Neel Kamal Sharan
nlkmlsharan@gmail.com

Perception of Creativity among Secondary Level Mathematics Teachers: A Qualitative Analysis

Abstract

Children are the future of a nation and creative thinking is an investment in a country's future. It influences almost all human activities. Hence, the teachers must understand and appreciate the importance of creative thinking and apply it in their teaching. The present paper was developed to gain an insight into the perception of secondary school mathematics teachers about creativity in mathematics. All the teachers agreed that creativity is important for teachers and the students. However, the data show a real picture of their knowledge and use of creativity in the classroom. Approximately 10 teachers, 5 U.P. board teachers, and 5 CBSE board teachers of Varanasi district participated and shared their viewpoint on mathematical creativity. For most of them, creativity in mathematics is only confined to the use of teaching aids and models. Their responses also show which of the activities they adopted by them in their teaching were considered being creative by them.

Introduction

Everything in our nature, like, the sun, moon, planets, stars, rivers, clouds, birds, animals, human beings, etc. are unique creations. Human beings are the special ones with certain rare qualities that are not found in any other creation. Creativity is one of such inborn quality of human beings. It is present in our everyday life and a man uses his creative ability while solving his practical life problem (Pehkonen, 1997). Looking at its importance it was recognized as the "cultural capital" of the twenty-first century (Sheriden-Rabideau, 2010 cited in Hirsh, 2010). It is also said that policy makers have recognized the importance of creative thinking like an investment in their country's future (Craft, 2007 cited in Kattou et al., 2009). However, the development of a nation depends on the quality of its education. Creativity is one of the media in the development of the quality of education. However, the development of creativity among school students is the responsibility of a teacher. Hence, they need creative practice to foster creativity among students. But, at first, they need to understand the meaning and importance of creativity.

Creativity

Vygotsky's (1930/1984) has argued that creativity (imagination in Vygotsky's term) is the tool by which new knowledge can be developed (Lev-Zamir & Leikin, 2011). The word "creativity" came into prominence in education after the presidential address of J. B. Guilford in the year 1950. Guilford discussed two types of thinking. Convergent thinking that aims towards the production of a single correct solution to a problem and divergent thinking attempting multiple solutions to a problem or phenomenon (Leikin, 2009). Guilford connected divergent thinking with creativity. After that many definitions have been proposed for creativity. For instance, creativity is the ability of a person to produce novel and previously unknown

compositions, products or ideas (Drevdahl, 1956). Creativity is the process of creating something new which must contribute to the solution of some problems (Wilson, Guilford, & Christenen, 1974). Runco (1993) described creativity as a creation involving both convergent and divergent thinking. For Alfuhaigi creativity is the phenomenon of cognitive development used by every person to solve problems encountered by them in a unique unfamiliar way (Alfuhaigi, 2015). Hence, it can be concluded that creativity is the application of divergent thinking to produce something original, may be ideas or composition or products along with unique solving ways of problems. Stenberg and Lubart (1995) investment theory of creativity states that creative thinkers buy low and sell high in the world of ideas just like the investors of the world of finance. And all the people in the world are more or less creative thinkers and creativity is a part of our daily life (Pehkonen, 1997). Most of the research on creativity leads to one of the two directions that are eminent creativity (also called "Big-C"), which is original work of great persons and everyday creativity (also called "little-c") which is based on the assertion that everyone can be creative (Kaufman, 2007). Creativity is not limited to some specific people and it can be taught and developed (Alfuhaigi, 2015).

Creativity and Mathematics:

Mathematics is used by the people, not from today but the Vedic period onwards. When people in the Vedic period felt the need to measure the number of things, time, and weight of the thing which they used in their daily life, they started calculations. These calculations were given the name mathematics as we know today. Hence, we can say that mathematics is related to calculations used for solving life problems (Yadav, 2015). Since it is important for human life it is taught in schools. Just like physical exercise is necessary for the body, mental exercise is necessary for the mind. And mathematics is that mental exercise for the students. It has the quality to develop the mental ability, problem-solving ability, abstract thinking, reasoning skills, creative thinking, and real mathematical activity has a strong correlation with creativity (Silver, 1997) because creativity is an essence of mathematics (Mann, 2006). Creativity ensures the growth of mathematics in totality (Sriraman, 2004). Mathematics involves challenging tasks that call for creative thinking (Vale and Barbosa, 2015). The essence of mathematics lies in thinking creatively, not merely getting the correct answer (Ginsberg, 1996 as cited in Vale and Barbosa, 2015).

Literature review reveals many ways to define this mathematical creativity or creativity in mathematics like creativity is a three-stage process of the preliminary, algorithmic and non-algorithmic stage and defined non-algorithmic stage as a creative stage (Ervynck, 1991). Sriraman (2005) presented seven levels of mathematical creativity and viewed mathematical creativity from two perspectives. At the professional level, it is original work that adds the body of knowledge and at the school level, it is related to the insight gained while solving problems. Creativity in mathematics is associated with problem-solving (Silver, 1997; Runco, 1993) and problem-posing (Pehkonen, 1997) and divergent (Runco, 1993; Levenson, 2013) and flexible thinking which open up different perspectives in solving a problem. According to Sriraman (2004), mathematical creativity is the ability to produce original work. Krutetskii (1976) considered mathematical creativity as problem finding, invention, independence, and originality. Haylock argued that mathematical creativity means mathematics and creativity (Lev-Zamir & Leikin, 2011). In general, originality, fluency, flexibility and elaboration, components of creativity are employed in each human activity (Torrance, 1974; Guilford, 1968). In line with this, some researchers applied the concept of originality, fluency, flexibility, and elaboration proposed by Torrance (Silver, 1997; Leikin, 2009) to the concept of mathematical creativity.

Mathematical Creativity and Mathematics Teachers

Creativity is the outcome related to cognitive abilities such as knowledge, aptitude, and approach (Stenberg & Lubart, 1995). Creativity is the product of the interaction between the individual, the system s/he is engaged and the surrounding social system (Feldman, et al., 1994). The modern educational system has shifted the static view of creativity as an unchanged personal trait to a dynamic view of creativity that can be developed by a person (Silver, 1997). This trend leads to the importance of developing creativity in every teacher (Lev-Zamir & Leikin, 2011) as a teacher cannot teach creatively and teach for creativity unless s/he is creative her/himself. Teacher training courses are aimed to bring excellence in mathematics teaching among the trainees. These courses seek to make the aware of teachers' personal and professional quality needed by a teacher as well as child psychology. Courses meant to provide information about the various techniques and strategies to deal with an inclusive classroom to the pre-service teachers. Courses intend to give the knowledge of innovative lesson plans in mathematics to the pre-service teachers to increase and sustain the interest of the class. It is also expected from the training courses to give information about the correlation of mathematics with daily life activities like home, school, college and recreational activities like puzzles, riddles, games, crosswords. Courses offer the trainees to make their teaching-learning material and also make them familiar with various evaluation techniques. Along with these, trainees get the real classroom experience where they teach using these learned techniques and strategies. Since teacher training courses are designed to include these activities, it can be said that teacher trainees are supposed to get opportunities to develop their creative abilities in the training institutes.

Teachers' Perspectives on Creativity in Mathematics

Several studies have been devoted, to know the teachers' views on creativity in mathematics teaching. Lev-Zamir and Leikin (2011) developed a model to describe and analyze the conceptions of creativity of teachers' in mathematics teaching. They found two types of teachers' conceptions of teaching mathematics: one is teacher-directed that is creativity in teaching is a teacher's act who makes his/her teaching creative and the other one is student-directed which means creativity in mathematics teaching is opportunities provided to the students for the development of their creativity. Leikin et al. (2013) has done an international survey to explore the secondary school mathematics teachers' conceptions of creativity in the mathematics classroom and found some variables of mathematical creativity to be culturally dependent and others to be intercultural. Bolden et al. (2010) explored pre-service primary teachers' conception of creativity in mathematics and revealed that their conceptions were limited to teaching creativity rather than teaching for creativity. Lithner (2008) analyzed classroom mathematical activities through the lens of creativity in opposition to imitation. Panaoura and Panaoura (2014) found pre-service primary school teachers to be unable to transfer the learned theory of creativity in mathematics teaching to practice. Kattou et al. (2009) found that teachers acknowledge the importance of creativity in teaching but many of them don't practice it. In the light of this present study concentrates on the analysis of secondary school mathematics teachers' perception of creativity.

Objectives of the Study

Great interest has been taken recently to know the perception of teachers towards mathematical creativity (Desli & Zioga, 2015). A similar attempt was made in the framework of the present study. The study adds to the

existing literature through the conceptions of 20 secondary school mathematics teachers teaching in Varanasi district of U. P. towards creativity in mathematics.

The present study was carried out by keeping in view the following objectives:

- To study the conceptions of school mathematics teachers from CBSE and U.P. board secondary towards creativity in the mathematics classroom.
- To identify the features of creative mathematics teachers from the descriptions given by the CBSE and U.P. board secondary school mathematics teachers.
- To recognize the importance of creativity in the eyes of CBSE and U.P. board secondary school mathematics teachers.
- To re-evaluate tasks used by the CBSE and U.P. board secondary school mathematics teachers to make their class creative.
- To discern the opportunities provided by the school organization to the CBSE and U.P. board secondary school mathematics teachers to make their class creative.

Methods

Research Design

The qualitative research method was adopted in the study. The data for the present study were collected through a structured interview consisting of five items based on the objectives of the study with the teachers.

Sample

The sample of the study consisted of 20 secondary school mathematics teachers of 20 different schools (10 CBSE and 10 U. P. board schools) of Varanasi district of Uttar Pradesh. The sample was selected randomly from 10 blocks (8 blocks + Nagar Nigam block + Nagar Palika Ramnagar block) of Varanasi district. A list of all the CBSE and U. P. board schools were collected from the DEO office. After that, one CBSE school and one U. P. board school was selected from each block by using a lottery system. After the selection of school, teachers were given a form to fill their personal information including their name, qualification, gender, age, and their teaching experience. Teachers varied in their teaching experience from 1 to 26 years. Teachers having long teaching experience (above 10 years) were included in the sample of the study. Teachers who are teaching for decades are considered already a good teacher but to know whether they are creative or not, they were taken in the sample of the study. The distinction between a good teacher and a creative teacher is one of emphasis and intention (Cremin, 2015). Good teachers recognize the importance of inventiveness while creative teachers seek creativity in their teaching (Cremin, 2015).

Instrument of Data Collection

A structured interview schedule of five items was prepared by the investigator herself. The interview was carried out by the investigator and the responses were noted and audiotaped by using a voice recorder. The data were collected and analyzed. After analyzing the data conclusions were drawn about teachers' perceptions of mathematical creativity.

Validity and Reliability

The structured interview schedule was reviewed based on the comments of the expert. So, it has face and content validity. To determine the reliability of the tool inter-rater reliability was adopted.

Result

The result of the present study was based on the responses on all the five items by the 20 secondary school mathematics teachers of CBSE and U. P. board schools of Varanasi and presented in the tabular form here in after (Table 1 and 2).

Table 1: Interview summary of CBSE board secondary school teachers

Teachers (CBSE Board)	What do you mean by creativity in mathematics teaching?	What are the characteristics of mathematics teachers?	Why is creative teaching important in mathematics?	How will you make your class creative? Please tell a few tasks.	How does your organization helps you in making your class creative?
1. Mount Litera Zee School	Visual representation	Famous Liked by students	Important for survival in modern era	Geometrical figures like 3D figures by using paper cutting to teach volumes and surface areas	Maths lab, library, smart class in every classroom, green board and stylus
2. Bal Niketan School	Providing TLM	Knowledge of TLM Up to date	Increases understanding power Students follow teacher and learn from them and feel satisfied	Pythagoras Theorem by using stick Use of chart for teaching any theorem	Library facility Maths lab full of equipment Institute is ready to bring the TLM No smart class
3. Scholar's Academy School	To find new methods to solve any kind of problem in mathematics	Teaching related to real life	Students don't understand theory	Teaching related to real life Angles, board plane 2D and 3D figures	Smart class facility Computer facility Library full of books and easily available No maths lab
4 Gyandeep Academy, Chitaipur	Correlating with the surroundings of the students	Accuracy Stick to the point	Not necessary for higher classes like IX and X where only practice is needed	Arithmetic Progression using demonstration method	Permit the teacher to use any method of teaching Allow to take smart classes two days in a week. Library facility
5. Jai Public School	Teaching maths like game	Mastery on the subject Use different methods of teaching Concentrate on week students	To teach some important concept	Binary operation by using composition table	Monitored with new teaching methods Smart class one day in a week No maths lab Provides books to the teachers
6 Mahatma J. F. Public School	Teach through examples Start with fundamentals	Ability to take on the spot decisions Focus on week students Free mind Doesn't take any kind of burden	Without creativity student's will not be aware in the class	Used cubes for teaching $(a+b)^3 = a^3+b^3+3ab(a+b)$	Maths lab facility with full of equipment and takes on class in maths lab Library facility Smart class, but less in use, once in a month
7 Varanasi Public School	Use of modern techniques for teaching particular topics Correlating with student's real life	Make students feel that mathematics is not a difficult subject Eradicate fear from students Teach as a whole	Makes the subject interesting Makes easier to understand	While teaching linear equation in one variable, starts from equation, then variables and then correlate them	School gives 40 minutes and it depends on the teacher that how they utilize it Maths lab and library facility No smart class

8 St. Xavier's High School	Teaching correlated with daily life of students	Always try to do something new in teaching	Without creativity child will not take interest	Starts teaching with anything in hand and tell about the relation between the object in hand and maths	No such help
9 Glenhill School	Emphasis on calculation Posing competitive question Teaching fundamentals	Good calculation power Have clear concept	Increases confidence level	Started from basics while teaching Trigonometry. Made a triangle on the board without any angle and asked about its base perpendicular and hypotenuse	Facilities like maths lab, smart class and library
10 Shree Aditya Narayan Singh Public School	Solving a problem in different ways	Disciplined Active Knowledge of different skills	It's the demand of time	Correlated with daily life to teach circumference of a Circle	No such facility except maths lab with some equipment

Table 2: Interview Summary of UP board secondary school teachers

Teachers (UP Board)	What do you mean by creativity in mathematics teaching?	What are the characteristics of mathematics teachers?	Why creative teaching is important in mathematics?	How will you make your class creative? Please tell few tasks.	How your organization helps you in making your class creative?
1 Queen's Inter College	Teaching related to student's background and their daily life	Effects on students psychologically	Students like the class and influenced by the teacher	Set theory Ask the students to tell about their village and draw it and tell them that it is universal and this is a set. After that ask them about how many literates, how many married etc.	Get books from library White board with good quality chalk
2 Sri KamlakarChowbey Adarsh Inter College	Solving problems by using new techniques which is different from textbooks	Use new techniques to solve mathematical problems	Mathematics is the mother of all subjects. It helps in rational development of students as well as teachers.	Using the rule of BODMAS for teaching simplification.	No such facility No technology and library facility
3 Sri KamlakarChowbey Adarsh Inter College	Effective teaching in the scarcity of resources	Good language Knowledge of mother tongue Attractive personality Use of movements in teaching	Mathematical knowledge is incomplete without creativity	Use of paper cuttings to teach triangles and its properties Use live examples	Books are made available to the teachers Teachers are monitored with teaching aids Provision of light in the classrooms

4 Shree Shanteshwar Balika Vidya Mandir	Practical base teaching To remove mathematical fear and pressure	Fun loving guy Elicit quick answer	It will make class interesting	Don't use blackboard Take the examples of the book and reach to the concept	No technology, no maths lab and no readymade teaching aids Library facility and computer lab for the students
5 Bangali Tola Inter College	Development of new thinking ability among students	Use activity-based teaching so that teaching becomes dynamic	Students learn easily Makes class interesting	Explaining by coming down to the level of students Use of papers to show the mathematical figures	No facility provided by the institute
6 Govt. Girls Inter College, Maldahiya	Learning by doing Involving students in teaching	Active and have practical knowledge also	Students will pay attention and they will be alert while teaching	Use the dimensions of the room for teaching Areas and Volume Use live examples for teaching	No library facility No smart class No maths lab Computer lab for students
7 Udai Pratap Inter College	Use of teaching models	Sensitive towards students Attractive attitude towards students Polite way of expression	To learn new things	While teaching Coordinate Geometry, used a simple bottle kept on a table to find out the exact position of the bottle	No help from the organization. Teach with the help of live examples only
8 Rani Murarika Inter College	Teach through effective examples Use of demonstration method	Pay more attention to the week students	It increases interest among students	Used compass and scale for visual representation of irrational number on number line	No facility is provided by the school even books are unavailable in the library
9 Govt. Girls Inter College, Cholapur	Use of different teaching methods for different students Correlating with daily life of students	Subject interest Answer as often as students ask question	Students learn better when they see it Learning by doing is more important for high school students	Used coins for teaching probability	Schools supports to teach through activity method Library facility No smart class No maths lab but there is one room where some teaching aids are kept
10 Chaubeypur Inter College	Breaking down problems into small steps	Deep knowledge of subjects Teaching through examples so learning doesn't become a burden for the students Logical based teaching	Students will take interest Learning will be like a game play for the students Learning will not be a burden for the students	Used graphs for the derivation of formula while teaching Inverse circular function	No facilities provided by the institution

Findings

In *the first item* of the interview schedule, it was asked to the teachers about the conception of creativity in mathematics teaching and most of the CBSE teachers (30%) summarized it as teaching correlated with real life. (20%) said that creativity in mathematics teaching is new techniques for solving problems. (20 %) teachers said that it is the use of TLM in teaching, (20%) said it is that teaching through examples and (10%) agreed on teaching like a game. Similarly, responses from U.P. board teachers reveal mathematical creativity is nothing but teaching mathematics concerning the student's daily life (20%), (20%) said that it is practical based teaching, (10%) said that it is solving problems with new techniques, (10%) said that creativity is effective teaching in scarcity of resources, (10%) agreed on the use of models in teaching, for (10 %) teachers creativity is teaching is breaking the concepts in small steps, (10%) agreed on involving students in teaching and developing thinking ability among students got (10%) agreement.

The *second item* was to study the perspectives of CBSE and U.P. board secondary school mathematics teachers regarding the attributes of creative teachers and (30%) CBSE teachers agreed on mastery on the subject. (20%) said that s/he knows different skills of teaching. (10%) teachers said that s/he knows of teaching-learning materials. (20%) said that the teacher will concentrate on the week students and (10%) said that s/he will teach by correlating to the daily life of the students. However, the teacher will be famous have got (10%) vote.

On the other hand, U.P. board teachers said that the teachers will have deep subject knowledge and interest in the subject (20%). (20%) of the teachers said that teachers have an attractive personality. (10%) said that the teacher will use new techniques to solve problems. (10%) said that a creative teacher will adopt activity-based teaching, (10%) said that the teacher will pay more attention to weak students, (10%) said that teachers will be active. (10%) said that the teacher will affect students and (10%) said that s/he will be a fun-loving person.

The *third item* was to know the reason for the importance of creativity. About (50%) of CBSE board teachers said that it makes the subject interesting and easier to understand. It is important for survival in the modern era (20%), students will be aware (10%), increases confidence level (10%), were some of the reasons behind the importance of creativity in mathematics classrooms. (10%) teacher said that creativity is not important for higher classes like IX and X. In the same way, (50%) of U.P. board teachers agreed that creativity is important because it makes the class interesting. (20%) said that it helps in better learning, (10%) said that it helps in the rational development of the teachers as well as students, (10%) said that mathematical knowledge is incomplete without creativity and (10%) agreed on the fact that creativity in teaching makes the students alert and attentive in the class.

The *fourth item* of the interview was to know the tasks adopted by the mathematics teachers to make their class creative. The most repeated answer of the (40%) CBSE school teacher was the use of live objects, teaching correlated with the real life of the students. Other answers provided by the teachers to make their class creative were the use of models, teaching-learning aids, compass, charts, and graphs (30%), (10%) teachers used the demonstration method of teaching and (20%) teachers teach by coming down to the level of students. While U.P. board (60%) teachers teach through lecture method and live objects easily available in the class. They try to connect their teaching with the daily life activities of the students. (20%) use graphs and scales, (10%) teachers use examples of the textbook for teaching and (10%) teachers make their class creative by teaching the rules first before starting any concept. Teachers of the U. P. board school hardly get any mathematical equipment from the school. Neither their school provides any type of teaching-learning aids nor they prepare it.

On the other hand, the *fifth and last item* of the interview schedule was to know the help provided by the school organization to the teachers to make their

class creative and the investigator came to know that most of the CBSE board schools (70%) of Varanasi district have good library facility for both teachers and students. (10%) school provides books to the teachers only not to the students and the other (20%) have no library facility. About (50%) schools have a smart class and (50%) schools run without smart classes. It was also found that only (10%) schools have maths lab full of equipment and (30%) schools have maths lab with some equipment. (60%) schools have no maths lab.

Coming down to U.P. Board schools only (30%) schools have library facility and (70%) schools have no library facility. No school provides maths lab and smart class or any type of technology for teaching. Only one school has a computer lab for the students. Schools allow the teachers to teach through any method but a very few who are younger ones use live examples in their teaching and rest prefer the lecture method with the conventional teaching-learning materials prepared by the students in their project work.

In addition to this, it was observed by the investigator that the teachers were overloaded with excessive work like maintaining the class register, taking admission of the students, collecting their fees, preparing a time table and question papers. Mathematics teachers have to take many classes because of the scarcity of mathematics teachers in the schools of both the boards. In addition to that teachers said that one teacher teaches all the three subjects' physics, chemistry, and mathematics. Teachers had to complete the syllabus on time as they have to help students to succeed in the board exam. They were given 40 minutes and within these 40 minutes they have to teach in such a way the syllabus would be completed on time, students are prepared for the exam and succeed in the exam with increased achievement.

Conclusion

The present paper aims to gain insight on the perception of CBSE and U.P. board secondary school mathematics teachers of Varanasi district of Uttar Pradesh on mathematical creativity, the extent as well as the tasks which they use to make their class creative and support from the organization to make their class creative. It was found that teachers' mathematical creativity is confined only to the use of teaching-learning aids, models and daily life examples in mathematics teaching which signifies that they touch only one aspect of originality. The study also reports that teachers are unaware of other components of creativity. CBSE and U. P. board teachers reveal that creativity in the mathematics classroom is important because it makes the class interesting and makes the concepts easier, Most of the CBSE board teachers said that they use live objects, different techniques of solving the problem and teaching-learning aids like the chart, model and compass. But teachers of the U. P. board teach by using the common objects present in their class. Regarding the help and support provided by the organizations to make the class creative CBSE board teachers reveal they were provided with all kinds of logistic supports but they were not given autonomy. Besides this, it was also found by the investigator that the organization of the U.P. Board doesn't provide logistic support to the teachers. It is also seen that the school organizations of both boards are lazy towards the professional development of the teachers. There is no provision for monitoring the teachers with the new teaching techniques. Neither, there is the provision of seminars, workshops, and conferences for the teachers nor they take an interest in their professional development. Most importantly there was no maths or science club in any school. Hence, there is a severe need that the organization, especially the U. P. board to consider the matter seriously and help their teachers to become a creative teacher indirectly their students to become a creative student.

References

Alfuhaigi, S. S. (2015). School environment and creativity development: a review of literature. *Journal of educational and instructional studies in the world*, 5(2), 33-37. Retrieved from http://www.wjeis.org/FileUpload/ds217232/File/05.sari_salem_alfuhaigi.pdf.

Bolden, D. S., Harries, A. V., & Newton, D. P. (2010). Pre-service primary teachers' conceptions of creativity in mathematics. *Educational Studies in Mathematics*, 73(2), 143-157.

Craft, A. (2007). Possibility thinking in the early years and primary classroom. In A. G. Tan (Ed.), *Creativity: A handbook for teachers*. Singapore: World Scientific.

Cremin, T. (2015). Creative teachers and creative teaching. *Creativity in Primary Education*. Retrieved from https://www.researchgate.net/publication/48990754_Creative_teachers_and_creative_teaching.

Desli, D. &Zioga, M. (2015). Looking for Creativity in Primary School Mathematical Tasks.

In Krainer, K. &Vondrová, N. (Eds.) Proceedings of the Ninth Congress of the European Society for Research in Mathematics Education, 989-995. Prague, Czech Republic. Retrieved from https://hal.archives-ouvertes.fr/hal-01287299/document

Drevdahl, J. E. (1956). Factors of Importance for Creativity. *Journal of Educational*

Psychology, 12 21-26. http://dx.doi.org/10.1002/1097-4679(195601)12:1<21::AID-JCLP2270120104>3.0.CO;2-S

Ervynck, G. (1991). Mathematical Creativity. In D. Tall (Eds.), *Advanced mathematical thinking*. (pp. 42-53). Dodrecht, The Netherlands: Kluwer Academic Publishers.

Hirsh, R. N. (2010) Creativity: Cultural Capital in the Mathematics Classroom. Creative

Education, 1 (3), 154-161. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.869.6203&rep=rep1&type=pdf.

Kattou et. al. (2009). Mathematical Creativity through Teachers' Perception. In Tzekaki, M.,

Kaldrimidou, M. &Sakonidis, H. (Eds.). Proceedings of the 33rd conference of the International Group for the Psychology of Mathematics Education, 3, 297-304. Thessaloniki, Greece: PME. Retrieved from https://s3.amazonaws.com/academia.edu.documents/31264777/D3.3.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1541394877&Signature=U8oBYxCRWqiBhnLi2X6nQQ1CLas%3D&response-content-disposition=inline%3B%2-0filename%3DMathematical_creativity_through_teachers.pdf.

Kaufman, J. C. (2007, February). Exploring mini-c across cultures. Invited talk at the Innovation and Education Symposium, hosted by the India China America Institute at Emory University, Georgia. Retrieved from https://www.researchgate.net/publication/228994174_Exploring_miniC_creativity_across_cultures

Leikin, R. (2009). Exploring mathematical creativity using multiple solution tasks. In Leikin, R, Berman, A., &Koichu, B. (Eds.), *Creativity in Mathematics and the Education of Gifted Students* (pp. 129-145). Israel: Sense Publishers. Retrieved from https://www.researchgate.net/publication/259772377_Exploring_mathematical_creativity_using_multiple_solution_tasks.

Leikin, R., Subotnik, R., Pitta-Pantazi, D., Singer, F. M., & Pelczer, I. (2013). Teachers' view on creativity in mathematics education: An international survey. *ZDM The International Journal of Mathematics Education*, 45(2), 309-324. Retrieved from https://www.researchgate.net/publication/257762361_Teachers'_views_on_creativity_in_mathematics_education_An_international_survey.

Lev-Zamir, H. & Leikin, R. (2011). Creative mathematics teaching in the eye of the beholder: focusing on teachers' conceptions. *Research in Mathematics Education*, 13(1), 17-32. Retrieved from https://www.tandfonline.com/doi/abs/10.1080/14794802.2011.550715

Lithner, J. (2008). A research framework for creative and imitative reasoning. *Educational Studies in Mathematics*, 67(3), 255-276.

Mann, E. (2006). Creativity: the essence of mathematics. *Journal for the Education of the Gifted,* 30 (2),236-260. Retrieved from http://journals.sagepub.com/doi/abs/10.4219/jeg-2006-264?journalCode=jegb.

Panaoura, A. &Panaoura, G. (2014). Teachers' awareness of creativity in mathematical teaching and their practice. *Issues in the Undergraduate Mathematics Preparation of School Teachers,* 4, 1-11. Retrieved from https://files.eric.ed.gov/fulltext/EJ1043048.pdf.

Pehkonen, E. (1997). The state-of-art in mathematical creativity. *ZDM*, 29(3), 63-67.

Retrieved from https://link.springer.com/article/10.1007/s11858-997-0001-z.

Runco, M. A. (1993). *Creativity as an educational objective for disadvantaged students* (RBDM 9306). Storrs: University of Connecticut, The National Research Center on the Gifted and Talented. Retrieved from https://nrcgt.uconn.edu/research-based_resources/runco/

Sheridan-Rabideau, M. (2010). Creativity repositioned. *Arts Education Policy Review, 111,* 54-58. doi:10.1080/10632910903455876

Silver, E. (1997). Fostering Creativity through Instruction Rich in Mathematical Problem

Solving and Problem Posing. *ZDM, 3,* 75-80. Retrieved from http://dx.doi.org/10.1007/s11858-997-0003-x

Sriraman, B. (2004). The Characteristics of Mathematical Creativity. *The Mathematics Educator,* 14(1), 19-24. Retrieved from https://files.eric.ed.gov/fulltext/EJ848493.pdf

Sriraman, B. (2005). Are Giftedness and Creativity Synonyms in Mathematics? *The Journal of Secondary Gifted Education* 17(1), 20-36. Retrieved from http://files.eric.ed.gov/fulltext/EJ746043.pdf.

Stenberg, R. & Williams, W. M. (2003, January 1). Teaching for Creativity: Two Dozen Tips. [Blog Post]. Retrieved from http://www.cdl.org/articles/teaching-for-creativity-two-dozen-tips/

Stenberg, R. J. &Lubart, T. I. (1995). *Defying the crowd: Cultivating creativity in a culture of conformity*. New York: Free Press.

Tok, et al. (2015). The Effects of Teaching Mathematics Creatively on Academic

Achievement, Attitudes towards Mathematics, and Mathematics Anxiety. *International Journal of Innovation in Science and Mathematics Education*, *23*(4), 1-24. Retrieved from https://openjournals.library.sydney.edu.au/index.php/CAL/article/view/7887.

Vale, I. & Barbosa, A. (2015). Mathematics Creativity in Elementary Teacher Training. *Journal of the European Teacher Education Network*, 10, 101-109. Retrieved from jeten-online.org/index.php/jeten/article/download/70/59.

Wilson, R. C., Guilford, J. P. and Christensen, P. R., (1974). Quoted by N. K. Dutt, *Psychological Foundations of Education*, Delhi: Daoba House.

Yadav, S. (2015). A Study of Relationship between Mathematical Creativity and Personality Traits of Secondary School Students. *Journal for Humanity Science & English Language*. 3/17, 3865-3868. Retrieved from http://oaji.net/articles/2016/1201-1476446549.pdf.