# STUDENT CREATIVITY IN MATHEMATICS EDUCATION IN EARLY CHILDHOOD IN JORDAN

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**Abstract**

This research investigated Mathematics teachers' perspectives on childhood student creativity. A group of (31) mathematics teachers completed a Childhood Mathematical Creativity Scale on (4) of their students. Total of (111) students were rated. (20) of them were observed by the researcher to complete the same scale for each child. This study seeks to answer the following questions: Is there a significant difference at the level (0.05 ≥ α) in early childhood teacher perspectives of student mathematical creativity with respect to school type, sex and grade level? Is there agreement ration between the teacher mathematical creativity scale rating and the observable rating on the same scale for the same child? Results indicate that mathematical creativity is not a common aspect for childhood students on Jordan. Kindergarten teachers rated their student the highest on creativity while third grade were rated the lowest. Also the ratio of agreement was moderate.

**Keywords:** Creativity, mathematical creativity, Early childhood, Government schools, UNRWA schools and private schools.

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The 21st century youths requires many sets of special skills in order to succeed in work and life. Educations have emphasized the importance of promoting favorable conditions for developing creative potential of students, and several studies have suggested ways to cultivate creativity in an educational environment. Therefore, educational systems must transform their objectives, to creativity, fluency in information and communication technologies, and the ability to solve complex problems (National Council of Teachers of Mathematics, NCTM, 2006). To accomplish these students must engage in activities to gain the 21st century skills and knowledge. One of the important skills is to have students think and act creatively in all subjects (Higginson, 2000; Runco, 2004; Torrance, 1982). This means that teachers must identify new ways of looking at and applying the principles which underpin creativity and thinking skills informed approaches to learning and teaching. In the field of thinking and creativity, there are currently a number of differing conceptions and meanings. Human creativity is a rare trait because it is a manifestation of the influence of a number of external and internal variables in one's overall life journey which starts as early as children begin building foundations for their cognitive development (Sternberg, 2006).

Creative thinking is influenced by multiple of factors including philosophy of education, strategies of teaching, age, environment, and knowledge gained in or out of schools (Craft, 2001; Craft & Jeffery, 2004; Grainger & Scoffham, 2006; Jeffery & Craft, 2004; Sternberg & Lubart, 1995; Weisberg, 1999;). Although no consensus as to what creativity is and how best to encourage it (Craft, 2005), it has been recognized as an important skill universally. In linking creativity and thinking, Sotto suggested that an understanding of creativity is the key to 'learning all learning' (Sotto, 1994). There is a growing concern in mathematics education to think about creativity in the teaching of mathematics, due to a rising demand for creative competence in an ever changing society. In many nations, mathematical educators are searching for new and effective ways to encourage the development of the mathematical creativity of the student. For a long time, mathematics and creativity have appeared as incompatible terms even for some educators (Higginson, 2000). The visionary of mathematical creativity described by leaders in the National Council of Teachers of Mathematics (NCTM) enable students to confidently engage in complex mathematical tasks, draw on knowledge from a wide variety of mathematical topics, approaching the same problem from different mathematical perspectives or representing the mathematics in different ways until they find methods that enable them to make progress (NCTM, 2000).

All of this in an environment where both teacher and student enjoy mathematics; and where the students feel free to make mistakes and to learn from them. Although environment can be enhanced to provoke creativity, it demands planning. Regarding this, in order to develop creativity in mathematics education, both teachers and students need much more than solid mathematics knowledge (Meissner, 2000). It is in this sense that Kurinova (1999) points out that, in order to produce creative, self- confident pupils, it is necessary to produce creative and self-confident teachers, that is, teachers who are able to hand over a complete knowledge and procedures, but who can also develop their pupils' skills to use their knowledge and react adequately to the changing conditions of their world.

To cultivate students' mathematically creativity, teachers must foster the all mentioned abilities (Bairral, 2003; Isbel & Raines, 2003; Jeffrey & Craft, 2004), they should be encouraged to recognize and value the creativity and creative potential in every child, and to nurture this creativity in all student. A creative classroom should allow more time for open-ended questioning, digression from the text, and for the development of creative thought (Behar-Horenstein, Ornstein, & Pajak, 2003; Bredekamp & Copple, 1997). Singh (1988) defined mathematical creativity as the "process of formulating hypotheses concerning cause and effect in a mathematical situation, testing and retesting these hypotheses and making modifications evaluating unusual mathematical ideas, sensing what is missing from a problem, and splitting general problems into specific sub problems and finally communicating the results". Others characterized mathematical creativity in the context of problem formation (problem finding), invention, independence, and originality and have applied the concepts of fluency, flexibility, and originality (Haylock, 1997; Kim et al., 2003).

Furthermore, little is known about children mathematics creativity that is prominent in teacher's mind concerning mathematical creativity. In sum there is a need for the research that provides knowledge about that queries teacher about their perspectives of on childhood mathematical creativity and teachers must be aware of the creative abilities within their classrooms to be able to develop them. Thus the purpose of this study is to examine the perspectives of childhood mathematics teachers of student creativity mathematical creativity with respect to school type, sex and grade level. This study sought to answer the following questions:

1. Is there a significant difference at the level ($0.05 \geq \alpha$) in childhood teacher perspectives of student mathematical creativity with respect to school type, sex and grade level?

2. What is the ratio of agreement between the teacher rating on mathematical creativity scale and the observable rating on mathematical creativity scale for the same child?

Method

*Participants*

The population of the study consists of all the teachers and their students for early childhood grades for the first semester for the year (2011-2012). Early childhood includes students from kindergarten through third grade (Bredekamp & Copple, 1997).The participants of this study were selected using stratified random sampling techniques. The participants were (31) teachers, and (111) students from different types of school, grade level and sex. Table (1) specifies participant's distribution.

*Table 1*

Number of Students, teachers, schools participates in the study

| Grade \Students | Teachers | Sex\Students | | School Type | Teachers\No. of schools |
|---|---|---|---|---|---|
| K-2 grade | 5\16 | Male | 48 | Government | 20\5 |
| 1st grade | 11\42 | Female | 63 | UNRWA | 39\11 |
| 2nd grade | 9\31 | | | Private | 52\15 |
| 3rd grade | 6\22 | | | | |

The students' ages ranged from five to eight years old. The Government schools are funded by the government and administered by publicly elected government bodies. These schools are required to admit all students and must follow the government program development and curriculum. The UNRWA schools are funded by the United Nations and it follows the government program development and curriculum. The private schools are funded through tuition, donations and private grants. Admission in private schools is selective and somewhat competitive. Private schools have mainly two programs: national program follows the government curriculum, and Foreign Program that have more freedom in designing curriculum and instruction. Teachers in Government, UNRWA, and national program in private school for this study received quite similar training programs with regard to mathematics as mandated by the Government. Permission for teacher participation was obtained followed official steps. Teachers who participate in this study were informed about purposes of the study.  Each teacher who participates in this study was asked to complete a mathematical creativity scale on four of their students randomly selected from their class. Total of (111) students were rated. Then (20) students were observed during mathematics classes by the researcher for (4) classes each to complete the mathematical creativity scale by the researcher.

*Measures*

A Mathematical Creativity Scale (MCS) was constructed to answer the study questions. The first section included general information such as student's name, sex, class level, and school type , whereas the second section included items to measure mathematical creativity scale .The items distributed into two dimensions. The dimensions are: creative activities (e.g. Child engages in deliberate systematic investigation, develops a plan of action) and Independency (e.g. Child is self-directed, self motivated). The scale was constructed based on the following stages: Review the literature related to mathematics creativity, selected those items related to the previous dimensions, and modified them to make them more meaningful and useful in the context of Jordan. Based on this review, the researchers put a list of (20) items as a primary version for the (MCS). Stage two: The primary version of the (MCS) was reviewed by a sample of faculty members specialized in the field of mathematics education, early childhood education, and educational psychology.

To obtain the (MCS) reliability, it was administered to sample of (30) teachers. The reliability coefficient (Cronbach α=0.91) have been established, and this was considered acceptable for the purpose of the study. Finally the (MCS) administered to fifteen kindergarten teachers who were randomly selected from the population of the study. Data received from the specialist and teachers were reviewed and changes were made so the final version of the (MCS) consisted of (13) items. Each item on the scale scored from 1 to 3: 3= excellent quality, 2= medium quality and 1=poor quality.

Data were analyzed using descriptive statistics. Multivariate Linear Model Test were also used to determine whether there is a significant difference at the level ($0.05 \geq \alpha$) in childhood teacher perspectives of student mathematical creativity with respect to the three dependent variables: school type, sex and grade level. To answer the second question a ratio of agreement between the teacher rate on (MCS) and the observable rate on (MCS) for the same child was calculated.

## Results

*Descriptive Data and Inter-correlations*

In order to answer the first question related to the difference in childhood teacher perspectives of student mathematical creativity with respect to school type, sex and grade level, the means and standard deviations were calculated for each class level. As shown in Table (2) this analysis revealed that KG2 teachers rated their student the highest mean (22.81) with standard deviation (4.90), while the third grade students have been rated the lowest on (MCS), where their mean is (19.86) and the standard deviation is (3.71) . The means and the standards deviation for the 1st and 2nd grades were (21.16, 21.93) and (5.76, 5.12) respectively. To find if the difference between means of each dependent variable of the study were significant at the level (0.05 ≥ α) , multivariate Linear Model Test was used .Table (3) shows the result of this test which indicate that there is no significant difference at the level (0.05 ≥ α) in teacher perspectives of student mathematical creativity with respect to school type, sex and grade level; as the value of F to the variables grade, sex and school are (.423,.257 and 1.037) respectively., and these values are not statistically significant at the level (0.05 ≥ α). These findings indicate that mathematics creativity in early childhood is not a common aspect in Jordan. Such creativity rating might be a function of many factors. When comparing the means of teacher's perspectives of students' mathematical creativity, it reveals that as the grade level increased, the creativity ranking of the students decreased.

*Table 2*

The Means and Standards Deviation of the Groups of the Study

| Groups | No. | Mean | Standard Deviation |
|---|---|---|---|
| Kg | 16 | 22.81 | 4.90 |
| 1st | 42 | 21.16 | 5.76 |
| 2nd | 31 | 21.93 | 5.12 |
| 3rd | 22 | 19.86 | 3.71 |

*Table 3*

Multivariate Linear Model Test Between-Subject Effect

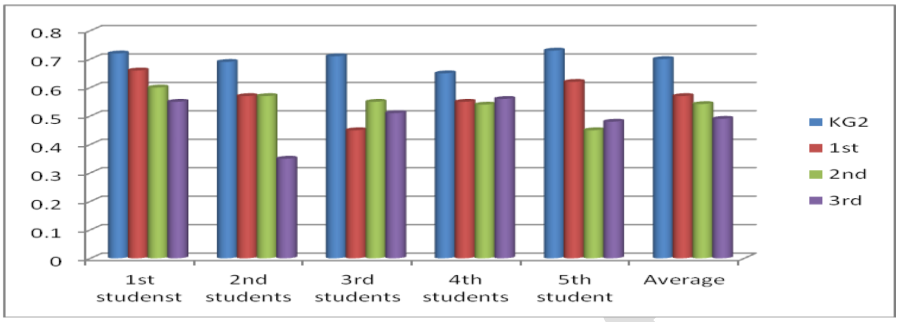
| Source | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Grade | 33.37 | 4 | 11.12 | .42 | .74 |
| Sex | 6.75 | 1 | 6.749 | .26 | .61 |
| School | 54.54 | 2 | 27.27 | 1.04 | .36 |
| Error | 2734.71 | 104 | 26.29 | | |
| Corrected Total | 897.59 | 110 | | | |

*p< .05

To answer the second question of this study: Is there an agreement ratio between the teacher rate on (MCS) and the observable rate on (MCS) for the same child. An agreement ratio for each child observed by the researcher was calculated, and the average for each grade is computed. Figure (1) shows that the agreement ratio. The results indicate that the highest ratio of an agreement was for the KG2 students, and as the grade level increased, the ratio decreased.

*Figure 1*

Agreement ratio between the teacher rate on (MCS) and the observable rate on (MCS) for the student




Discussion

This study set out to investigate the early childhood Mathematics teachers' perspectives on student creativity. The results reveal that as the grade level increased the creativity raking decrease. This is supported by prior research, Behar believe that after large schooling, children become cautious about expressing their ideas creativity (Behar-Horenstein et al., 2003). Educators believe that creative thinking is influenced by multiple factors including environment, teaching strategies, age and knowledge gained in or out of schools (Craft, 2001; Craft & Jeffery, 2004; Grainger & Scoffham, 2006; Jeffery & Craft, 2004; Sternberg & Lubart, 1995; Weisberg, 1999). Some researchers believe that creativity in the classroom seems to be encouraged or discouraged depending upon the educational philosophies of the teachers, schools, and families (Isbel & Raines, 2003; Moran, et al.1991). This supported by the researcher observation while staying in some schools to observe the students to complete (MCS) score .He notice that mathematics teachers for grades l,2,and 3 are more burdened with paper work and record keeping, and there is more pressure to drill skills and prepare for tests , so there was little time for exploration and less time for creativity. For children to be mathematical creative, they should consistently and confidently engage in complex mathematical tasks, draw on knowledge from a wide variety of mathematical topics, approaching the same problem from different mathematical perspectives or representing the mathematics in different ways until they find methods that enable them to make progress, solve the problems, ask and answer the questions, and create new solutions (Behar-Horenstein et al., 2003; NCTM, 2000:3).

A creative classroom should allow more time for open-ended questioning, digression from the text, risk taking, curiosity, and for the development of creative thought, all of this in an environment where both teacher and student enjoy mathematics; and where the students feel free to make mistakes and to learn from them. (Bairral, 2003; Behar-Horenstein, Ornstein, & Pajak, 2003; Bredekamp & Copple, 1997). Besides to give the children numerous opportunities every day to talk openly, to express their thoughts and stories, so that they feel that their opinions are important and valued (Paley, 2004). Also the researcher notice while he observing the students, that teachers do not provide students with multiple opportunities to create and solve problems, instead posing questions that require one quick answer. This is supported by prior research which states that children are allowed to use multiple resources and are given ample time to explore, discover, and rediscover many solutions to a problem (Isbel & Raines, 2003; Jeffrey and Craft, 2004). This type of teaching is expensive—it takes time, patience, tolerance for ambiguity and mess. However, this type of teaching is also immensely rewarding and essential.

Also the results of this study indicate that the ratio of agreement between teachers' perspectives and the researcher observation was decreased as the grade level increased. This means that teaching and learning rarely get beyond the knowledge and leaves no room for creativity or creative thinking. These findings indicate that many factors could have contributed to this result, one is what Mayfield's found in his study for 573 third graders that teacher ratings of intelligence corresponded to student achievement on standardized tests but they were unable to judge student creativity (Mayfield, 1979), also Gear (as cited in Mayfield, 1979) found many examples of inaccuracy of teacher judgments when rating gifted students. Jackson wrote "A teacher's perceptions of creativity are too limited and biased to be the only catcher (Jackson, 2005).

Several interesting themes and implications of this research emerged: first, teachers must engage youngsters in creative, constructive, student centered learning activities. Moreover, it would be highly beneficial for Ministry of Education in Jordan to design teacher preparation towards improving students' creativity in math. Besides further research should consider different grade level, and on-site observations of teachers' activities and interaction during math classes to encompass a number of core features, including the posing of questions, risk talking, being imaginative self determination and intentionality.

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