specifying a number of intelligences would be helpful in more understanding of human abilities" (p. 291).

Gardener (1983, 1999) is also against the notion of determining human intelligence with a single general factor. He has a wide view of intelligence that considers creativity a parallel ability, with a focus on providing the conditions for the utilization of human multiple intelligences rather than just concerning about assessment. According to Gardner (1983), each human being possesses a blend, with different levels, of several basic intellectual competences/ semi-independent intelligences that include linguistic, logical-mathematical, musical, bodily-kinesthetic, spatial, interpersonal, and intrapersonal intelligence. Gardner (1999) discussed also the possible existence of three additional kinds of intelligence, the naturalist, spiritual, and the existential intelligence. He also indicated that the discussion is still open for additional types of intelligences; as human intelligence is hard to capture.

According to Gardner (1999), creativity is a part of the intellectual realm that is parallel with, but different than intelligence. Gardner (1999) defined creativity as "the faculty of solving problems, creating products, or raising issues in a domain in a way that is initially novel, but is eventually accepted in on or more cultural setting" (p. 116). He (1999) pointed out that the major difference between creativity and intelligence is that creativity is a domain-specific activity that results in novel products or changes in the domain. Gardner (1999) admitted that the relationship between intelligence and creativity is complex, as he discussed different possible factors, kinds, and levels of creativity that emerged from personality theories and social psychology.

Sternberg's Triarchic Theory of Intelligence (1985) was one of theories that clearly included creativity as an aspect of intelligence. Sternberg's Triarchic Theory of Intelligence (1985) viewed creativity as an aspect among three interacting aspects of intelligence. The first aspect is analytical intelligence which involves information processing skills. The second is practical intelligence which involves using mental components of intelligence to adapt to, shape, or select environment that appropriate for oneself. The third aspect is creative intelligence which involves using mental components of intelligence to create new products or make new discoveries.

In terms of empirical research, the issue of whether current Intelligence Quotient tests (IQ) truly assess human intelligence, in addition to the difficulties in the assessment of creativity itself, has been the major challenge toward providing a commonly accepted conclusion about the relationship between human intelligence and creativity. Even with the reliance on IQ tests, Torrance (1993) argued that the possession of high intelligence as measured by IQ tests is not enough for outstanding creative success. He explained that creative thinking includes responding constructively to existing or new situations which may take time for incubation, rather than merely adapting to them using limited intellectual abilities.

Jauk, Benedek, Dunst, and Neubauer (2013) stated that "investigations of the relationship between intelligence and creative potential provide a scattered view" (p. 214). They added that even studies of the prominent threshold hypothesis of the relationships between intelligence and creativity showed inconsistent results. They indicated that the threshold of 120 IQ points, as the minimum level of intelligence necessary for creativity, represents an educated guess; as empirical reliable supporting studies still are inadequate in this aspect.

Batey and Furnham, (2006) indicated that making unequivocal conclusions about the relationship between creativity and intelligence is unwise. They indicated that it is unwise because of inconsistent definitions provided for creativity and intelligence, the different types of psychometric instruments used, as well as the influential traditional issues faced in such measurement studies including the design of IQ and creativity tests, sample sizes, and statistical analyses. Kim (2005) concluded that “the negligible relationship between creativity and IQ scores indicates that even students with low IQ scores can be creative” (p. 65)

In conclusion, data obtained from empirical studies of the relationship between creativity and intelligence as measured by IQ tests reveals that both high IQ and average students have the potential to develop and expand their creative thinking skills (Kim, 2005). Research in this aspect also indicates that creativity is not solely dependent upon intelligence as studies showed that average students can score higher than high IQ students on some parts of creativity tests, as well as high IQ students are not always able to score consistently on all tasks of cognitive problem solving and creativity tests (Russo, 2004).

Therefore, creativity should be considered as a multifaceted human development phenomenon that includes a broad range of personality characteristics, life skills, general mental skills, and domain-related skills (specialized creativity). Demonstrating evolving skills related to a certain academic field can be a sign of creativity in that field; mathematical creativity for example. Sings of creativity in mathematics can be further developed in order to reach the highest level of creativity which represents the production of novel solutions that extend knowledge in the field.

Creativity as the Essence of Mathematics

Although a common definition of mathematical creativity does not exist in mathematics and mathematics education domains, mathematicians agree that creativity is a major element of mathematical activities (Yuan & Sriraman, 2011; Lee, Hwang, & Seo, 2003). Literature in this aspect suggests that creativity, in general, represents a wide range of cognitive abilities, different categories of performance, and multiple kinds of outcomes. Creativity in mathematics is also connected to multiple mathematical abilities that can be nurtured; the commonly discussed abilities of which are problem finding, problem reformulating, and problem solving (Norwich, 1997; Sheffield, 2009; Juter & Sriraman, 2011).

Contemporary mathematics educators view creativity as “an orientation or disposition toward mathematical activity that can be fostered broadly in the general school population” (Silver, 1997, p. 75). Mann (2006) pointed out the creativity is the essence of mathematics and the most influential factor of effective learning, mathematical talent development, and future mathematical accomplishments. Creativity in school mathematics is viewed as a relativistic phenomenon that should be evaluated with reference to each student’s previous knowledge and experiences and to the performance of other students who have similar social and educational status (Liljedahl & Sriraman, 2006). Leiken (2009) also indicated that mathematical creativity is “the dynamic property of the human mind and each child’s creative potential can be developed and realized, or on the contrary, deprived” (p.129).

Sriraman (2005) added that although creativity in mathematics is often looked at as the exclusive domain of professional mathematicians, “students at the K-12 level are capable of creativity” (p.86). He explained that at the professional level, mathematical creativity can be defined as the ability to produce original work that significantly extends the body of knowledge, and/or one who opens up avenues of new questions for other mathematicians. On the other hand, mathematical creativity in school settings can be defined as the process that results in unusual and/or insightful solutions to a given problem or analogy problems; and/or the formulation of new questions and/or possibilities that allow an old problem to be regarded from a new angle requiring imagination which is similar to those for creativity in professional mathematics.

It can be concluded that creativity in mathematics is a malleable multi-level ability that is considered the essence of mathematical learning and accomplishment. All students have the potential of expressing and developing mathematical creativity as it is contained in a larger phenomenon that has been also viewed in different ways; giftedness and talent in mathematics.

Giftedness and Talent in Mathematics

There is no one definition of giftedness and talent that is universally accepted. Freiman (2010) stated that “the terminology used in the context of identification of children with special abilities operates with many words such as promising, advanced, talented, high ability, extraordinary, above average, gifted; whose sense may differ from one author to another” (p. 3). Kaufman, Plucker, and Russell (2011) indicated that the prominent theories of giftedness include creativity as a major component.

Marland (1971), Gagné (1995, 2005), Sternberg (2003), and Renzulli (2005) defined giftedness with creativity as a component. Marland's (1971) definition of giftedness and talent included six areas: general intellectual ability, specific academic aptitude, creative or productive thinking, leadership ability, visual and performing arts, and psychomotor abilities. Gagné's (1995, 2004) Differentiated Model of Giftedness and Talent (DMGT) conceptualizes "gifts" as the natural untrained abilities (or aptitudes) in one or more domain including intellectual, creative, socio-affective, and sensorimotor domains; and "talents" as well-trained skills that emerges from the transformation of these gifts through systematic development. In Sternberg's (2003) model, giftedness is conceptualized as a synthesis of wisdom, intelligence, and creativity (WICS). Renzulli's (2005) Three-Ring Conception model views giftedness as the outcome of the interaction of well above average ability, creativity, and task commitment. Renzulli (2005) proposed two interacted types of giftedness: schoolhouse giftedness and creative productive giftedness. The schoolhouse giftedness refers to the ability of lesson-learning and test-taking and can be measured by IQ or other cognitive ability tests. The creative productive giftedness involves generating novel ideas and creating products that have an impact on others and cause change in the environment.

The National Association of Gifted Children NAGC (2010) published a position paper proposing a new definition of giftedness that emphasizes talent development as a lifelong process. Gifted individuals, according to NAGC (2010), are those who "demonstrate outstanding levels of aptitude (defined as an exceptional ability to reason and learn) or competence (documented performance or achievement in top 10% or rarer) in one or more domains; domains include any structured area of activity with its own symbol system (e.g., mathematics, music, language) and/or set of sensorimotor skills (e.g., painting, dance, sports)" (p. 1).

Subotnik, Olszewski-Kubilius, and Worrell (2012) discussed definitions of giftedness and talent with more emphasis in cognitive and psychosocial variables as determining malleable factors in the successful development of talent. Their proposed definition of giftedness and talent includes that giftedness is:

> The manifestation of performance that is clearly at the upper end of the distribution in specific talent domain, even relative to other high functioning individuals in that domain, that can be viewed as developmental in the beginning stages, potential is the key variable; in later stages, achievement is the measure of giftedness; and in fully developed talents, eminence is the basis on which this label is granted; both cognitive and psychosocial variables play an essential role in the manifestation of giftedness at every developmental stage, are malleable, and need to be deliberately cultivated. (p. 176)

As a result of the different perspectives in giftedness, giftedness in mathematical has been viewed in a variety of ways. Sheffield (1994) indicated that "definition of giftedness in mathematics as scoring above the 95th percentile on a test of mathematical achievement is narrow" (p. 3); she pointed out that there are many characteristics and abilities that represent giftedness in mathematics. These characteristics and abilities include early and keen awareness, curiosity, and understanding quantitative information; ability to perceive, visualize, and generalize patterns and relationships; ability to reason analytically, deductively, and inductively; ability to reverse reasoning processes, and to switch methods easily but not impulsively; ability to work with mathematical concepts in fluent, flexible, and creative ways; energy and persistence in solving difficult problems; ability to transfer learning to novel situations; tendency to formulate mathematical questions, not just to answer them; and ability to organize and work with data in a variety of ways and to disregard irrelevant data.

Miller (1990) mentioned that mathematical giftedness refers to “an unusually high ability to understand mathematical ideas and to reason mathematically, rather than just a high ability to do arithmetic computations or get top grades in mathematics” (p. 2). NCTM defines the group of students with high ability in mathematics as mathematically promising; the NCTM Task Force on Mathematically Promising Students identifies mathematical promise as “a function of ability, motivation, belief, and experience or opportunity with large range of abilities and a continuum of needs that should be met” (Sheffield et al., 1999, p. 310).

Diezmann (2002) stated that mathematically gifted students differ from their non-gifted peers in three clusters of characteristics including “capacity for learning, quality and type of reasoning, and mathematical orientation” (p. 4). According to Frieman (2010), gifted students in mathematics have the ability to think mathematically in various school situations that allows them to collect and organize information; analyze facts, patterns and relationships; formalize situations and generalize; calculate and reason abstractly; interpret data, explain, and prove logically. Juter and Sriraman (2011) added that giftedness in mathematics can be recognized though general intelligence (g); as logical, quantitative and visual-spatial reasoning play a significant role in IQ tests.

Based upon what has been discussed in literature about giftedness, talent, and creativity, the researcher suggests that mathematically gifted students are individuals who have above average aptitudes in mathematics with average general Intelligence Quotient/IQ (genetics), and task-commitment/motivation with strong attitudes toward continued learning and applications of mathematics in real life situations (creativity: personality). Giftedness with above average general intelligence, can turn to talent if creativity (creativity: person and process) is developed as a major component of talent development. Original productivity in the discipline (creativity: person, process, and product) requires not only talent, but also more time, task commitment, and an environment that further supports creativity (creativity: person, process, product, and press/environment).

Identifying the Gifted and Talented in Mathematics

It is not simple to identify mathematically gifted students accurately like it is to identify gifted students in other areas. Literature includes that developing potential talent for all students is recommended, and the identification for just labeling is not advocated. However, the identification for the purpose of providing additional special programs is advised by using collectively different ways of discovering talents; some of which include standardized tests, observations, students' interviews, open-ended tasks, portfolios, and nomination by teachers, parents, peers, or self-nomination (Koshy & Casey, 2005; Sheffield, 1999). Standardized tests include tests for mathematical proficiency in each branch of the field, general intelligence, general creativity, and mathematical creativity. Examples of standardized tests that have been considered as good measures of general cognitive abilities and mathematical aptitudes include the Wechsler Intelligence Scale for Children (WISC IQ Test), the Scholastic Aptitudes Test (SAT-M), the Torrance Tests of Creative Thinking (TTCT-Figural), the Stanford Education Program for Gifted Youth (EPGY) Mathematical Aptitude Test (SEMAT) (Stanley, 1991; Pack & Holland, 1999; Kim, 2006; Flynn, 2007; Flanagan & Sotelo-Dynega, 2009).

Sheffield (1994) indicated that mathematically gifted students must be identified using a range of measures that go beyond traditional standardized tests; she recommended different steps to allow students to demonstrate their capabilities in mathematical performance, and identifying the mathematically gifted. These steps include giving students a wide variety of rich, inviting tasks that require spatial as well as analytic abilities; encouraging students to persist in solving mathematical problems; expecting students to not only solve problems posed by others, but to pose and solve new problems of their own; using a variety of identification measures; providing students with assessment tasks that tap skills beyond computation and paper and pencil multiple choice tests; and having a wide range of opportunities such as exciting mathematics classes, clubs and contests where students can demonstrate and hone their mathematical abilities.

Assessing creativity is a central procedure of identifying gifted students, and it is more significant in identifying mathematically gifted students because of the nature of mathematics that requires creative thinking. Lee, Hwang, and Seo (2003) indicated that creative thinking ability in mathematics can be measured through open-ended problems and questions that require more than one answer. Kim (2006) believes that the Torrance Tests of Creativity Thinking TTCT are good measures for identifying and educating the gifted, as they are designed with the purpose of discovering and nurturing creativity among students, and encouraging everyday life creativity in the general population. Assessment and evaluation processes of creativity should include various methods and different tools such as interviews, self-reports, rating scales and performance activities. The purpose is to have information, not only about those who are clearly creative and talented, but also to find out indicators of creativity and talent in individuals who may be facing obscuring factors of their potential.

Treffinger, Young, Selby, and Shepardson (2002) mentioned that “the topic of creativity presents some unique and complex challenges relating to assessment” (p. 27). They pointed out that creativity is an important element of giftedness in all areas as a thread that runs through many expressions of talent; as well as that people use their learning style preferences, personality differences, cognitive abilities, social and interpersonal skills, and content interests in many different ways to behave creatively, individually, as well as in groups.

Moreover, although the different ways that are used to identify mathematically gifted students, there are always a number of students who have abilities in mathematics, that can be nurtured to become at higher levels, but they cannot demonstrate them because of different obscuring factors. These factors include disabilities, cultural diversity, disadvantaged situations, underachieving cases, stereotype ideology, lack of opportunities, and socioeconomic status. All categories of students should be given an opportunity to be represented in programs of gifted and talented education; such circumstances should be considered when looking for mathematically talented students in order not to overlook any student with high potential. Teaching for creativity in the general classroom is a way through which all students can find opportunities to express and develop their abilities regardless of what they are labeled; gifted, or non-gifted (typical).

Teaching Mathematics for Creativity

Teaching for creativity is based on providing a positive school environment. Snyder, Lopes, and Pedrotti (2011) emphasized the importance that teachers interact positively with students in order to identify and expand their strengths. Positive schooling, according to Snyder, Lopes, and Pedrotti (2011), represents "an approach to education that consists of a foundation of care, trust, and respect for diversity, where teachers develop tailored goals for each student to engender learning and work with him or her to develop the plans and motivation to reach their goals; positive schooling includes the agendas of installing hope in students and contributing to the larger society" (p. 415).

The positive school environment that enhances student creativity requires that teachers provide a psychologically safe and motivating climate (Rogers, 1954; Amabile, 1996), that allows each student to think, try, share, use different ways, make mistakes, question, feel worthy, build autonomy, and achieve self-esteem. Psychological safety can be achieved by accepting and valuing all students' contributions, encouraging participation and collaboration, limiting competition, avoiding punitive assessment tests, and contributing to addressing personal and social student issues such as bullying, taunting, home and social status (Fairweather & Cramond, 2010).

In mathematics education, teachers can teach for creativity as illustrated formerly through opportunities for self-regulation development, self-efficacy building, intrinsic motivation, and enrichment experiences. Sheffield (2009) stated also that "students should be helped to realize that not only can they make sense of and be successful in mathematics, but also they can solve problems in unique and creative ways" (p. 90). For example, teachers can build student intrinsic motivation by occasionally choosing not to evaluate student work in solving such mathematical problems, or at least evaluate their work based on the processes they go through only, and let them know and feel safe that the accuracy of the final result would not affect their grade. Feeling safe may lead students to engage in the tasks, interact appropriately, communicate findings scientifically, and evaluate their ways of thinking independently, which are essential features of creativity as a factor of effective learning.

The Heuristic Model of Problem Exploration proposed by Sheffield (2000) is considered a useful tool for developing creative problem solving in mathematics. This model emphasizes questioning and allows students to start at any point and proceed in any order of several processes that include investigating, relating, creating, evaluating, and communicating. Sheffield

(2009) emphasized that questioning can be the way for developing student creativity in mathematics. She explained that students should be asked, and taught to ask questions that promote deeper exploration, and increase interest in mathematics, rather than just questions that require memorization. The following figure represents the Heuristic Process of Problem Solving that teachers might use to encourage students to think like creative, and investigative like mathematicians.

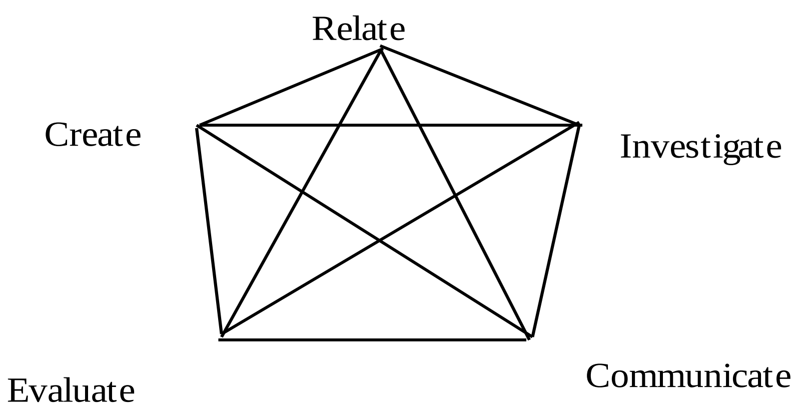

Figure 1: The Heuristic Model of Problem Exploration (Sheffield, 2000, p. 417)

Thomas (2006) also indicated that effective mathematics learning would be enhanced when students are provided with a metacognitive training tool that encourages them to think about the mathematical problem-solving processes, reflect on their ways of thinking, ask probing questions, and communicate ideas scientifically in a cooperative atmosphere. According to Thomas (2006), designing group discourse using a metacognitive tool such as THINK framework enhances students' mathematical reasoning behaviors. The following figure illiterates THINK interaction framework proposed by Thomas (2006) for improving students' skills of mathematical problem solving. She also indicated that the THINK framework could be modified to "I-THINK" to allow "I-independent thinking" by individual students before they communicate about problems and contribute to the cooperative work, in order to strengthen individual students' ability to think independently about how to solve problems they encounter.

THINK Interaction Framework

TALK about the problem with one another. Describe the situation. Explain what the problem is asking. Talk about the important information.

HOW can the problem be solved? Have each person share ideas for how to solve the problem. Ask others how and why their plan will work.

IDENTIFY a strategy for solving the problem. Use it. Talk about how to use your strategy. Is your strategy working, or do you need to choose another one to solve the problem?

NOTICE how your strategy helped you solve the problem. Have each person share how the strategy helped him or her understand and solve the problem.

KEEP thinking about the problem. Does your answer make sense? If you can think of another way to solve the problem, share it.

Figure 2: THINK Framework of Classroom Interaction (Thomas, 2006, p. 88)

Teachers may also direct students' attention to the applications of mathematics in real life and facilitate real life tasks of personal interest to them (Renzulli & De Wet, 2010). Mann (2006) indicated that students should be provided with opportunities to feel the beauty and benefits that mathematics brings through tangible examples. He added that mathematical creativity can be developed by allowing students to go beyond the practice exercises, and demonstrate their conceptual understanding by working in open-ended tasks and real applications of math in related fields with enough time and less emphasis on accuracy and speed.

Such real life experiences would be effective in making students enjoy learning mathematics with less anxiety and high intrinsic motivation; as they work and learn with positive beliefs about mathematics for self-satisfaction which allows them to be more open-minded to learn, flexible with different perspectives, original thinkers, collaborative, and skillful in communicating thoughts in respectful manners, moving significant steps toward maximizing general creativity skills and mathematical creativity. The roles of technology have been discussed in promoting mathematical creativity for all students. Utilizing technology in teaching and learning provides opportunities for connecting mathematics to the real world, student engagement in mathematical thinking, questioning, and inventing (Christopher, 2005; Yerushalmy, 2009; Milgram & Hong, 2009). Providing engineering activities is another way to allow rich opportunities for creativity in mathematics as they are based on real-world technologies and problems. Mann, Mann, Strutz, Duncan, and Yoon (2011) indicated that engineering concepts should be integrated in mathematics education in order to promote creativity and productivity for all students. The following model illustrates an engineering design process that can be utilized in mathematics and science education; it was developed by Engineering is Elementary project (EiE) (2003) at the Museum of Science, Boston (MOS).

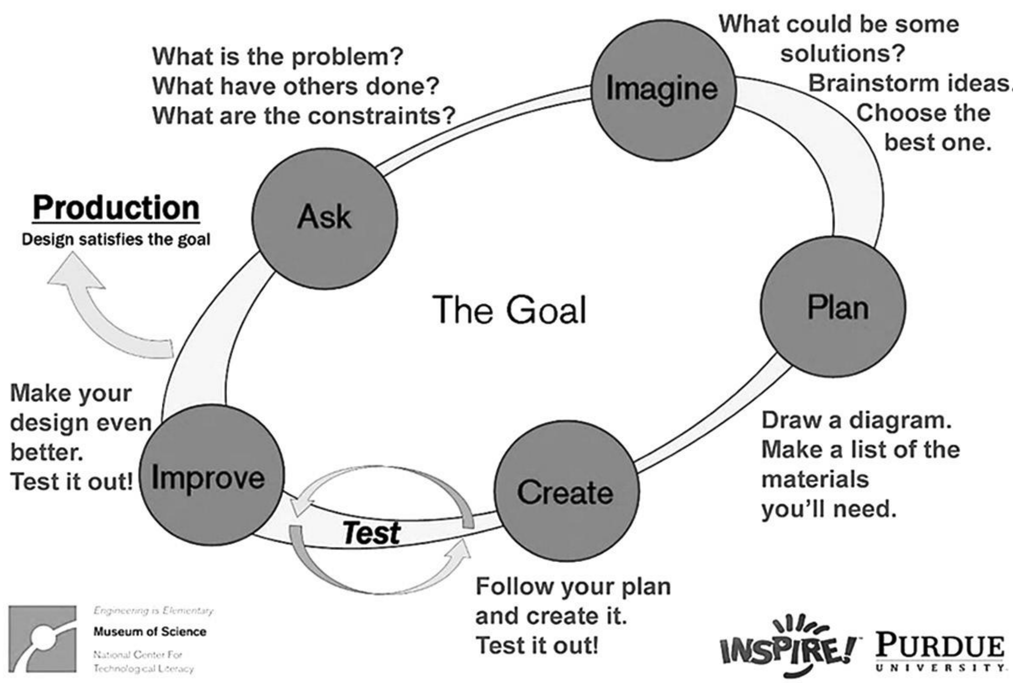

Figure 3: Elementary Level Engineering Design Process (EiE, 2003)
Note: Used with permission from Engineering is Elementary, the Museum of Science, Boston.

Mann and his colleagues (2011) believe that students, with their natural interests and curiosities, can be better enhanced through engineering explorations which are based on mathematics as a fundamental tool for relationship representation and model development to predict outcomes. They explained that the integrated STEM education should be not only about related academic parts (integrated curriculum of science, technology, engineering, mathematics), but should also be an approach of teaching mathematics and science within an engineering context that allows students to realize the interdisciplinary nature of the STEM disciplines, think in multiple dimensions, and use scientific mathematical knowledge to design technological tools that make life better.

Providing Model-Eliciting Activities (MEAs) is an example of the integration of engineering into existing content instruction (Mann et al., 2011). The terms, models and modelling, have been used with reference to several processes including solving word problems, conducting mathematical simulations, creating representations of problem situations, and purposefully describing and constructing explanations of natural phenomena and systems (English, 2007).

Model-eliciting activities provide students with opportunities to develop various types of thinking through working in teams to develop a model or solution procedures for real life problems. This kind of activities was discussed as applied mathematical problem solving activities (Lesh, 1981), as authentic mathematical activities (Lesh & Lemon, 1992), as thought-revealing mathematical problems (Lesh, Hoover, Hole, Kelly, & Post, 2000), and as Case Studies for Kids (Purdue University, n.d). According to English (2008), effective modeling activities provide opportunities for students to explore multidisciplinary meaningful complex systems, elicit powerful important mathematical ideas and processes that are essential for applied scientific models, explicitly document their thinking and understanding, use criteria for self-assessment, and construct sharable and reusable models.

Model-eliciting activities have received continuous support as a significant approach in teaching mathematics for creativity and talent development. The learning principle of the NCTM (2000, p.20) includes that “students must learn mathematics with understanding” through experiences that require them to actively build new knowledge from prior knowledge and experiences, in order to be able to “solve the new kinds of problems they will inevitably face in the future” (p. 21). The fourth standard of the CCSS (2014) of mathematical practices includes that students should be taught to “model with mathematics” (p. 7); it emphasizes the importance that students apply the mathematics they know to solve problems arising in everyday life, society, and the workplace.

Sriraman and Lesh (2006) pointed out that modeling to make sense of complex systems that occur in real life situations should be emphasized in teaching and learning from early levels of education, especially for students who are prepared for success in future-oriented fields that heavily depend on mathematics, science, and technology. Consensus exists that model-eliciting activities that include multidisciplinary tasks similar to the tasks that applied mathematicians complete, enhance student abilities in self-directed learning, mathematical representation, modeling, and creativity (Chamberlin & Moon, 2005; Eric, 2008; Kim & Kim, 2009; Coxbill, Chamberlin, & Weatherford, 2013).

In conclusion, teaching mathematics for creativity requires allowing students to work in a psychologically safe systematic multidisciplinary rich environment with authentic experiences, self-assessment opportunities, and an occasionally evaluation-free atmosphere, so they can develop deep meaningful transferable mathematical knowledge and skills, student school attachment, and creativity expression at a minimum. Teaching for creativity in mathematics classrooms is essential for mathematical talent development as it provides the foundation of further development of creativity in mathematics through teaching for mathematical talent development, moving gifted students to be talented and future mathematicians with necessary personal and social skills of successful individuals.

Teaching for Mathematical Talent Development

Teaching for mathematical talent development requires teaching for creativity as illustrated formerly with additional opportunities for developing domain-specific skills and expertise for students who express potential mathematical talent/giftedness. There are a wide range of provisions to be considered for extending skills of the mathematically gifted students and address the lack of challenge they may feel, some of which are within general classrooms and others are used as out-of-classroom/school experiences. These opportunities of development can be through differentiation, enrichment, acceleration, self-selected projects, mentorships, technology, real-life applications, and university programs (Diezmann & Watters, 2000; Tomlinson, 2001; Bicknell, 2008; Assouline & Lupkowski-Shoplik (2011); Katz, 2013; Brush, Glazeweski, Otetnbreit-Leftwich, & Baker, 2014).

Differentiation, as an approach of teaching, has gained popularity in the field of education and the education of gifted students. It is a key teaching approach through which teachers can meet the needs of gifted students in general education settings and address the lack of special gifted education programs. According to Tomlinson (2001) differentiation in instruction is “providing different avenues to acquiring content, to processing or making sense of ideas, and to developing products so that each student can learn effectively” (p.1). In other words “A differentiated classroom offers a variety of learning approaches to content, process, and product in anticipation of and response to students differences in readiness, interests, and learning needs" (Tomlinson, 2001, p. 7). Differentiated instruction is based on the belief that each student has different evolving abilities, learns at different paces, and finds challenge and stimulation in different types of tasks. Holding high expectations for all students, and using ongoing assessment and student preferences to guide instructional decision-making are important bases of differentiated instruction (Little, Hause, & Corbishley, 2009).

The characteristics of effective differentiation as identified by Tomlinson (2001) include that differentiated instruction is proactive; the teacher proactively plans a variety of ways to "get at and express learning" (p.3). Effective differentiation is proactively planned to become robust enough to address a range of learners' needs. Differentiated instruction is student-centered and more qualitative than quantitative; it provides qualitatively different opportunities of learning based upon each student's needs. Differentiation is a blend of whole-class group, small groups, and individual instruction in order to provide multiple approaches to content, process, and product. In differentiated classrooms, instruction is a dynamic process; both the teacher and students learn continually. The teacher learns about his/her students' needs through ongoing assessment, monitoring and matching between the learner and the learning, and making adjustments when necessary.

Several potential impacts of differentiation in the development of gifted students are expected. Nurturing creativity and increasing achievement for all students, based upon each student's aptitudes, is a key gain. Creativity in this case is a multilevel phenomenon that includes all types of thinking skills that are essential for self-actualization; and achievement as human growth that includes all personality aspects; behavioral, cognitive, and affective traits. When a teacher plans and receives support to implement successfully differentiated instruction, it is expected that gifted students develop their higher-level thinking skills. Successful implementation of differentiation should allow gifted students to grow through meaningful understanding of the subject content, working in real life math problems and investigating the role and the beauty of mathematics, engaging in inquiry-based interesting tasks cooperatively and independently, and through social engagement as a part of community of learners who have different characteristics.

For example, when ongoing assessment shows that some elementary mathematics students have already understood and mastered the concepts and skills of the lesson, the teacher who has a robust proactive plan may choose to provide this group with different types of activities that expand their thinking on the topic, requires them to apply creativity skills, and help them understand the real life applications of mathematics. The teacher might offer them different projects and give them the option to choose, and to decide to work independently or cooperatively at the learning center, library, or classroom. It is also important to explain and discuss with students whether they want to work on different tasks or not, so they do not feel that they are punished by providing extra work because they show early capability of the new content and skills.

In differentiated classrooms, the level of thinking skills and achievement being developed vary from one student to another based upon each student's prior knowledge and skills. Effective differentiated instruction provides opportunities for excellence to all students, so creativity as a life skill and the achievement as human growth, should be developed for all students assuming that all students are capable for achievement but at varying paces with different strategies. Gifted students have a high potential to achieve more and to be more creative dealing with real life problems if they exposed to an appropriate nurturing environment.

There are different methods of differentiation that teachers can employ to meet the needs of gifted students in the general mathematic classroom. These methods cover differentiating the content, process, and product of the learning. Commonly recommended strategies of differentiation include curriculum compacting, independent projects, interest centers or groups, tiered assignments, flexible grouping, and apprenticeship (Tomlinson, 2001). In its position paper, the National Association of Gifted Children NAGC (2014) supports providing appropriate educational experiences for gifted students in the general classroom through differentiation, at a minimum. According to NAGC (2014) differentiation should consist of carefully planned, coordinated learning experiences that extend the core curriculum, combine the curricular strategies of enrichment and acceleration, and integrate instructional strategies that engage learners at appropriate levels of challenge utilizing flexible grouping for effective classroom management.

Gifted students benefit from all methods of differentiation as long as they are designed and implemented to meet their needs; however, gifted students differ in their preferences in the ways they learn which should be taken into account when planning for differentiating instruction. Moreover, some gifted students might have personal issues, such as perfectionism or introversion, which should be addressed as part of student development along with academic needs. In the field of gifted education, several methods have been viewed to be effective with students who have high potential, some of which are tiered assignments, curriculum compacting, and apprenticeship.

Providing tiered assignments is an example of methods that can be used to differentiate instruction for mathematically gifted students. In this method, the teacher initially develops varied levels of activities to ensure that students explore concepts and master skills at levels that build on their prior knowledge and promote continued growth. The tasks involved in each activity should be worthwhile and represent important mathematical skills and concepts with flexibility to make adjustments depending on students' evolving needs through ongoing assessment (Tomlinson, 2001). For example, some students may need assignments that have more complexity or abstraction; others might need more concrete tasks. Developing the tiers requires that they respond to students' readiness and needs around the same core mathematical concept or process, so teachers can assess all students' progress toward the core (Little, Hause, & Corbishley, 2009).

Curriculum compacting is another important method of differentiation for high ability learners developed by Reis and Renzulli (1992). In the curriculum compacting process, students who demonstrate their proficiency on a pretest of the unit or lesson collaborate with the teacher to select alternative activities. Students may use the time to work on independent projects of their own design inside or outside the classroom, or the teacher might assign an enrichment activity that the class is not yet ready to pursue (Stepanek, 1999).

Reis and Renzulli (1992) described the process of curriculum compacting in three phases. Defining goals and outcomes of a given unit or lesson is the first phase of the compacting process. This phase is important for teachers to make decisions for individual programming. Identifying candidates for compacting is the second phase through which teachers identify students who have already mastered the objectives or outcomes of the unit/lesson that is about to be taught. Identifying candidates for compacting includes estimating which students have the potential to master new content at a faster than normal pace. Scores on previous tests, completed assignments, and classroom participation are appropriate ways of identifying highly likely candidates for compacting. A second step in identifying candidates is finding or developing appropriate tests or other assessment techniques that can be used to evaluate specific learning outcomes as pretests, such as unit pretests or end-of-unit tests. The final phase of the compacting process is providing acceleration and enrichment options through cooperative decision making on the parts of both teachers and students. Such enrichment options include self-directed learning activities, instructional materials that focus on particular thinking skills, and a variety of individual and group project oriented activities that are designed to promote investigative skills in real life problems/issues. Time and resources should be made available through compacting to provide opportunities for authentic enrichment, and for rotating through a series of self-selected mini-activities.

Renzuilli (2008) concluded that general classrooms should be places where all students are kept engaged and motivated for developing all kinds of talents by focusing on their strengths and interests. He suggested several methods to provide opportunities for all students to continue learning and growing in the areas where they have the greatest strengths. Such recommended methods for talent development include providing open-ended assignments, creating opportunities for collaboration, allowing opportunities for independent projects, helping students find appropriate resources, considering accelerated programs, and aiming for school-wide enrichment.

Freiman (2010) indicated that the school-wide enrichment model presented by Renzulli (1994) can be used to provide important activities for nurturing mathematical talent. He explained that the first phase, which includes general exploratory activities, can be implemented to stimulate interest in mathematics subject areas. Group training activities, the second phase, can be used to develop processes related to the areas of interest developed through general activities. Group training activities aim to enable students to deal more effectively with content through high level thinking skills. These activities include inquiry, critical thinking, problem solving, reflective and divergent thinking, sensitivity, awareness development, and creative thinking. The third type of activities include individual and small-group activities of real life problem solving; in these types of activities, students should be facilitated to develop willingness to engage with more complex and self-initiated discovery activities in order to move them to become problem finders, as well as problem solvers, using appropriate methods of inquiry (Freiman, 2010).

VanTassel-Baska & Stambaugh (2006) provided other recommendations to design and implement successful curriculum for mathematics emphasizing the importance of addressing issues of gender, minority groups, and disadvantaged students. They indicated that "curriculum decision for mathematics must include parent education about how their perceptions impact their child's, especially daughter's, mathematics career decision and conception" (p. 135). They added that minority, disadvantaged, and female students must have opportunities to build relationships with successful mathematicians from their specific, culturally relevant group in order for them to understand that they too can attain high achievement in mathematics. VanTassel-Baska & Stambaugh (2006) also emphasized providing different options for curriculum and instruction such as using hands-on, rigorous engaging, and relevant mathematics curriculum beginning with early schooling, guest speakers, appropriate reading related to mathematicians, and integrated and interdisciplinary approaches to mathematics at all grade levels in order to accommodate, assimilate, and make appropriate connections to mathematics curriculum.

Although that differentiation of curriculum and instruction is necessary, it does not provide sufficient comprehensive services for gifted and talented students (Hertberg-Davis, 2009; NAGC, 2014). University-based mathematical talent search and development, and other research-based educational projects and special programs are also important for more focused experiences and authentic development of student expertise in the field. The Study for Mathematically Precocious Youth (SMPY), Project M^3: Mentoring Mathematical Minds, and Project M^2: Mentoring Young Mathematicians are examples of effective scientific contributions that can be further utilized for providing special enrichment programs that focus on conceptual understanding, reasoning, creativity, and appropriate challenge for mathematical talent development (Stanley, 1990; Gavin et al., 2007; Gavin et al., 2009; Gavin &Adelson , 2014, Gavin, n.d.; UCONN, n.d.).

For example, the project M^2: Mentoring Young Mathematicians focuses on early childhood mathematics education, Grades K-2. Through this project, learning units are designed to meet the needs of all students, and engage students in problem solving activities that encourage critical and creative thinking, as well as verbal and writing communication like practicing mathematicians. These learning units have the Common Core State Standards for Mathematical Practice as the core philosophy including that students make sense of problems and persevere in problem solving, construct viable arguments and critique the reasoning of others, model with mathematics to solve real-world problems, use appropriate tools strategically, and attend to precision by communicating with appropriate mathematical vocabulary.

It is clear that literature in mathematics education of the gifted and talented includes nurturing creativity in most teaching approaches for developing mathematical talent; as developing mathematical talent requires teaching for creativity, and teaching for creativity leads to developing mathematical talent. However, creativity is not only about thinking mathematically; creativity is the essence of mathematics, and also is about general cognitive, metacognitive, personal, and social skills. Therefore, it is important that teaching be directed toward developing creativity as a comprehensive life skill, and toward mathematical talent development which includes the development of creativity in the domain. Teaching for Creativity and Mathematical Talent Development (TCMT) is proposed as a philosophy for teaching mathematics.

Based on TCMT as a philosophy of teaching, mathematically gifted students could be viewed as individuals who have above average aptitudes in mathematics with average general intelligence, and task-commitment with strong motivation and attitudes toward continued learning and applications of mathematics in real life situations (creativity: personality). The giftedness with above average general intelligence can turn to become talent if creativity (creativity: person and process) is developed as a major component of talent development. Original productivity in the discipline (creativity: person, process, and product) requires not only talent, but also more time, task commitment, and further environmental support for creativity (creativity: person, process, product, and press/environment). Teachers should help each student through TCMT to reach the highest level possible of overall development including maximizing academic achievement, nurturing creativity and mathematical talent along with personal and social skills necessary for authentic growth and life success. TCMT is further discussed in chapter 5 as a proposed philosophy for teaching mathematics.

Chapter Summary

Creativity and talent are important phenomena to study; however, there is no complete agreement on what these two constructs mean. The absence of consensus in universally accepted definitions leaded to different views of giftedness, creativity, and talent, as well as different methods of identification of the gifted individuals, and many methods for nurturing and development. Generally, literature suggests broad conceptions of these two constructs and multiple ways of identification processes, as well as providing fostering school environments for both creativity and domain-related giftedness in the general educational settings. Teaching for Creativity and Mathematical Talent development (TCMT) is proposed; this requires that teachers hold positive attitudes, engage in appropriate professional development, and receive adequate support, in order to use effective teaching methods and provide additional external options to nurture creativity and mathematical talent based upon students' needs and the situation of each education setting.

Based on TCMT, mathematically gifted students are viewed as individuals who have above average aptitudes in mathematics with average general intelligence, and task-commitment with strong motivation and attitudes toward continued learning and applications of mathematics in real life situations (creativity: personality). The giftedness with above average general intelligence can turn to become talent if creativity (creativity: person and process) is developed as a major component of talent development. Original productivity in the discipline (creativity: person, process, and product) requires not only talent, but also more time, task commitment, and further environmental support for creativity (creativity: person, process, product, and press/environment). The aim of TCMT is to help students increase their achievement, become gifted, talented, and then perhaps future mathematicians.

CHAPTER 3: RESEARCH METHODS

Research Setting and Participants

This study was conducted in the Midwestern and Northeastern regions of the United States of America. The participants were elementary school teachers who teach mathematics. The convenience sampling was used because of the difficulty of applying census or random sampling. The study sample included any teacher who meets the criteria, and is easily accessible.

The process of collecting data included several procedures that were implemented in order to meet the research policy on human subjects and ensure validity of the study. These procedures include obtaining an approval letter from the Institutional Review Board at the University of Kansas before conducting the study (Appendix A), determining the appropriate sample size, clarifying and confirming the voluntarily anonymous participation, as well as ensuring that participants express their consent with adequate information prior to getting involved in the study (Appendix B).

To determine the sample size of this study that provides reliable estimates of the population regression coefficients, the rule-of-thumb suggested in literature regarding sample sizes in regression analysis were reviewed; such guidelines consulted include $N \geq 10p$, $N \geq 15p$, $N \geq 50+8p$, $N \geq 104 + p$; where N refers to the number of participants, and p refers to the number of predictors (Green, 1991; Brooks & Barcikowski, 1994; VanVoorhis & Morgan, 2007). G*Power software was also utilized for calculating how many participants are needed at a minimum; a group 76 participants was the sample size proposed as the minimum sufficient size to achieve a power analysis of 80% with five predictors (IVs), assuming a moderate effect size of .2, and using .05 as a level of significant (Faul, Erdfelder, Buchner, & Lang, 2009).

An online link of the research instrument was created and sent out to teachers through an agreement with Qualtrics Incorporation using their partners of professional panels (Appendix C). The researcher was able to reach 102 teachers from these two regions of the United States, the Midwest and the Northeast. However, the participations of nine of them were not accepted and removed due to invalid responses, the remaining 93 participants were used as data resources for this study. Although this sample size is less than what was recommended by Green (1991) for testing individual predictors; $N \geq 104 + p$, it is still considered acceptable based on the power analysis conducted using G*power software which yielded 76 subjects as the minimum sufficient sample size.

Research Design and Variables

The quantitative research methodology was used. A questionnaire with a five-point Likert type scale was developed to investigate mathematics teachers' attitudes and their opinions about the features of support that they feel are available in their community and school environments related to teaching for creativity and mathematical talent development.

Several variables were included in this study. The independent variables included gender, academic degree, years of mathematics teaching experience, professional development related to creativity and gifted mathematics education, and the extent of overall perceived support related to teaching for creativity and mathematical talent development. The dependent variable was teachers' attitudes toward teaching for creativity and mathematical talent development in general education settings.

Research Instrument

For the purpose of investigating elementary teachers' attitudes and features of support related to teaching for creativity and mathematical talent development, a questionnaire with a five-point Likert scale has been developed after reviewing relevant literature and utilizing related existing instruments that have been already used in a large scale of studies including Gagné and Nadeau (1985), Gagné and Nadeu (1991), Drain (2008), McCoach and Siegel(2007), Alajmi (1994), Aljughaiman and Mowrer-Renolds (2005), Rosemarin (2002), Cheung (2012), Kampylis, Berki , and Saariluoma (2009), and Kim and Gentry (2008).

The questionnaire contains two scales, one for teachers' attitudes toward creativity (10 items) and another for teachers' attitudes toward mathematical talent development (10 items); in addition to a section for investigating the availability degree of features of support that are found necessary for teaching for creativity and mathematical talent development. However, in this study, creativity and talent are hypothesized as two connected phenomena that are parallel in the development process; teaching for creativity leads to talent development and talent development requires teaching for creativity. Therefore, the two scales for teachers' attitudes were dealt with as one scale for the purpose of this study. The purpose of this study is to examine teachers' attitudes toward nurturing creativity and mathematical talent as one process.

The participants were asked to indicate their level of agreement for each statement of the attitude part; strongly agree (5), agree (4), neither agree nor disagree (3), disagree (2), or strongly disagree (1). For the extent of support that teachers perceive, the participants were provided with statements that represent certain features and resources that are essential, based on relevant literature, for an effective learning environment for creativity and mathematical talent development; they were asked to determine the availability degree of each of these features and resources in their communities and schools on a scale of (1) through (5) where (1) means “unavailable”, and (5) means” highly available”.

Validity and Reliability

To produce a valid instrument, the researcher has made sure that the items of the questionnaire’s scales assess the target construct by connecting them to relevant literature and utilizing existing related instruments that have been validated and reliably used in a large scale of studies including Gagné and Nadeu (1985); Gagné and Nadeau (1991); Drain (2008), McCoach and Siegel (2007), Alajmi (1994), Aljughaiman and Mowrer-Renolds (2005), Rosemarin (2002), Cheung (2012), Kampylis, Berki, and Saariluoma (2008), Kim & Gentry (2008). The questionnaire includes items that are quoted directly from literature and previous studies, modified, or made up by the researcher in light of relevant literature and personal experiences from teaching and dealing with teachers. For example, the item “creativity is a key factor for personal and social progress” exists literally in the instrument utilized in the study of Alajmi (1994), however, this item carries a conceptualization that is supported by theoretical literature and used in most empirical studies on creativity, with different vocabulary. Likewise, the other items have been constructed in light of many studies and a wide range of literature.

Furthermore, the researchers conducted informal and formal discussions with teachers and graduate students in education to gain more insight into the topic for developing the instrument; Appendix (D) includes two examples of feedback obtained from the preliminary process of developing the instrument. The first version of the instrument was also reviewed by several practitioners and specialists in the fields of elementary mathematics, mathematics education, gifted education, and research methodology. The suggestions of the reviewers have been taken into account for improving the instrument and increasing its validity. For example, some of reviewers provided suggestions related to improving statements that have both concepts, creativity and talent together, as they may confuse respondents and lead to invalid responses; others suggested using the phrase “high-ability students” instead of the phrase “gifted students” as the term “giftedness” may carry a different meaning from one participant to another.

Further examination of the validity of the questionnaire has also been made by conducting two mini-focus groups to make sure that each statement has an accurate meaning for the study population; Appendix (E) include the HSCL approval for this additional validation procedure. The first focus group was an electronic mini focus group and included four educators who have either Ph.D. or Ed.D in mathematics education, and the second was a face to face mini focus group and included four elementary teachers who teach mathematics. The two groups agreed on several changes to improve the questionnaire related to the overall content and some of the terms used in the statements.

The focus group discussions covered several topic-related ideas, as well as the construct of each item in the questionnaire. The participants raised concern about using revers-scaled items; they suggested one direction construct of the statements to help respondents answer accurately with no confusion. This concern led the researcher to minimize the number of reversed statements, with the belief that some of them are necessary for examining the validity of responses. Moreover, the focus group members agreed that the questionnaire is long to a degree that might lead respondents to get tired, stop completing participation, or provide inaccurate information. They suggested removing some items that are not important and condense others that can be represented in one statement. Appendix (F) includes the suggestions obtained from the two focus groups for improving the items that have ambiguous terms to make the statements clear for the respondents. The feedback obtained from these focus group discussions have been taken into account, in light of relevant literature, to improve the draft version of research instrument and set up the final version for the actual study; Appendix (G) includes the final version used to collect data for this study.

To examine the reliability of the instrument, Cronbach's Alpha coefficient for internal consistency has been calculated for the actual data received; using the Statistical Package for Social Sciences (SPSS). High value of the alpha coefficient was sought with the value of .7 as the minimum acceptable threshold of consistency. Cronbach's Alpha coefficient calculation of the instrument internal consistency resulted in a value of .88 for the overall scale as indicated in Table 1.

Table 1: *Cronbach's Alpha Coefficients*

Scale	Cronbach's Alpha	N of Items
Subscale1: Creativity	.84	10
Subscale 2: Mathematical Talent Development	.77	10
Overall Scale	.88	20

The Cronbach's Alpha coefficient of .88 is high enough to conclude that the instrument of this study is reliable. Furthermore, item-total statistics showed that there was no any item of the scale that would cause considerable change on the Alpha coefficient if it is removed.

Data Analysis

Using the Statistical Package for Social Sciences (SPSS), various statistical methods were used to describe and analyze the data collected in this study and get answers for its questions. Descriptive statistics, including frequencies, percentages, means, standard deviations, and graphs, are utilized for providing a summary of the participants' demographics, teachers' attitudes, as well as the features of support that are available related to teaching for creativity and mathematical development.

Pearson's correlation test was used to investigate the relationships between selected major variables (teachers' attitudes, overall perceived support, and professional development). Multiple linear regression analysis based on the partial correlation was also conducted to examine the unique contribution of each variable, overall perceived support, and professional development, after accounting for the other variables. All data analyses were conducted using $\alpha = .05$ as a level of statistical significance.

CHAPTER 4: RESEARCH RESULTS

Preface

The findings of the current study are reported in this chapter. Demographic and background information of the participants is presented first. Then, descriptive and inferential findings are provided in a sequence that aligns with the research questions. This study was guided by the following questions:

- What are mathematics teachers' attitudes toward teaching for creativity and mathematical talent development in general education U.S. elementary schools?
- What are the features of support, related to teaching for creativity and mathematical talent development, that teachers feel are available?
- Does the extent of overall perceived support contribute of a statistically significant proportion of unique variance (using an alpha level of .05) in teachers' attitudes toward teaching for creativity and mathematical talent development; after accounting for gender, academic degree, years of teaching experience, and professional development?
- Does professional development contribute of a statistically significant proportion of unique variance (using an alpha level of .05) to teachers' attitudes toward teaching for creativity and mathematical talent development; after accounting for the gender, academic degree, years of teaching experience, and overall perceived support?

Descriptive Statistics Findings

Demographics

The participants in this study were mathematics teachers in elementary schools in mid-western and northeastern states of the United States of America. The sample of this study included 93 participant teachers, 49 teachers (52.7%) from the Midwest region, and 44 teachers

(47.3%) from the Northeast region. Female teachers of them were 72 (77.4 %), and male teachers were 21 (22.6 %). The participants were from several states; Table 2 includes the participants by sate.

Table 2: *Participants by State*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Connecticut	2	2.2	2.2	2.2
	Illinois	8	8.6	8.6	10.8
	Indiana	7	7.5	7.5	18.3
	Iowa	4	4.3	4.3	22.6
	Kansas	3	3.2	3.2	25.8
	Maine	1	1.1	1.1	26.9
	Massachusetts	5	5.4	5.4	32.3
	Michigan	6	6.5	6.5	38.7
	Minnesota	2	2.2	2.2	40.9
	Missouri	6	6.5	6.5	47.3
	Nebraska	1	1.1	1.1	48.4
	New Hampshire	2	2.2	2.2	50.5
	New Jersey	11	11.8	11.8	62.4
	New York	10	10.8	10.8	73.1
	Ohio	6	6.5	6.5	79.6
	Pennsylvania	12	12.9	12.9	92.5
	Vermont	1	1.1	1.1	93.5
	Wisconsin	6	6.5	6.5	100.0
	Total	93	100.0	100.0	

Background Information

Background information includes the participants' academic degrees, years of experience in teaching mathematics, and professional development in creativity and mathematics education of the gifted and talented. The academic degrees reported were Bachelor's with a frequency of 46 (49.5%) and Master's with a frequency of 74 (50.5%); there was no participant reported holding a doctoral degree. Table 3 shows the number of participants and the level of higher education completed.

Table 3: *Participants by Academic Degree*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bachelor	46	49.5	49.5	49.5
	Master	47	50.5	50.5	100.0
	Total	93	100.0	100.0	

Teachers' experience in teaching mathematics ranged from one year to 40 years of teaching with a mean of 11.23 years (SD= 9.5). 58 participants (62.4 %) had more than five years of teaching experience. The other 35 participants (37.6%) had five years or less of teaching experience.

The professional development in creativity and gifted mathematics education received by the participants is divided into four questions in two stages; college/university level coursework, and school district professional development. The participants were asked to answer Yes/No questions whether they had taken courses or received training in fostering student creativity, and in mathematics education of the gifted and talented at each level of professional development (college, school district). The "Yes" answers were counted as one point for each "Yes" reported; each answer of "No" was counted as a (0) point. Overall professional development variable was determined by adding up the points that each participant received using his/her answers of the four questions with a range of 0-4 points.

The following tables, 4, 5, 6, and 7, show the number of participants who answered (Yes) that they have taken courses or received training, and the number of the participants who answered (No) that they have not taken any course or received training in each area (fostering student creativity, and gifted mathematics education) in each level of professional development (college, and school district).

Table 4: *Participants based on whether they Have Taken any University Level Course Specifically in Fostering Student Creativity*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	47	50.5	50.5	50.5
	Yes	46	49.5	49.5	100.0
	Total	93	100.0	100.0	

Table 5: *Participants based on whether thy have Received any School District-Level Professional Development in Fostering Student Creativity*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	46	49.5	49.5	49.5
	Yes	47	50.5	50.5	100.0
	Total	93	100.0	100.0	

Table 6: *Participants based on whether They Have Taken any University Level Course Specifically in Mathematics Education of the Gifted and Talented*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	61	65.6	65.6	65.6
	Yes	32	34.4	34.4	100.0
	Total	93	100.0	100.0	

Table 7: *Participants Based on whether They Have Received any School District-Level Professional Development in Mathematics Education of the Gifted and Talented*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	62	66.7	66.7	66.7
	Yes	31	33.3	33.3	100.0
	Total	93	100.0	100.0	

Descriptive statistics of the data obtained related to the professional development in creativity and gifted mathematics education, as indicated in the previous tables; reveal that a considerable percentage of the participants were engaged in professional development opportunities in fostering student creativity from at least one source of professional development; college, or school district. On the other hand, there were a small number of the participants who received professional development related to gifted mathematics education.

The following table (8) represents the participants based on the total points gained from the answers of the two questions related to the professional development in fostering creativity. Table (9) includes the total points that the participants gained from answering of the two other questions related to professional development in gifted mathematics education. A total point of zero means that the participants have not received any professional training neither at the college education level, nor at school district level.

Table 8: *Participants based on the Total Points Gained from Professional Development in Fostering Student Creativity*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	34	36.6	36.6	36.6
	1.00	25	26.9	26.9	63.4
	2.00	34	36.6	36.6	100.0
	Total	93	100.0	100.0	

Table 9: *Participants based on the Total Points Gained from Professional Development in Mathematics Education of the Gifted and Talented*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	52	55.9	55.9	55.9
	1.00	19	20.4	20.4	76.3
	2.00	22	23.7	23.7	100.0
	Total	93	100.0	100.0	

The numbers from previous tables, (8, 9), show that 63.5 % of the participants have engaged in at least one opportunity of professional development in fostering student creativity at either the college education level, or school district level. In terms of professional development in gifted mathematics education, 55.9% reported that they have not received any training neither at the college education level, nor at the school district level.

As formerly indicated, the overall professional development variable was determined by adding up the points that each participant received using his/her answers for the four previous questions where each "Yes" answer was counted as one point, and each "No" answer was counted as a zero. The following table (10) includes each total of points reported with its frequency; the number of participants who gained a total point of zero represents those who have not received any professional development in creativity or gifted mathematics education neither at the college education level, nor at school district level.

Table 10: *Participants based on the Total Points Gained in the Professional Development Variable* in Creativity and Gifted Mathematics Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	26	28.0	28.0	28.0
	1.00	19	20.4	20.4	48.4
	2.00	22	23.7	23.7	72.0
	3.00	11	11.8	11.8	83.9
	4.00	15	16.1	16.1	100.0
	Total	93	100.0	100.0	

The previous table (10) shows that 26 participant teachers (28%) reported that they have not received any professional development in foresting student creativity, or mathematics education of the gifted and talented neither at the college level, nor at school district level. Only 15 participants (16.1%) reported that they had received training from both sources of professional development, the college and school district levels, in both areas; creativity and gifted mathematics education.

Teachers' Attitudes

Teachers' attitudes toward teaching for creativity, and their attitudes toward teaching for mathematics talent development are reported in this section. The research instrument contained two scales, one for teachers' attitudes toward creativity (10 items) and another for teachers' attitudes toward mathematical talent development (10 items). The overall attitude is the variable involved in this study; it represents teachers' attitudes toward both teaching for creativity and mathematical talent development as one process utilizing the average degree of agreement of all items in the two scales.

In this study, creativity and talent are hypothesized as two connected phenomena that are parallel in the development process; teaching for creativity leads to talent development and talent development requires teaching for creativity. Therefore, the two scales for the teachers' attitudes were dealt with as one scale for the purpose of this study. The purpose of this study is to examine teachers' attitudes toward nurturing creativity and mathematical talent as one process. The participants were asked to indicate their level of agreement for each statement provided; strongly agree (5), agree (4), neither agree nor disagree (3), disagree (2), or strongly disagree (1).

In general, descriptive statistics of teachers' attitudes showed that teachers hold positive attitudes toward teaching for creativity and mathematical talent development. Table 11 includes the average of teachers' attitudes toward each; creativity, mathematical talent development; and the overall teachers' attitudes.

Table 11: *Statistics of Teachers' Attitudes*

		Attitudes toward Teaching for Creativity	Attitudes toward Teaching for Mathematical Talent Development	Attitudes toward Teaching for Creativity and Mathematical Talent Development
N	Valid	93	93	93
Mean		3.98	4.05	4.02
Std. Deviation		.52	.463	.45

The previous table indicates that teachers' stated attitudes toward teaching for creativity generally were positive, the average score of their attitudes was 3.98, SD=.52. The results of teachers' attitudes also indicate that only three participants (3.2%) reported attitudes with averages that are less than 3. The statement that has been viewed inconsistently among teachers was "*Creativity is an innate ability that cannot be taught or developed*" where the results indicate that 18 of the participants (19%) agree with this statement, and other 24 participants (26%) stated that they that they neither agree nor disagree. Appendix (I) includes the frequencies of teachers' responses in all statements related to teaching for creativity.

Teachers' attitudes toward teaching for mathematical talent development were reported to be also positive with an average of 4.05, SD=.46. Only two participants (2.2%) reported attitudes with averages that are less than 3. The statement that has been viewed inconsistently among teachers with was "*Students who have high abilities in mathematics are always able to fully develop their abilities without support*" where the results indicate that 18 of the participants (19%) agree with this statement, and other 18 participants (19%) stated that they that they neither agree nor disagree. Appendix (G) includes the frequency of teachers' responses in all statements related to teaching for mathematical talent development.

Accordingly, teachers' overall attitudes toward teaching for creativity and mathematical talent development were positive with a mean of 4.02, SD=.45; there were only four participants (3.2%) who stated attitudes with averages that are less than 3. In general, teachers' attitudes were distributed almost normally; the following chart, Figure (6), illustrates how teachers' attitudes are distributed compared to the normal distribution curve.

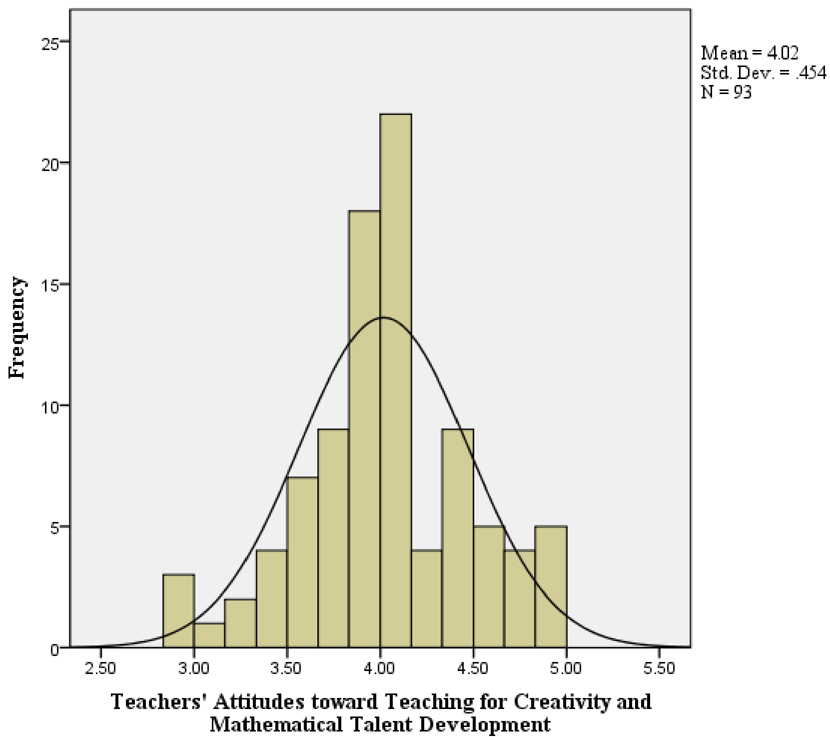

Figure 4: Distribution of Teachers' Attitudes

Some of the participants provided additional qualitative comments that further illustrate their attitudes. The conclusion of these additional text responses is that teachers hold positive attitudes, but they need to be facilitated to put their beliefs into practice. The following table 12 includes all provided additional responses.

Table 12: *Teachers' Attitudes; Additional Text Responses*

1	Allowing students to come up with ideas and then showing students that they are listened to and supported in their ideas leads those students and others to become even more creative.
2	General education teachers need far more support to be able to meet all of the needs present in their classrooms.
3	It is imperative that we foster environments that promote creativity and critical thinking skills.
4	We have to teach for a state test in math and reading, creativity is not an option for math and reading.

Features of Perceived Support

For the extent of support that teachers perceive, the participants were provided with statements that represent certain features and resources that are necessary, based on relevant literature, for an effective learning environment for creativity and mathematical talent development; they were asked to determine the availability degree of each of these features and resources in their communities and schools on a scale of (1) through (5) where (1) means "unavailable", and (5) means "highly available".

The results of this section indicated that teachers are somewhat supported to teach for creativity and mathematical talent development; the mean of the overall perceived support was 3.04 (SD=.84). Table 13 includes statistics of overall perceived support.

Table 13: *Statistics of Overall Perceived Support*

N. Valid	Mean	Std. Deviation
93	3.04	.84

The results also showed that several features of support had a mean of availability that is less than 3. Examples of features that had the least degrees of availability included "*rewards/incentives for effective teachers in developing student creativity and academic abilities*" with an availability mean of 2.54, "*Sufficient professional development opportunities related to the education of mathematically gifted and talented students*" with an availability mean of 2.63, and "*sufficient professional development opportunities related to developing student creativity*" with an availability mean of 2.73. Appendix (K) includes the frequency of teachers' responses about the degree of availability of each feature of support related to teaching for creativity and mathematical talent development.

Some of the participants provided additional qualitative comments that further illustrate their points of view regarding features of support available for them; the most frequent issue that participants indicated was the emphasis on state tests as the criterion for school progress; they stated that the focus on standardized tests limits their teaching toward enhancing creativity and meeting the needs of high-achieving students. All provided comments are reported in the following table (14).

Table 14: *Features of Support; Additional Text Responses*

1	The movement toward strong reliance on high stakes testing as a means of benchmarking virtually destroys the ability to concentrate on experimentation and creative thinking skills.
2	Our school is so focused on students who are below grade level in reading and math that there is no time for professional development for teaching those at or above grade level.
3	Funding is a problem.
4	Common Core is supposed to address this concern but more training for teachers is needed.
5	Let kids be creative; no more testing.

Continued- *Features of Support; Additional Text Responses*

6	Much more positive school environment before act 10.
7	Our principal would be supportive of research-based methods for teaching; however, our school is the lowest in our large school district for both reading and math, so our day is strictly structured to provide multiple opportunities for the lower scoring students to get teaching, re-teaching and extra practice. No extra time is available to spend on higher achieving students except the TAG program; our TAG teacher is excellent, but only in our building 2 days a week.
8	Curriculum is too scripted and schedules are pre-determined/rigid so teachers do not have autonomy to teach creativity in any subject. Resources/manipulatives are basic and not thought of as "important" by administration.
9	Teaching is directed towards high scores on state tests.
10	Need funding; wish my school had most of these.

Inferential Statistics Findings

Preface

Finding out key factors to understand teachers' attitudes toward teaching for creativity and mathematical talent development was the major purpose of this study. The overall perceived support and professional development were examined, as potentially influential variables on teachers' attitudes, after accounting for other independent variables (gender, years of teaching experience, and academic degree). The relationships among teachers' attitudes, and the two selected major independent variables (perceived support, professional development) were reported first; then, the unique contribution of each of the selected variables to the variance on teachers' attitudes was examined using multiple linear regression analysis. The data analysis in this section was guided by the following research questions:

- Does the extent of overall perceived support contribute of a statistically significant proportion of unique variance in teachers' attitudes toward teaching for creativity and mathematical talent development; after accounting for gender, academic degree, years of teaching experience, and professional development?

- Does professional development contribute of a statistically significant proportion of unique variance to teachers' attitudes toward teaching for creativity and mathematical talent development; after accounting for the gender, academic degree, years of teaching experience, and overall perceived support?

The Relationships among Major Variables

The relationships among teachers' attitudes, perceived support, and professional development were examined using Pearson's correlation test; the results are reported in the following table 15.

Table 15: *Pearson's Correlations among Major Variables*

		Professional Development in Creativity and Gifted Mathematics Education	Attitudes toward Teaching for Creativity and Mathematical Talent Development
Overall Perceived Support	Pearson Correlation	.48**	.08
	Sig. (2-tailed)	.00	.46
	N	93	93
Professional Development in Creativity and Gifted Mathematics Education	Pearson Correlation	1	.29**
	Sig. (2-tailed)		.01
	N	93	93

The coefficients of Pearson's correlation test show that there was not a significant relationship between the overall perceived support and teachers' attitudes toward teaching for creativity and mathematical talent development at α of .05; $r=.078$, $p=.46$. This means that teachers' attitudes were not related to the extent to which they feel supported to teach for creativity and mathematical talent development. On the other hand, there was a small significant positive relationship between overall professional development and teachers' attitudes toward teaching for creativity and mathematical talent development; $r=.29$, $p=.005$. This means that teachers who have received more professional development in creativity and gifted mathematics education hold stronger positive attitudes toward teaching for creativity and mathematical talent development.

Moreover, a medium significant positive relationship was found between the overall perceived support and professional development received; $r= .48$, $p<.0001$, $\alpha=.05$. The possible effect of each variable on the others was not accounted in this test of correlation; accordingly, further investigation of the unique contribution of each variable in explaining teachers' attitudes is still needed. The following sections clarify the unique relationship of teachers' attitudes with each, the perceived support and professional development, after holding the other and other independent variables (gender, years of teaching experience, and academic degree) constant.

Teachers' Attitudes and Perceived Support

Multiple liner regression analysis was used to examine variability in teachers' attitudes accounted for by the overall perceived support after controlling the other independent variables (gender, years of teaching experience, academic degree, and professional development). The results of the regression analysis indicated the overall perceived support did not contribute of a statistically significant proportion of unique variance (using an alpha level of .05) in teachers' attitudes toward teaching for creativity and mathematical talent development (*R^2 change<.0001, F change observed (1, 87) =.04, p=.85*). This means that the extent of perceived support does not help in understanding the variance in teachers' attitudes after controlling the other independent variables. The following table (16) includes the summary of the regression model.

Table 16: *Model Summary of Attitudes Regression based on Perceived Support*

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.38[a]	.14	.1	.43	.14	3.62	4	88	.01
2	.38[b]	.14	.09	.43	.00	.04	1	87	.85

a. Predictors: (Constant), Professional Development in Creativity and Gifted Mathematics Education, Years of Experience in Teaching Mathematics, Gender, Academic Degree

b. Predictors: (Constant), Professional Development in Creativity and Gifted Mathematics Education, Years of Experience in Teaching Mathematics, Gender, Academic Degree, Overall Perceived Support

Teachers' Attitudes and Professional Development

Multiple liner regression analysis was used to examine variability in teachers' attitudes accounted for by professional development after controlling the other independent variables (gender, years of teaching experience, academic degree, and perceived support). The results of the regression analysis indicated that professional development did contribute of a statistically significant proportion of unique variance (using an alpha level of .05) in teachers' attitudes toward teaching for creativity and mathematical talent development (*R^2 change=.1, F change observed (1, 87) =9.92, p=.002*).

This means that professional development was found to be a significant variable contributes to the variance in teachers' attitudes; about 10 % of variance in teachers' attitudes was uniquely accounted for by professional development. Teachers who have received more professional development in creativity and gifted mathematics education hold stronger positive attitudes toward teaching for creativity and mathematical talent development. The following table (16) includes the summary of the regression model.

Table 17: *Model Summary of Attitude Regression based on Professional Development*

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.21[a]	.04	.00	.45	.04	1.01	4	88	.41
2	.38[b]	.14	.09	.43	.1	9.91	1	87	.00

a. Predictors: (Constant), Overall Perceived Support, Academic Degree, Years of Experience in Teaching Mathematics, Gender

b. Predictors: (Constant), Overall Perceived Support, Academic Degree, Years of Experience in Teaching Mathematics, Gender, Professional Development in Creativity and Gifted Mathematics Education

It is worth mentioning also that the combination of the other independent variables collectively (gender, years of teaching experience, academic degree, and perceived support) did not provide any statistical contribution to explaining the variance of teachers' attitudes toward teaching for creativity and mathematical talent development. Model 1 in the previous table (17) represents the regression of teachers' attitudes to the combination of the independent variables except the professional development; the values indicated no statistical relationship ($r = .21$, $R^2 = .04$, F *observed* $(4, 88) = 1$, $p = .41$).

The following table (18) provides further information about the relationship of each independent variable with the dependent variable (teachers' attitudes) including Beta weight for each variable in the full regression model where all variables are included.

Table 18: *Coefficients of Regression and Correlation of each Independent Variable with the Dependent Variable*

Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations		
		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part
2	(Constant)	3.37	.32		10.6	.00			
	Gender	.25	.12	.23	2.15	.04	.16	.22	.21
	Academic Degree	.03	.1	.04	.35	.73	.05	.04	.04
	Years of Experience in Teaching Mathematics	.00	.01	-.01	-.04	.97	.05	-.01	-.00
	Overall Perceived Support	-.01	.06	-.02	-.19	.85	.08	-.02	-.02
	Professional Development in Creativity and Gifted Mathematics Education	.12	.04	.36	3.15	.00	.29	.32	.31

a. Dependent Variable: Attitudes toward Teaching for Creativity and Mathematical Talent Development

Overall perceived support and professional development were the independent variables of interest in this study. The previous table (18) further confirms that professional development is the independent variable statistically contributing more to the explanation of the dependent variable variance after controlling for the other independent variables; $\beta = .36$, $t(88) = 3.15$, $p=.002$. On the other hand, Beta weight that is contributed by the overall perceived support to attitude's regression equation was not statistically significant; $\beta = -.02$, $t(88) = -.19$, $p = .85$.

Chapter Summary

This study aimed to further investigate teaching for creativity and mathematical talent development by examining three influential factors on teachers' practices toward nurturing creativity for all students and meeting the needs of gifted/talented mathematics students in general education schools; teachers' attitudes, overall perceived support, and professional development. The major purpose is to contribute to understanding teachers' attitudes and enhancing school trends toward teaching for creativity and mathematical talent development utilizing broad conceptions of creativity and talent, and internalizing positive beliefs about student capability for success.

The study sample included 93 elementary mathematics teachers from several states in the United States of America. The analysis of obtained data revealed that teachers hold positive attitudes toward teaching for creativity and mathematical talent development (M=4.02), SD=.45). In regard to the extent of available support, teachers' reported responses indicated that they are somewhat supported to teach for creativity and mathematical talent development in general education settings; the mean of the overall perceived support was 3.04, SD=.84.

The inferential analysis also revealed that the overall perceived support did not contribute of a statistically significant proportion of unique variance (at alpha level of .05) in teachers' attitudes toward teaching for creativity and mathematical talent development (R^2 *change<.0001, F change observed (1, 87) =.04, p=.85*). Professional development, however, was found to be the major variable accounting for a statistically significant proportion of unique variance (10%) in teachers' attitudes (R^2 change=.1, F change observed (1, 87) =9.92, p=.002).

The following chapter includes further discussion of the findings, implications, and recommendations for school improvement and future research.

CHAPTER 5: DISCUSSION

Overview of the Study

This study further investigated teachers' attitudes toward teaching for creativity and mathematical talent development with a focus in two potentially influential factors, overall perceived support, and professional development. The major purpose was to discover the unique relationship of each major variable with teachers' attitudes after accounting for other independent variables. This study was conducted with the aim of understanding teachers' attitudes and enhancing school trends toward teaching for creativity and mathematical talent development utilizing broad concepts of creativity and talent, and internalizing positive beliefs about student capability for success.

The study sample included 93 elementary mathematics teachers from several states in the United States of America. A five- point Likert survey instrument was developed and utilized in collecting data to answer the following research questions:

1- What are mathematics teachers' attitudes toward teaching for creativity and mathematical talent development in general education U.S. elementary schools?

2- What are features of support, related to teaching for creativity and mathematical talent development, that teachers feel are available?

3- Does the extent of overall perceived support contribute of a statistically significant proportion of unique variance (using an alpha level of .05) to teachers' attitudes toward teaching for creativity and mathematical talent development; after accounting for gender, academic degree, years of teaching experience, professional development?

4- Does professional development contribute of a statistically significant proportion of unique variance (using an alpha level of .05) to teachers' attitudes toward teaching for creativity and mathematical talent development; after accounting for gender, academic degree, years of teaching experience, and overall perceived support?

Descriptive statistics and multiple liner regression analysis were used. The findings included that teachers hold positive attitudes, and feel they are somewhat supported. The results of the data analysis also indicated that the overall perceived support did not have any significant effect in teachers' attitudes toward teaching for creativity and mathematical talent development, whereas professional development was found to be the major variable accounted for a statistically significant proportion of unique variance (10%) in teachers' attitudes.

Discussion of the Findings

Teachers' Attitudes

The findings of the study included that teachers' overall attitudes toward teaching for creativity and mathematical talent development generally were positive with a mean of 4.02, SD=.45. Based on the criteria used in this study, there were only four participants (3.2%) stated attitudes with means that are less than 3 using a 5-point Likert type scale.

In this study, teaching for creativity and mathematical talent development was addressed theoretically to be one process toward which attitudes are analyzed as one variable. However, for better understanding, a close examination of teachers' attitudes was made by descriptively analyzing each subscale separately; attitudes toward teaching for creativity, and attitudes toward teaching for mathematical talent development. The mean score of each subscale, however, pointed out the same overall conclusion with positive attitudes held by teachers toward each; teaching for creativity (*M=3.98. SD=.52*), and teaching for mathematical talent development (*M=4.05, SD=.46*), as it is with the overall attitude average score (*M=4.02. SD=.54).*

First, teachers' attitudes toward teaching for creativity generally were positive as the mean score of positive agreement was 3.98, SD=.52. The results in this subscale also indicate that only three participants (3.2%) reported attitudes toward teaching for creativity with averages that are less than 3 in the attitude scale. Appendix (I) includes the frequencies of teachers' responses in all statements related to teaching for creativity.

The statement that has been viewed inconsistently among teachers was "*Creativity is an innate ability that cannot be taught or developed*" where the results indicated that 18 of the participants (19%) agree with this statement, and another 24 participants (26%) stated that they neither agree nor disagree. The percentage of teachers who agree with statement is not high (19%), and inconsistency about this statement is expected to a certain degree. One rational to state that this result is not of great concern is that teachers responded with the highest score of positive agreement on the statement of "*Most students, if not all, have the potential to be creative individuals*", where 85 of the participants (91%) agreed with this statement. It is also worth mentioning that the participants expressed a strong agreement that creativity can be developed in general education classrooms, as well as fostering creativity is one of the essential roles of the general classroom teacher. These statements might have been clearer for teachers to express their implicit views of creativity accurately in relation to school context.

Furthermore, scholars and researchers in psychology of creativity themselves still are in a debate about the nature of creativity using different bases, and different components of focus that yielded multiple respected perspectives. Most of the contemporary researchers, however, are in the positive direction of adopting a broad conception of creativity that allows enough space for everyone to be creative at different levels in any context and in any field (Davis, 2004). This broad view of creativity is the view that should be adopted by teachers, so they can facilitate optimal growth for all students, with respect to research findings about the functions of the neuro system, genes, and the state of being unconscious.

The overall result that can be stated here is that teachers, in general, believe that nurturing creativity for all students should be an important aspect in teaching mathematics. This result aligns with several previous studies. For example, Alajmi (1994) found that teachers' attitudes toward creativity overall were positive, with a group mean of 5.18 based on 7-point Likert type scale. Another study conducted by Aljughaiman and Mowrer-Renolds (2005) also revealed that teachers hold positive perceptions and attitudes toward creativity with more than 50% of the participants agreeing with all the positive statements included in the questionnaire used.

Second, teachers' attitudes toward teaching for mathematical talent development were reported to be also positive with a group mean of 4.0, SD=.46. Only two participants (2.2%) reported attitudes toward teaching for mathematical talent development with averages that are less than 3 in the attitude scale. Appendix (G) includes the frequency of teachers' responses in all of the statements related to teaching for mathematical talent development.

The statement that has been viewed inconsistently among teachers was "*Students who have high abilities in mathematics are always able to fully develop their abilities without support*" where the results indicated that 18 of the participants (19%) agree with this statement, and another 18 participants (19%) stated that they that they neither agree nor disagree. However, the percentage of agreement with this statement is too small to rely on for judging teachers' overall attitudes. In addition, most teachers with another compatible statement expressed a strong positive agreement; this statement is *"Students who have high abilities in mathematics need additional support to further develop their abilities",* N=76 (82%), M=4.1. Explanations of this inconsistency might include that the current dominating focus on academic achievement as the sole criteria of student full development leaded some participants to agree that students who have high abilities in mathematics are always able to fully develop their abilities without support. Although the participants who had inconsistent views were few, implications of such conceptualizations of student full development are of great concern, as teaching should be considered as a process of human development that is not limited only to academic achievement measured by scores on standardized tests.

There were several statements that received a high level of positive agreement in the subscale of teaches' attitudes toward teaching for mathematical talent development. The statement that received the highest level of positive agreement was "*It is important that students be provided with different avenues to learn based upon their aptitudes and interests (differentiation of instruction)"*. Almost all participants (N=85, 91%) agree with this statement which can be explained that teachers recognize that all students deserve equal quality education including, although implicitly, gifted students. The high level of consistency in this aspect can potentially be attributed to the current focus on differentiation of curriculum and instruction in both levels; college education and school district professional development. Professional development programs of differentiated instruction should explicitly address issues related to gifted and talented education; implications of possible overlooking gifted students' needs in such programs are of great concern.

The overall result in this aspect is that teachers generally believe that facilitating further development of mathematically gifted students should be an important aspect of teaching mathematics. Although, investigations of teachers' attitudes toward gifted education yielded mixed results, the result that teachers hold positive attitudes were reached in several previous studies. For example, the study conducted by McCoach and Siegel (2007) revealed that the teachers in the sample were generally supportive of gifted education with a mean score of 5.45 on a 7-point Liker type scale (78%). Drain's (2008) study also provided the same conclusion that teachers' overall had somewhat positive attitudes toward gifted education with an average score of 3.4 on a 5-point Likert scale.

All together, the concluding descriptive finding related to teachers' attitudes is that teachers' overall attitudes toward teaching for creativity and mathematical talent development were generally positive with a mean of 4.02, SD=.45. This finding supports the research hypothesis, and aligns with several previous studies that examined teachers' attitudes toward creativity and gifted education either separately, or together; as most studies of teachers' attitudes toward gifted education implicitly include at least items related to creativity as a central concept in gifted and talented education.

Perceived Support

The results of this part indicated that teachers are somewhat supported to teach for creativity and mathematical talent development; the mean of the overall perceived support was 3.04 (SD=.84). Appendix (K) includes the frequency of teachers' responses about the availability of each included feature of support related to teaching for creativity and mathematical talent development.

Several features of support had less than 3 in the availability average. Examples of features that had the least degrees of availability included "*Rewards/incentives for effective teachers in developing student creativity and academic abilities*" with an availability mean of 2.54, "*Sufficient professional development opportunities related to the education of mathematically gifted and talented students*" with an availability mean of 2.63, "*Sufficient professional development opportunities related to developing student creativity*" with an availability mean of 2.73, and "*An appropriate daily school schedule that gives teachers sufficient time to plan and administer activities for developing talent in mathematics*" with an availability mean of 2.92.

Some of the participants provided additional qualitative comments that further explain their points of views regarding features of available support; these comments were around several issues. The most frequent issue indicated by participants was the overemphasis on state tests as the central criterion for teacher performance and school progress; they mentioned that the focus on standardized tests puts on them pressure, and hinders their teaching toward enhancing creativity and facilitating further development of high-achieving students.

These findings are consistent with previous studies. For example, Curtis (2012), through a nation-wide study of the U.S., found that mathematics teachers were not highly satisfied, indicating several challenges such as lack of administrative and parental support, low salaries, pressure over state assessment, and the frequent blame they receive. Teacher feeling of not being supported is of great concern, as it might lead not only to less effective teaching practices, but might also lead qualified teachers to leave the profession. Loeb, Darling-Hammond, and Luczak (2005) found that the conditions of schools with high levels of teacher turnover had poor working conditions and low salaries. Another study conducted by Skaalvik and Skaalvik (2011) examined the relationships between school context variables and teachers' feeling of belonging, emotional exhaustion, job satisfaction, and motivation to leave the teaching profession. The findings included that teachers who hold higher levels of motivation to leave the teaching profession were less satisfied with their school conditions including value consonance, supervisory support, relationships with colleagues, connections with parents, time pressure, and discipline problems.

The importance that teachers be provided with a supportive school environment has been heighted in literature, in order to keep qualified teachers not only stable in their schools, but also facilitated to successfully implement effective educational programs for positive student outcomes. Such necessary support discussed in literature included appropriate condition of school facilities, administrative support, respected teacher status, colleague cooperation, parent involvement, appropriate teaching load, small class size, clear school philosophy, effective learning resources, and accessible professional development programs (McIntosh et al., 2014; Skaalvik & Skaalvik, 2011; Loeb, Darling-Hammond, & Luczak, 2005).

Relationships

The correlations part of this study included the examination of the potential unique relationship of each major independent variable with the dependent variable after accounting for the other, and other selected variables. The overall perceived support and professional development were the major variables examined to have possible unique contributions to understanding the variance in teachers' attitudes toward teaching for creativity and mathematical talent development.

The variability in teachers' attitudes accounted for by the overall perceived support was examined first after accounting for the other independent variables (gender, years of teaching experience, academic degree, and professional development). The results indicated that the overall perceived support did not contribute of a statistically significant proportion of unique variance (using an alpha level of .05) in teachers' attitudes toward teaching for creativity and mathematical talent development (R^2 *change*$<$*.0001, F change observed (1, 87) =.04, p=.85*). This means that the extent of perceived support does not help in understanding the variance in teachers' attitudes after accounting for the other independent variables.

The result that perceived support is not significantly related to teachers' attitudes does not support the research hypothesis of the current study. It is also not consistent with previous relevant studies (e.g., Loeb, Darling-Hammond, & Luczak, 2005; Skaalvik & Skaalvik, 2011). Possible explanations of this result include that teachers are ideologically qualified enough that their belief systems are not affected by the extent of external provided support; they have high levels of intrinsic motivation toward effective teaching. Further external support of those teachers who are ideologically mature and intrinsically motivated can significantly strengthen their positive attitudes and extend their effort toward effective teaching for creativity and mathematical talent development.

The second correlation investigation was conducted to understand how much professional development explains the variability in teachers' attitudes after accounting for the other independent variables (gender, years of teaching experience, academic degree, and perceived support). The results of this examination indicated that professional development did contribute of a statistically significant proportion of unique variance (using an alpha level of .05) in teachers' attitudes toward teaching for creativity and mathematical talent development (R^2 *change=.1, F change observed (1, 87) =9.92, p=.002*).

This means that the extent of received professional development was found to be a significant factor contributes to understanding the variance in teachers' attitudes; about 10 % of variance in teachers' attitudes was uniquely accounted for by professional development. Teachers who have received more training in creativity and gifted mathematics education had stronger positive attitudes toward teaching for creativity and mathematical talent development. This result implies quality effective training received, and further highlights the importance of professional development in teachers' attitudes.

This result also supports the research hypothesis that professional development in creativity and gifted education is positively related to their attitudes. Although it is inconsistent with what McCoach and Siegle (2007) found in their study, it aligns with findings of other previous studies. For example, in Kim and Gentry's (2008) study, teacher training in gifted education was found to be an essential factor influencing teachers' perceptions by increasing their knowledge of, and interest in, gifted education. In general, previous investigations of potential factors of teachers' attitudes provided inconsistent results (Bégin & Gagné, 1994; Jung, 2014); the kind of research methods and instruments used in such studies; as well as, common limitations from which these studies, including the current study, suffer are possible explanations of this inconsistency.

Limitations

The validity of this study's findings might be hindered by several factors. First, although several validation methods for the obtained responses have been used, the level of accuracy of the information provided still is a concern as the participants' seriousness in responding to the questionnaire cannot be completely determined. Second, the sample in this study was not drawn randomly. It was a convenient sample of participants of elementary mathematics teachers from only two regions of the United States; the Midwest and the Northeast, so it is hard to conclude generalizable findings.

Although, the sample size of this study (N=92) is still acceptable in explaining the relationship between the involved variables, as the required sample size calculated using G*power software with about the same criteria was only 76 participants, it does not meet the rule that Green (1991) suggested for the partial correlation analysis which was the major statistical test. Green (1991) indicated that the accurate rule-of thumb for determining the minimum sample size needed to get a power of 80% for the aggression analysis with a medium effect size, and a .05-level of significance is the combination formula ($N \geq 50+8p$) for the multiple correlation, and ($N \geq 104+p$) for the partial correlation; where (N) is the number of the participants, and (p) is the number of the predictors (IVs). Furthermore, cause-effect relationships between the involved variables cannot be claimed due to the absence of random assignment which is not applicable in this study. Accordingly, the findings of this study should be read with caution taking into account its limitations for better understanding and utilization.

Implications and Recommendations

Although the current study had several limitations, numerous implications can be drawn and utilized as references for future improvement of educational policies. Recommendations for developing pre-service teacher education courses, in-service professional development programs, and school environments can also be obtained in light of the findings of this study.

First, the findings of this study include that teachers hold positive attitudes toward teaching for creativity and mathematical talent development. This positive finding implies a high level of knowledge and interest in gifted mathematics education; however, teachers' positive attitudes seemed mostly to be a result of their self-professional growth with the potential impact of professional development related to creativity and differentiation of instruction. The rationale for this possible attribution is that most teachers (N=52, 55.9%) reported that they have not received any professional development courses in gifted mathematics education neither at the college education level, nor at the school district level.

Therefore, further strengthening of these positive attitudes, through additional professional development, is recommended especially since findings included that professional development is the major significant factor that has a positive relationship with teachers' attitudes. Teachers' attitudes to become highly positive, and to lead effective practices in the classroom, continued professional development courses are needed specifically in mathematics education of the gifted and talented at both levels; college level, and school district level. These courses should be designed especially to address educational issues related to mathematically gifted and talented students, which includes creativity as a central topic. General courses in gifted and talented education are effective in providing necessary foundational background, but they may fail to address each area of talent intensively, such as methods and programs for mathematical talent development. Such special professional development courses, provided by mathematics teacher educators, can be more effective in helping teachers to expand their views of student capability for success in mathematics, and develop their skills to provide further opportunities for mathematical talent development in general education settings.

Second, the findings of this study imply that teachers are somewhat supported to teach for creativity and mathematical talent development. The participating teachers reported lack of several necessary features of support, most of which were related to the education system and how teachers are positioned within it, facilitated, and evaluated. This research finding should lead educational policy makers and stake holders to reconsider teachers' needs beginning with understanding the nature of teaching profession as a process of human development that includes multiple variables of which teachers might not have control unless they receive enough support. Continued professional development is significant for teacher growth and effective teaching; additional adequate support that goes beyond professional development is important as well. Kinds of support that teachers need begin with an honest professional hiring process that not only leads to have qualified colleagues, but also provides a prior clear idea of the teaching process and possible common challenges for candidates to decide ahead of time whether they really have enough passion to engage in this profession.

Educational policy and strategic programs should be developed based on a reliable teaching philosophy with consideration of teachers' needs in a way that ensures prior healthy conditions for successful implementation including a clear mission and vision, continuous professional development, ongoing personality development courses, administrative and supervisory support, trust, respect and encouragement, flexibility, resources, affordable teaching load, and fair evaluation processes that aim to improve teacher performance and school environments, and result in a cooperative safe school climate that supports student creativity and effective teachers. Teaching for Creativity and Mathematical Talent development (TCMT) is proposed and recommended to adopt as a philosophy of mathematics education that aims for the best educational outcomes possible for all students based on broad conceptualization of creativity and talent, as well as positive beliefs on student capability for success.

A Proposed Philosophy for Teaching Mathematics

Teaching for Creativity and Mathematical Talent development (TCMT) is recommended to be adopted as a philosophy of teaching in general education schools. TCMT requires that teachers hold positive attitudes toward effective teaching as a process of human development. Teachers who hold positive beliefs and passion for effective teaching will look for professional development opportunities, so he/she can use different teaching methods and provide additional options that nurture creativity and mathematical talent based upon students' needs and the situation of each education setting.

In order to teach for creativity and mathematical talent development, teachers should understand their roles as a facilitator of optimal human development, conceptualize creativity as an ongoing process of self-development, and hold positive beliefs about student capability for success. The mission is to provide opportunities for all students to develop academic, personal and social skills necessary to become successful individuals, increase their achievement to reach the highest level possible, become gifted, then talented, and perhaps become future mathematicians.

Adopting TCMT as a philosophy of teaching entails that creativity is perceived as "Human Development toward Self-Actualization". Self-actualization was defined by Maslow (1943) as "the desire for self-fulfillment and being everything that one is capable of becoming" (p. 382). The humanistic self-actualization approach to creativity (Maslow, 1943; Rogers, 1954; Maslow, 1968) has been supported either explicitly or implicitly by many scholars. According to Davis (2004), the relationship between creativity and self-actualization is one of the most influential concepts in the field of creativity, and argued that creativity is a way of thinking and living that leads to personal development and a productive successful life. Creativity, as human development, includes a broad range of personality characteristics, life skills, general mental skills, and domain-related skills (specialized creativity).

Teaching for Creativity in this case means facilitating ongoing overall development of humans/students that leads them to positively actualize themselves and reach the highest level possible appropriate for their special aptitudes, potentials, circumstances, and community needs. As the highest level of self-actualization may vary from an individual to another; students should be facilitated to develop positive belief systems related to their personal abilities, achievement goals, and future success; and lead them to keep an active and regenerated desire for self-actualization through unlimited high-level personal goals of achievement.

Based on TCMT philosophy, teachers should teach for creativity for all students considering each student's unique aptitudes, and circumstances, as well as the educational situation. Teaching for creativity requires certain classroom conditions and teaching practices, as discussed in the literature review, that provide a healthy environment for all students to express and develop their creativity and mathematical abilities. The following model, Figure 5, illustrates the researcher's view of Teaching for Creativity and Mathematical Talent development (TCMT).

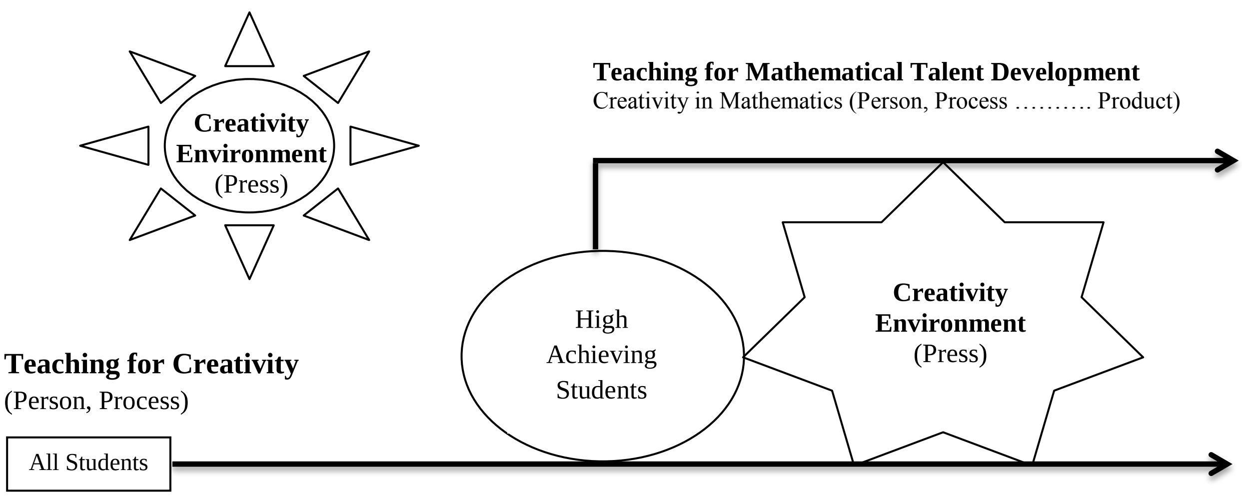

Figure 5: The TCMT Model for Teaching Mathematics

Creativity in Phase I of this model can be viewed as general learning, personal, and social skills; it might be mathematical creativity at a low level. All students benefit from the creativity atmosphere in the phase 1, move forward in their meaningful effective learning and personal/social development, and may express signs of giftedness in mathematics later. It is highly possible that some students are encouraged to express high ability in mathematics/ high achievement/ giftedness, and it is also possible that other students are influenced and enhanced by the creativity environment to systematically work hard and extend their abilities and become potentially gifted. Students who have high potential in mathematics should be provided with additional enrichment opportunities, Phase II.

In Phase II, gifted students are facilitated to further develop their potential mathematical talent and creativity in mathematics, for being future mathematician who can develop original produces with time, if intrinsic motivation/task commitment and environmental support for creativity continue to be available. The focus in Phase II is on mathematical creativity development, but it does not mean neglecting the development of general creativity as skills of effective learning, personal, and social growth; which should be an ongoing development process for all students as the essence of the philosophy of teaching for creativity and mathematical development. In phase II, possible services for the gifted students include special activities and programs inside or outside the classroom that can be extended for further enrichment out-of-school environment. The aim of this philosophy is not only to develop mathematical talent, but is also to develop necessary skills for all students to be effective creative continued learners, and perhaps some of them move further ahead, with enrichment programs, to be mathematicians with needed personal and social skills that make their contributions in the field and their society more effective and valuable.

Effective teaching practices depend on several factors related to the components of each educational situation. Best decisions related to teaching methods used are expected from teachers themselves; teachers, as classroom experts, should understand more than others what might effectively help their students achieve desired goals in each educational setting. Teaching practices for developing creativity and mathematical talent might include, but are not limited to, ensuring that students have prior knowledge and skills needed to success in the new topic, using advanced organizers and inquiry activities to help students construct knowledge and skills, providing needed learning tools with utilization of technology, allowing independent thinking, encouraging multiple methods and responses, informing students of the creative process and creative individuals, developing creativity as personal/social/life skills, developing creativity as a process/thinking skills, assigning heterogeneous group tasks, helping students feel safe and enjoy learning, encouraging social communication/ sharing, respectfully discussing and evaluating of ideas, effectively using questions, providing positive feedback, building upon student ideas, assigning homogenous group tasks, differentiating of instruction and evaluation, helping students feel of the aesthetic and benefits of mathematics using real life applications, and collaborating with significant others to provide additional remedy or enrichment activities such as tutoring and university level advanced experiences. Teaching for creativity and mathematical talent development might lead students to move through different developmental stages of academic and life success.

The researcher views mathematically gifted students as individuals who have above average aptitudes in mathematics with average general intelligence quotient/IQ (genetics), and task-commitment/motivation with strong attitudes toward continued learning and applications of mathematics in real life situations (creativity: personality). Giftedness with above average general intelligence, can turn to become talent if creativity (creativity: person and process) is developed as a major component of talent development. Original productivity in the discipline (creativity: person, process, and product) requires not only talent, but also more time, task commitment, and further environmental support for creativity (creativity: person, process, product, and press/environment). The following model, Figure 6, simplifies the possible transitional stages of mathematical talent development through TCMT. This model is based on the researcher's view, in light of theoretical literature, about the characteristics of the individuals in each level of mathematical proficiency development for the purpose of understanding TCMT; future modifications and development of this model is possible.

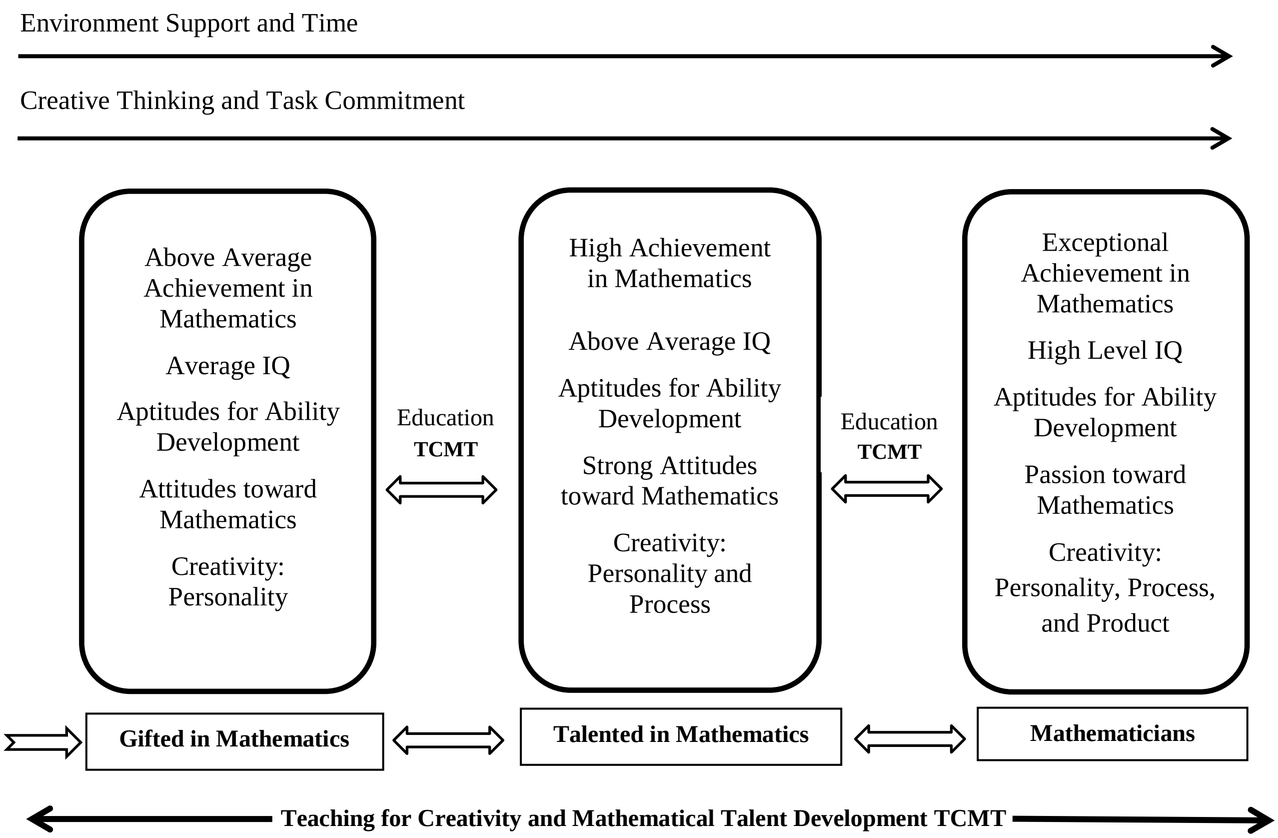

Figure 6: Potential Stages for Mathematical Talent Development through TCMT

Although this model might be more applicable in the field of mathematics, especially that general IQ is included as a criterion; it does not propose a generalizable sequence of human development in mathematics or other fields as the researcher believes that human intelligence is an elusive phenomenon. Creativity in this model is an essential component that exists at each level of mathematical ability development; however, it has different elements at each level as creativity can be nurtured first as personality skills, then can be developed into personality skills and skills of thinking/processes, and later, after considerable time, continued environment support, hard work, and incubation, illumination may appear and novel ideas or products are released for verification; creativity in this case represents personality, process, press, and product.

The TCMT model is designed to have an open gate for any student to become gifted in mathematics and to develop their potential for being talented and future mathematician if certain conditions are met with continued availability and ongoing utilization. These conditions are related to environment, personality, and time. Although it is rare that students in K-12 schools highly accomplish in mathematics to the level of mathematicians, they still should be facilitated toward achieving this aim at a future time with positive beliefs about student capability for success. Teaching for Creativity and Mathematical Talent development is the core of the optimal school environment for facilitating students to move toward the highest level possible of these developmental stages in mathematical accomplishment.

Conclusion and Suggestions for Future Research

Teachers' attitudes and features of support related to teaching for creativity and mathematical talent development were investigated in this study. The major purpose was to contribute to understanding teachers' attitudes and enhancing school trends toward teaching for creativity and mathematical talent development as a philosophy of teaching, utilizing broad conceptions of creativity and talent, and internalizing positive beliefs about student capability for success. The analysis of obtained data revealed that teachers hold positive attitudes toward teaching for creativity and mathematical talent development. The extent of available support was reported to be somewhat available in the U.S. for teachers to teach for creativity and mathematical talent development in general education settings. Moreover, professional development was found to be the only major variable accounting for a statistically significant proportion of unique variance (10%) in teachers' attitudes toward teaching for creativity and mathematical talent development.

Future research should continue to expand the philosophy of teaching for creativity and mathematical talent development proposed in this study, in order to translate its theoretical concepts to applicable practices. The findings of this study should be further validated also through replicated studies that address its limitations. For example, this study can be replicated at another level of education, with a large scale population that includes all states of the U.S., with random sampling techniques, or it can be replicated in other countries. Moreover, this study failed to support the research hypothesis that perceived support is related to teachers' attitudes which also is not consistent with previous studies, so more studies that focus on this aspect are needed.

Future research should also continue to investigate teachers' attitudes toward teaching for creativity and mathematical talent development using different research methods and instruments. Although the research instrument used in this study has passed several processes of validation, instruments with higher levels of validity are always more effective in providing accurate conclusions. The current study was conducted using quantitative research methodology, so future studies through qualitative research methods are recommended for clearer understanding of teachers' implicit theories of creativity and mathematical talent development, as well as the extent of support they receive, challenges they face, and improvements they seek.

The issue of standardized state tests has been highlighted by several participants in this study which leads to recommending deep investigations of this issue considering all of its dimensions in order to reach appropriate decisions to avoid its possible negative impacts on schooling outcomes. This might include improvements of the design and usages, as well as helping teachers to psychologically adapt with such assessment and focus on effective teaching. Students should also be included in such studies; their perspectives, satisfaction, and needs are important subjects for investigation in order to plan and provide effective opportunities for all students to become more creative and mature talented. Useful implications of these types of study are highly possible, for policy makers and school reform committees.

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APPENDICES

Appendix A: HSCL Approval Letter

KU RESEARCH & GRADUATE STUDIES
The University of Kansas

APPROVAL OF PROTOCOL

January 22, 2014

Majed Wadaani
m709w932@ku.edu

Dear Majed Wadaani:

On 1/22/2014, the IRB reviewed the following submission:

Type of Review:	Initial Study
Title of Study:	Teaching for Creativity and Mathematical Talent Development: Teachers' Attitudes and Features of Support at the Elementary General Education Schools
Investigator:	Majed Wadaani
IRB ID:	STUDY00000562
Funding:	None
Grant ID:	None

The IRB approved the study on 1/22/2014.

1. Any significant change to the protocol requires a modification approval prior to altering the project.
2. Notify HSCL about any new investigators not named in original application. Note that new investigators must take the online tutorial at https://rgs.drupal.ku.edu/human_subjects_compliance_training.
3. Any injury to a subject because of the research procedure must be reported immediately.
4. When signed consent documents are required, the primary investigator must retain the signed consent documents for at least three years past completion of the research activity.

Please note university data security and handling requirements for your project:
https://documents.ku.edu/policies/IT/DataClassificationandHandlingProceduresGuide.htm

You must use the final, watermarked version of the consent form, available under the "Documents" tab in eCompliance.

Sincerely,

Stephanie Dyson Elms, MPA
IRB Administrator, KU Lawrence Campus

Human Subjects Committee Lawrence
Youngberg Hall I 2385 Irving Hill Road I Lawrence, KS 66045 I (785) 864-7429 I HSCL@ku.edu I research.ku.edu

Appendix B: Statement of Information and Recruitment

Teaching for Creativity and Mathematical Talent Development: Teachers' Attitudes and Features of Support in the Elementary Education Schools

Dear teacher,

The Department of Curriculum and Teaching at the University of Kansas supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish to participate in this study. You should be aware that even if you agree to participate, you are free to withdraw at any time without penalty.

This study aims to investigate teachers' attitudes and features of support related to teaching for creativity and mathematical talent development in the elementary education schools. This will entail your completion of a questionnaire. Your participation is expected to take approximately 15 minutes to complete. The content of the questionnaire should cause no more discomfort than you would experience in your everyday life.

Although participation may not benefit you directly, we believe that the information obtained from this study will help us gain a better understanding of teachers' attitudes toward creativity and mathematical talent development. Your participation is solicited, although strictly voluntary. Your name will not be associated in any way with the research findings. Your identifiable information will not be shared unless (a) it is required by law or university policy, or (b) you give written permission. It is possible, however, with internet communications, that through intent or accident someone other than the intended recipient may see your response.

If you would like additional information concerning this study before or after it is completed, please feel free to contact the principal investigator or the faculty supervisor.

Completion of the questionnaire indicates your willingness to take part in this study. If you have any additional questions about your rights as a research participant, you may call (785) 864-7429 or write the Human Subjects Committee Lawrence Campus (HSCL), University of Kansas, 2385 Irving Hill Road, Lawrence, Kansas 66045-7563, email irb@ku.edu.

Sincerely,

Majed R Wadaani
Principal Investigator
Curriculum and Teaching
University of Kansas
1122 W Campus Road
Lawrence, KS 66045
majedrwd@ku.edu

Kelli R Thomas, Ph.D.
Faculty Supervisor
Curriculum and Teaching
University of Kansas
1122 W Campus Road
Lawrence, KS 66045
kthomas@ku.edu

KU Lawrence IRB # STUDY00000562 | Approval Period 6/20/2014

Appendix C: Data Collection Agreement

Invoice

Qualtrics, LLC
2250 N. University Pkwy, 48-C
Provo UT 84604
801-374-6682

Tax ID: 45-4964116

Date	10/8/2014
Invoice #	3936
Terms	Net 30
Due Date	11/7/2014
PO #	
Sales Rep	

Bill To

Majed Wadaani
University of Kansas-Education
1450 Jayhawk Blvd
Lawrence, KS 66045

Description
Project Name:Qual712-0731ElementryTeacher Number:93 Demographic:-Elementary school teachers who teach math -Currently working -Midwestern states: n=49 Northeastern states: n=45 LOI:10 CPI:18.00 Panels Sales Rep:Lincoln Bradshaw (LINCOLNB)

Total	1,674.00
Amount Due	USD $1,674.00

To make payment online through credit card or electronic check/ACH, please visit our payment portal.
Please Note: 3% credit card surcharge for invoices over $10,000 US: https://payments.qualtrics.com/invoice

If unable to utilize the payment portal, please use the following information for bank transfers or paper checks:

Bank Information

JPMorgan Chase Bank, N.A.
201 S. Main Street, Suite 300
Salt Lake City, UT 84111

Paper Check:
Qualtrics, LLC
2250 N. University Pkwy, 48-C
Provo, UT 84604

Account Name: Qualtrics, LLC
Account Number: 207865283
ABA Routing for ACH and Check: 124001545
ABA Routing for Wire: 021000021
SWIFT (Int'l): CHASUS33

Appendix D: Feedback Obtained from the Preliminary Process of the Instrument Development, Example 1

Dear educator,

I have been working on developing a questionnaire for my Ph.D. dissertation proposal, and a part of it is related to *the features* of *support that teachers need in order to teach for creativity and mathematical talent development in the regular/general education settings*. Since opinions of practitioners and specialists are important to produce a valid instrument, please provide me with what you think is important for teachers to have in order to facilitate creativity and mathematical talent development in the general education schools. Your opinions could be related to the support that teachers need, the support that students need, the attributes of the physical environment, the school work atmosphere, or other aspects you think are important.

Thanks. **Majed Wadaani, C&T. majedrwd@ku.edu**

Teachers' needs	Students' needs	Physical features and work atmosphere
Professional development to learn what this would look like in a classroom - less focus on Standards and teaching to them	More freedom to guess - use creativity to try to solve w/out demand for right answer only.	⟷ More moving around, real-world, hands on inquiry and experience & problem solving, less book work.

Additional aspects:

Participant's Information

Name (optional):	Academic degree: Teaching	
Specialization	Current academic situation/position	Institution
Science	grad student	KU

You can use the other side of the paper for additional remarks.

Appendix E: Feedback Obtained from the Preliminary Process of the Instrument Development, Example 2

Dear educator,

I have been working on developing a questionnaire for my Ph.D. dissertation proposal, and a part of it is related to *the features* of *support that teachers need in order to teach for creativity and mathematical talent development in the regular/general education settings*. Since opinions of practitioners and specialists are important to produce a valid instrument, please provide me with what you think is important for teachers to have in order to facilitate creativity and mathematical talent development in the general education schools. Your opinions could be related to the support that teachers need, the support that students need, the attributes of the physical environment, the school work atmosphere, or other aspects you think are important.

Thanks. **Majed Wadaani, C&T. majedrwd@ku.edu**

Teachers' needs	Students' needs	Physical features and work atmosphere
- chalk/chalkboard - computer to display tech friendly videos - lesson plans/detailed curriculums - electronic scoring/test development (could be Word, Excel) - depending on which math class teaching helpful display/learning tools like fraction bars/shapes	- calculators - great if they had smartphones/tablets or PCs - good book or workbook to use as references - pencils/paper - support from teacher and parent/guardians - frequent feedback from teacher	- non-judgmental environment - approachable teacher - good chair/big enough desk - quiet during individual work/exams
Additional aspects:		

Participant's Information

Name (optional): [redacted]		Academic degree: working on MA Education
Specialization	Current academic situation/position	Institution
Math	GRA for CETE @KU	

You can use the other side of the paper for additional remarks.

Appendix F: HSCL Approval Letter for the Focus Group

THE UNIVERSITY OF KANSAS
Research

APPROVAL OF PROTOCOL

June 20, 2014

Majed Wadaani
m709w932@ku.edu

Dear Majed Wadaani:

On 6/20/2014, the IRB reviewed the following submission:

Type of Review:	Modification and Continuing Review
Title of Study:	Teaching for Creativity and Mathematical Talent Development: Teachers' Attitudes and Features of Support at the Elementary General Education Schools
Investigator:	Majed Wadaani
IRB ID:	STUDY00000562
Funding:	None
Grant ID:	None
Documents Reviewed:	• Focus group Consent Form, • Protocol For Focus Group, • Protocol and Questions for Focus Group ,

The IRB approved the study on 6/20/2014.

1. Notify HSCL about any new investigators not named in the original application. Note that new investigators must take the online tutorial at https://rgs.drupal.ku.edu/human_subjects_compliance_training.
2. Any injury to a subject because of the research procedure must be reported immediately.
3. When signed consent documents are required, the primary investigator must retain the signed consent documents for at least three years past completion of the research activity.

Continuing review is not required for this project, however you are required to report any significant changes to the protocol prior to altering the project.

Please note university data security and handling requirements for your project:
https://documents.ku.edu/policies/IT/DataClassificationandHandlingProceduresGuide.htm

You must use the final, watermarked version of the consent form, available under the "Documents" tab in eCompliance.

Sincerely,

Stephanie Dyson Elms, MPA
IRB Administrator, KU Lawrence Campus

Human Subjects Committee Lawrence
Youngberg Hall | 2385 Irving Hill Road | Lawrence, KS 66045-7568 | (785) 864-7429 | www.research.ku.edu

Appendix G: Feedback Obtained from the Focus Group Discussion

Teachers' Attitudes toward Creativity and Mathematical Talent Development

#	Statement	Suggestions for improvement
C1	Creativity is an important goal of education	
C2	Creativity is an inborn ability that cannot be taught or developed *Reverse Score*	Using "Innate" instead of "Inborn"
C3	Creativity is limited to fine art products *Reverse Score*	Using " specific disciplines" instead of " fine arts products"
C4	Creativity is an essential element in the process of human development	
C5	Creativity is an ability that can be developed in any field if it is systemically taught	Using "explicitly" instead of "systematically"
C6	Most students are capable of being creative individuals	
C7	Systematic efforts can develop creativity for all students	
C8	Teachers are responsible for nurturing creativity in the regular classrooms	Using the "general education classrooms" instead of "regular classrooms"
C9	Mathematics is an area within which creativity skills can be well-developed	Removing "well" from " well-developed"
C10	There is no place to nurture creativity in the regular mathematics classroom *Reverse Score*	Using the "general education classrooms" instead of "regular classrooms"

#	Continued-Statement	Suggestions for improvement
C11	Fostering students' creativity should be an essential teaching act in the regular classrooms	Removing "teaching act"/ using" general" instead if " regular"
C12	It is important that teachers take training courses that help them teach for creativity development in the regular classrooms	Using " teachers engage in professional learning" instead of " take training courses"
T13	Students need a supportive environment to express their abilities in mathematics	
T14	Students who have high abilities in mathematics do not need stimuli and support to further develop them *Reverse Score*	
T15	Schools should provide special education services for those students who have high abilities in mathematics	Using " additional educational service" instead of " special education"
T16	Students who have high abilities in mathematics need special attention in the regular classrooms to fully develop their abilities	Using "additional support" instead of "special attention" / using "general" instead of "regular"
T17	Students who have high abilities in mathematics are always able to further develop their abilities by themselves *Reverse Score*	
T18	Students who have high abilities in mathematics should be provided with enrichment opportunities in the regular classrooms	Using "general" instead of "regular"

#	Continued-Statement	Suggestions for improvement
T19	Providing high ability students with special educational activities causes behavioral issues among students, such as bragging or bullying *Reverse Score*	Using "differentiating" instead of "special"
T20	High ability students should be provided with time and facilities to work on self-selected projects	Using "materials and space" instead of " facilities"
D21	It is important that students be provided with different avenues to learn based upon their aptitudes and interests through differentiated instruction	
D22	Differentiation in the regular classroom is difficult because it requires individualized instruction *Reverse Score*	
D23	Differentiation of instruction leads to chaos in the regular classroom *Reverse Score*	
D24	There are several applicable ways to differentiate instruction in the regular classroom	Using "ways that teacher can use" instead of "applicable"
T25	Students who have high abilities in mathematics are in the minority and attention should be focused on the other students *Reverse Score*	
T26	High ability students in mathematics should be given the opportunity to accelerate on the regular content	Using "curriculum" instead of " regular content"
T27	Providing high ability students with additional enrichment learning activities is not a role of the general teacher in the regular classroom *Reverse Score*	Using " general" instead of " regular"

#	Continued-Statement	Suggestions for improvement
T28	If they are provided with effective education, students who have high ability in mathematics would play major roles in solving real life problems and bringing up new innovations	Using “ may” instead of “ would”/ and “developing” instead of “ bringing up”
T29	It is important that teachers take training courses that help them teach for mathematical talent development in the regular classrooms	Using “ engage in professional learning” instead of “ taking training courses”

Features of Support and Resources Related to Teaching for Creativity and Mathematical Talent Development:

#	Features of Support and Resources	Suggestions for improvement
S1	An appropriate school environment that facilitates developing creativity and talent in mathematics	
S2	A learning resource center with sufficient facilities for extending students’ learning and thinking	Using “tools” instead of “facilities”
S3	A special resource room with sufficient equipment for mathematics activities	
S4	A gifted/talented coordinator who assists teachers to develop and implement special activities for nurturing creativity and talent in mathematics	Using “enrichment” instead of “special”
S5	A school administration staff who facilitates teachers’ practices toward developing creativity and talent in mathematics	Using” a school leadership team” instead of “A school administration staff”

#	Features of Support and Resources	Suggestions for improvement
S6	Cooperative colleagues who support each other toward developing creativity and talent in mathematics	
S7	Flexibility on the school schedule that allows teachers to implement untraditional learning activities	Using " opportunities" instead of "activities"
S8	A space of freedom on instructional practices that allow teachers to use new effective approaches in their teaching	Using" A school environment that promotes teachers to use new effective approaches in their teaching"
S9	Systematic pull-out programs for developing talent in mathematics	Using "enrichment" instead of " pull-out"
S10	Accessible university courses related to nurturing creativity in schools	
S11	Accessible university courses related to the education of gifted and talented in mathematics	
S12	Sufficient school district training courses related to nurturing creativity	Using "sufficient professional learning opportunities provided by the school district related to nurturing creativity in schools"
S13	Sufficient school district training courses related to the education of gifted and talented in mathematics	Using "sufficient professional learning opportunities provided by the school district related to the education of gifted and talented in mathematics"
S14	Equipped classrooms with necessary learning tools	
S15	An appropriate number of students in each classroom for effective implementation of learning activities	

#	**Features of Support and Resources**	**Suggestions for improvement**
S16	Students’ mathematics text-books designed with the consideration of improving student creativity skills	
S17	Supplemental mathematics books for further development of students’ abilities	Using “ resources” instead of “books”
S18	An appropriate teaching load that gives teachers sufficient time to plan and implement activities for developing creativity and talent in mathematics	Using “ A daily schedule that gives teachers sufficient time to plan and implement activities for developing creativity and talent in mathematics”
S19	An evaluation system of student achievement that includes multiple aspects of human development.	Using “honors” instead of “ includes”
S20	An evaluation system of teacher performance that is based on accurate resources of effective instructional practices	An important point to be included

Appendix H: The Final Version of the Research Instrument

First: Background Information

Please provide answers for the following questions:

B1- What is the State where you currently work as an elementary mathematics teacher?

……………………..

B2- What is your gender?

Male ( ) Female ( )

B3- What is the highest level of education you have completed?

Bachelor ( ) Master ( ) Doctorate ( )

B4- How many years have you taught elementary school mathematics?

………………

B5- Have you taken any university/college course specifically in fostering student creativity?

Yes ( ) No ( )

B6- Have you taken any university/college course specifically in mathematics education of the gifted and talented?

Yes ( ) No ( )

B7- Have you received any professional training in fostering student creativity as a part of the school district professional development program?

Yes ( ) No ( )

B8- Have you received any professional training in mathematics education of the gifted and talented as a part of the school district professional development program?

Yes ( ) No ( )

Second: Teachers' Attitudes toward Creativity and Mathematical Talent Development

In order to understand your opinions about teaching for creativity and mathematical talent development, please indicate how much you agree with each of the following statements:

Teaching for Creativity						
#	Statement	Level of Agreement				
		Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
C1	Creativity is a key factor for personal and social progress					
C2	Creativity is limited to particular fields *"Reverse Scored"*					
C3	Creativity is an innate ability that cannot be taught or developed *"Reverse Scored"*					
C4	Creativity can be developed in general education classrooms					
C5	Teaching for creativity is necessary to enhance student academic achievement					
C6	Most students, if not all, have the potential to be creative individuals					
C7	Developing creativity for all students is an essential role of the general classroom teacher					
C8	Schools should provide additional programs for developing student creativity that go beyond general education classrooms					
C9	Mathematics is an area through which creativity can be developed					

#	Statement	Level of Agreement				
		Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
C10	Teachers should engage in professional learning that helps them teach for creativity					
Teaching for Mathematical Talent Development						
D11	It is important that students be provided with different avenues to learn based upon their aptitudes and interests (differentiation of instruction)					
D12	There are several methods that teachers can use to successfully differentiate instruction in the general education classroom					
D13	Differentiation of instruction leads to chaos in the general education classroom *"Reverse Scored"*					
T14	Students need a supportive environment to demonstrate their abilities in mathematics					
T15	Students who have high abilities in mathematics need additional support to further develop their abilities					
T16	Students who have high abilities in mathematics are always able to fully develop their abilities without support *"Reverse Scored"*					
T17	Providing students who have high mathematical abilities with enrichment learning opportunities is an essential role of the general classroom teacher					
T18	Students who have high abilities in mathematics should be supported to work on self-selected projects					

#	Statement	Level of Agreement				
		Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
T19	Schools should provide additional programs for developing mathematical talent that go beyond the general education classrooms					
T20	It is important that teachers engage in professional learning that helps them teach for mathematical talent development					

Please provide additional comments about what you think would describe your point of view regarding teaching for creativity and mathematical talent development in the general education schools:

....
....

Third: Features of Support and Resources Related to Teaching for Creativity and Mathematical Talent Development

The purpose of the following part is to find out how much you are supported to teach for creativity and mathematical talent development. Based upon what you feel and experience, please rate how much each of the following features and resources is available in your community and school environment on a scale of (1) through (5); where (1) means "Unavailable" and (5) means "Highly Available". Please notice the condition of each feature of support to determine the degree of availability.

#	Features of Support and Resources	Degree of Availability				
		Unavailable 1	2	3	4	Highly Available 5
S1	Community members who value teachers' roles in human development					
S2	Supportive parents who are positively involved in the school education process of their children					
S3	A school leadership team that promotes teacher practices toward developing creativity for all students					

#	Features of Support and Resources	Degree of Availability				
		Unavailable 1	2	3	4	Highly Available 5
S4	Cooperative colleagues who support each other toward developing student creativity					
S5	A school-wide trend toward developing creativity for all students					
S6	A gifted/talented coordinator who assists teachers in designing and implementing activities for developing mathematical talent					
S7	Effective programs for further developing mathematical talent beyond the general education classroom					
S8	Flexibility in the school schedule that allows teachers to provide non-traditional learning activities					
S9	A school environment that promotes teacher autonomy in using new effective methods of teaching					
S10	Sufficient professional development opportunities related to developing student creativity					
S11	Sufficient professional development opportunities related to the education of mathematically gifted and talented students					
S12	Appropriate classrooms equipped with effective learning tools					
S13	A learning resource center with effective tools for extending student learning and thinking					

#	Features of Support and Resources	Degree of Availability				
		Unavailable 1	2	3	4	Highly Available 5
S14	An appropriate number of students in each classroom for effective implementation of the learning activities					
S15	Student mathematics textbooks designed to facilitate teacher practices toward developing student creativity					
S16	Supplemental resources for further development of student mathematical abilities					
S17	An appropriate daily school schedule that gives teachers sufficient time to plan and administer activities for developing talent in mathematics					
S18	An evaluation system of student achievement that includes multiple aspects of personality development					
S19	An evaluation system of teacher performance that is based on accurate resources of effective instructional practices					
S20	Rewards/Incentives for effective teachers in developing student creativity and academic abilities					
S21	An overall positive work environment that provides teachers with adequate support in order to teach effectively for developing student creativity and mathematical talent in the general classroom					

Please provide additional comments that describe how much you are supported to teach for developing student creativity and mathematical talent:

……

Appendix I: Attitudes toward Teaching for Creativity; Frequency of Responses

#	Statements	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Mean
1	Creativity is a key factor for personal and social progress	1	0	11	56	25	4.12
2	Creativity is limited to particular fields	25	38	18	9	3	2.22
3	Creativity is an innate ability that cannot be taught or developed	13	38	24	11	7	2.58
4	Creativity can be developed in general education classrooms	0	1	12	53	27	4.14
5	Teaching for creativity is necessary to enhance student academic achievement	0	5	16	49	23	3.97
6	Most students, if not all, have the potential to be creative individuals	0	1	7	48	37	4.30
7	Developing creativity for all students is an essential role of the general classroom teacher	0	6	16	42	29	4.01
8	Schools should provide additional programs for developing student creativity that go beyond general education classrooms	0	5	18	47	23	3.95
9	Mathematics is an area through which creativity can be developed	0	2	16	52	23	4.03
10	Teachers should engage in professional learning that helps them teach for creativity	0	2	15	50	26	4.08

Appendix J: Attitudes toward Teaching for Mathematical Talent Development; Frequency of Responses

#	Statements	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Mean
11	It is important that students be provided with different avenues to learn based upon their aptitudes and interests (differentiation of instruction)	0	1	7	37	48	4.42
12	There are several methods that teachers can use to successfully differentiate instruction in the general education classroom	0	1	10	38	44	4.34
13	Differentiation of instruction leads to chaos in the general education classroom	21	33	22	13	4	2.42
14	Students need a supportive environment to demonstrate their abilities in mathematics	0	1	4	47	41	4.38
15	Students who have high abilities in mathematics need additional support to further develop their abilities	1	3	13	47	29	4.08
16	Students who have high abilities in mathematics are always able to fully develop their abilities without support	15	42	18	12	6	2.48
17	Providing students who have high mathematics abilities with enrichment learning opportunities is an essential role of the general classroom teacher	0	1	13	55	24	4.10

#	Continued-Statements	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Mean
18	Students who have high abilities in mathematics should be supported to work on self-selected projects	0	4	24	45	20	3.87
19	Schools should provide additional programs for developing mathematical talent that go beyond the general education classrooms	0	3	13	53	24	4.05
20	It is important that teachers engage in professional learning that helps them teach for mathematical talent development	0	0	11	51	31	4.22

Appendix K: Features of Support; Frequency of Responses

#	Features of Support	(Unavailable) 1	2	3	4	(Highly Available) 5	Mean
1	Community members who value teachers' roles in human development	11	25	33	22	2	2.77
2	Supportive parents who are positively involved in the school education process of their children	3	15	27	38	10	3.40
3	A school leadership team that promotes teacher practices toward developing creativity for all students	6	13	35	31	8	3.24
4	Cooperative colleagues who support each other toward developing student creativity	2	8	18	45	20	3.78
5	A school-wide trend toward developing creativity for all students	7	21	29	24	12	3.14
6	A gifted/talented coordinator who assists teachers in designing and implementing activities for developing mathematical talent	21	16	17	29	10	2.90
7	Effective programs for further developing mathematical talent beyond general education classrooms	11	17	30	31	4	3.00
8	Flexibility in the school schedule that allows teachers to provide non-traditional learning activities	18	22	22	24	7	2.78
9	A school environment that promotes teacher autonomy in using new effective methods of teaching	8	21	25	28	11	3.14
10	Sufficient professional development opportunities related to developing student creativity	14	26	26	25	2	2.73

#	Continued- Features of Support	(Unavailable) 1	2	3	4	(Highly Available) 5	Mean
11	Sufficient professional development opportunities related to the education of mathematically gifted and talented students	18	26	24	22	3	2.63
12	Appropriate classrooms equipped with effective learning tools	8	19	23	29	14	3.24
13	A learning resource center with effective tools for extending student thinking and learning	15	15	34	20	9	2.92
14	An appropriate number of students in each classroom for effective implementation of the learning activities	11	16	27	27	12	3.14
15	Student mathematics textbooks designed to facilitate teacher practices toward developing student creativity	10	14	22	40	7	3.22
16	Supplemental resources for further development of student mathematical abilities	7	24	27	24	11	3.09
17	An appropriate daily school schedule that gives teachers sufficient time to plan and administer activities for developing talent in mathematics	17	17	22	30	7	2.92
18	An evaluation system of student achievement that includes multiple aspects of personality development	12	18	27	31	5	2.99
19	An evaluation system of teacher performance that is based on accurate resources of effective teaching practices	10	16	36	26	5	3.00
20	Rewards/Incentives for effective teachers in developing student creativity and academic abilities	27	18	24	19	5	2.54
21	An overall positive work environment that provides teachers with adequate support in order to teach effectively for developing student creativity and mathematical talent in the general classroom	10	13	24	35	11	3.26