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Creativity as a means of solving unique problems in mathematics and its influence on motivation for learning on students with learning disabilities in junior high schools in the Arab sector in Israel

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Abstract

This research investigates the ability of students to tackle solving unique mathematical problems in the domain of numerical series, verbal and formal, and its influence on the motivation of junior high students with learning disabilities in the Arab Sector. Two instruments were used to collect the data: mathematical series were checked by "The Working Paper for Challenging Problem Solving in Mathematics" (Hakim & Gazit, 2011) and motivation for learning by the questionnaire entitled "The Student's Motivation for Learning" ((Roeser, Midgley & Urdan, 1996).

The findings fully confirmed our hypothesis. There is a difference between the series in terms of student achievement: When the series deal with mathematical content, success rates are higher than verbal series dealing with the issues. However, not according to speculation, there was no significant difference between the numerical series and series formal rate of correct answers. Furthermore, the findings fully confirmed hypothesis II, which examined the relationship between the percentage of correct answers, unconventional problem solving in mathematics and motivation for learning. Success in coping series, especially those concerning formal content, which are considered a challenge series in students' eyes, is associated with increased levels of motivation for learning.

It is recommended to use a challenge in the field of mathematical tasks - literal and formal. Emphasizing the formal sector, as revealed in the present, the use of these contents may contribute to improving the level of motivation for learning, and consequently have implications for a variety of pedagogical realm

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contracting effects such as reducing the phenomenon molt, promoting student achievement and improving social relations.

1. Introduction

Mathematics is perceived as one of the hardest subjects in school, since one has to cope with a variety of topics, such as verbal questions, illustration by mathematical representation and understanding of connections between concepts. In Mathematics, one has to master the basics perfectly in order to be able to advance to higher thinking levels. The new Mathematics Curriculum (Ministry of Education, 2006) emphasizes both outcomes and modes of thinking. Therefore, Mathematics is not just a rigid subject that requires one solution and one way of solving, but a subject with a broader scope that enables a combination of algorithmic-convergent (inductive?) and creative-divergent (deductive?) task performance.

This is the source of the importance of motivation for learning, which is a consistently planned and directed process for the reaching of a specific solution (Pintrich & DeGroot, 1990; Mymon, 2008).

This study investigates the creativity of students to solve unique mathematical problems and their connection with the level of motivation for learning among junior high school students in the Arab Sector.

Given the missing information of unique characteristics of teaching mathematics and their connection with the motivation for learning among junior high school students with learning disabilities in the Arab Sector, this program deals with the definition of creativity in unique mathematical problem solving, and checks the connection between creativity and motivation for learning among students with learning disabilities. Defining the differences in terms of the characteristics of creativity in solving unique problems may allow a better understanding of the relationship between institutional components and achievements of students and more efficient planning of the curriculum.

The purpose of the study is to measure the ability of students to cope with unique, challenging problems solving in the field of numerical, verbal and formal series and the link with motivation for learning in junior high schools in the Arab Sector.

2. The Teaching of Mathematics: Means and Approaches

Mathematics is perceived as a tricky, tedious and boring subject by almost everybody from the beginning of his or her school life. The reasons for these difficulties and the lack of interest stem from the specific type of subject and the methods of teaching. The teaching of Mathematics to children with learning disabilities is particularly difficult and the need to teach the required content according to the curriculum is a difficult mission. Therefore, the need to use extensive visual aids and adapted teaching methods facilitates the learning of the material required by the curriculum, which is designed by the Ministry of Education (Gazit, 2000; Geary 2004).

The Mathematics Curriculum of the Ministry for elementary school is structured in a hierarchic manner from first to fifth grade.

1. Acquisition of terms and structures in Arithmetic and Geometry.
2. Development of required skills in each of the subjects (arithmetic and geometric insights, mastery of mathematical skills, solution of verbal problems, coping with investigation tasks, understanding attributes and connections of the terms, knowing the mathematical language and using it correctly).
3. Preventing failure and a sense of failure and making the students like the subject. In order to generate success, one has to take into account the functioning of the child in different mathematical topics, as well as in other subjects. It is important to know whether the child has failed in all subjects or only in one. This piece of information can help understand the sources of his difficulties, (Gazit, 2000; Kashti, Arieli & Shalansky, 1997).

The findings about the level of achievements being the lowest in the world raised many question marks: how can new teaching technologies become incorporated in the teaching of Mathematics? How can the applied-practical nature of Mathematics be emphasized? Mathematics is one of the most important subjects in school from kindergarten to high school, and it is obligatory for the acquisition of the Matriculation Certificate (Eylon & Linn, 1988; Fischbein, 1997; Kashti, Arieli & Shalansky, 1997; Ministry of Education, 2006).

In the United States, beginning in 1920 formed: five approaches to teaching mathematics: practice and training approach (1920-1930), focusing on developing computational capability through repetition; Significant teaching approach (1930-1950), which advocated the development of an understanding of the concepts and procedures; New mathematical approach (1960-1970)), emphasizing the formal structural aspects of mathematics; Access to sources of return (1970-1980), which focused on mastery learning basic skills; Problem-solving approach (1980-1990), which tried to develop the learner's ability to describe a problem using a mathematical model which can be solved. Changing approaches to teaching mathematics was due to a lack of satisfaction with the level of achievement. The findings regarding the low level of achievement raised many questions, including, how to integrate new educational technologies in teaching mathematics, and how to emphasize the practical and functional nature of mathematics (Geary, 2004).

3. Mathematical problems, both unique and routine

The presentation of an unconventional problem enables the testing of the student's ability to apply the material on a level that is not the usual algorithm and procedure practiced in class. According to Gazit (2004), the use of an enigma or a challenging problem in class will not only enhance the thinking process, but will also increase motivation and interest of the students on all levels. Therefore,

the purpose of dealing with extraordinary problems (Giron, 2009) is focused on the process of solution and the broadening of the points of view of the students for mathematical topics and ideas by the means of:

a. Problems with a variety of possible solutions.
b. Problems that enable extraction options and encourage methodical solutions.
c. Problems that enable the discovery of a pattern.
d. Problems that have not been studied in class directly.
e. Problems that spur the finding of multiple solutions.

According to Nevo (1997), the creative process is imperceptible, one can only guess about its existence from the solution. It is easier to point out what the process is not. From this point of view, the creative process is not identical to the regular thinking processes or to systematic ways of acquiring knowledge. In the next chapter, ways of solving challenging problems in mathematics will be presented.

4. Creative Mathematical Solutions

Creativity in Education deals with fluency, flexibility, new connections, imagination, use of means, and questioning. Creativity is a way of learning that enables the learner to make connections between unrelated elements, identification of important problems, asking questions that stem from curiosity, open to new ideas, reluctance to accept regular norms, along with flexibility and originality, new categorization and organization of those norms.

Creativity in Mathematics is expressed through the following: new formulation of non complicated problems, discovery of ways and means to their solution, discovery of original methods of solution to unusual problems. One of the ways of creating situations of original thinking is to present the students with open questions that require creative thinking and allow more than one possible answers. For instance, instead of asking 'How do we divide 12 apples in 3 bowls

equally?', and the algorithm is unequivocal, we can say, 'How do we divide 12 apples among a number of bowls?', there is more than one answer, and the student will have to make assumptions before choosing the right answer from different answers (Yee, 2005)**.**

Problem solving is at the core of mathematics; it includes also solving of exercises, which are not based on an algorithm. Littlewood (1953) said that a good mathematical riddle is better than a dozen mediocre exercises. A mathematical riddle is a challenge to the mind and humans seek challenges and enjoy coping with challenges. This statement is even more justified for learning disability students who need maximum encouragement and support.

5. Motivation for Learning among Students with Learning Disabilities

Motivation is important to all children of all ages and all levels. It is divided into:

a. Intrinsic motivation, which includes curiosity and mastery, self-perception as a person of efficacy for learning.
b. Extrinsic motivation, which includes the need for social recognition and for receiving feedback and help from the teacher (Ben-Tov, 2000).

Motivation for learning is a process that arouses, directs and preserves a behavior for the achievement of a special goal (learning), and it reflects the complex reasons that cause one to act in a certain way in a given situation. Thus, students endowed with motivation for the learning of Mathematics are driven by the need to achieve the goal, such as understanding the learning material and answering the questions. Research studies show that students, who set themselves goals of mastery of the material perceive the task as interesting, challenging and important; tend to engage in meta-cognitive activities to adopt more cognitive strategies and invest more efforts into tasks (Mymon, 2008; Pintrich & DeGroot, 1990).

A learning disability, according to the definition of the Israeli Ministry of Education (Ministry, 2004), is based on NJCLD, 1994, and includes two diagnostic conditions:

a. There is a significant gap between the student's learning achievements and those expected from him according to his age and class level.

b. There is a significant gap between the student's learning achievements and his objective intellectual achievements based upon his IQ Tests.

Thus, the accepted definitions, including those of the Ministry of Education, are based on two kinds of gaps: the first is the gap between the actual achievements and the ones expected from the student according to his age and the level of his class. The expected achievements are detailed in the Curriculum. Therefore, the diagnosis must be based on the Mathematics Curriculum. In the absence of a validated and standardized diagnosis, one must use an informal diagnosis based on the way and the extent to which the student fulfills the general and specific goals of the Curriculum according to the level of his class.

The second gap mentioned in the definition is between achievements and ability. However, there is ongoing criticism against this parameter (Eylon & Linn, 1988; Fischbein, 1997; Geary, 2004). Moreover, administering an ability test to every student with difficulties seems unrealistic and unnecessary from the point of view of the process of decision making for the optimal way of helping the student progress in his studies.

It is important to emphasize that there is a lack of accurate tests, tests that would assess the level of knowledge of the student with learning disabilities in each and every topic. In any case, a student with learning disabilities must first be assisted to acquire the basic material and only later, if possible, to acquire the higher level of the material (Avissar, 2004).

The findings of this study refer to a population of students with learning disabilities that study in mixed classes of regular education who can cope with

certain topics of the Mathematics Curriculum. The importance of the research study stems from investigating quality teaching that uses challenging problems in Mathematics; this approach can improve the self-image and motivation of students with learning disabilities, and the teaching of Mathematics can greatly benefit from it (Avissar, 2004).

6. Creativity in Solving Unique Mathematical Problems and Motivation for Learning of Students with Learning Disabilities

Difficulties in the teaching of Mathematics are not a new thing and have been at the forefront for many years. However, it can be taught even to a child of learning disabilities. Slow progress can be due to lack of developmental stimuli, low motivation for learning, speech impairments, slow reactions, etc.

Children with learning disabilities need special teaching methods that would enable location and implementation of suitable didactic ways that would help repair the disability or reduce its damage. The use of active learning in the teaching of Mathematics, according to selected topics, enables the students to perform operations from memory, mechanical operations and problem solving. This approach also strengthens the student's self-image, and the processes of friendship and relations with others (Berg, 2000).

Recently, there is an increase in the awareness of the needs of students of learning disabilities in Israel. The expression of this tendency is anchored in comprehensive diagnostic testing and is compatible with coping with tests according to the results. There is also a need to concentrate the energies of pedagogical and assisting teams in schools to cooperate and to try to cope with the most difficult cases among students.

The presence of students with learning disabilities in a regular class makes it heterogeneous and problematic. Teachers from the general education are not equipped with tools and do not have the training to cope with special education

children, a phenomenon that might leave each of these children with his own problems (Gazit, 2000).

Contents in Mathematics are identified with hard rules, terms and principles, and the students are required to remember rules, principles, terms, ways, comparison, relations, theorems and formulae even if they cannot understand them. Therefore, in order to be able to cope with rules and formulae, they must remember a lot, otherwise, they will have difficulties to progress through the extensive material. On the other hand, a child defined as special education with learning disabilities has different characteristics from any other child in society: some have visual-spatial deficits; some have problems with hearing processing, memory problems, motor and language deficits, social and emotional, cognitive and meta-cognitive difficulties. These characteristics make the study of Mathematics harder for the child with learning disabilities. Hence, the importance of unusual teaching approaches include challenges in mathematical tasks in order to simplify and suit the teaching material to the special students and increase their motivation (Berg, 2000).

Inclusion of creativity in unique mathematical problem solving might simplify the acquisition of the learning material for the student, enhance understanding and internalization. It is impossible to teach topics such as fractions, percents, geometric forms without the help of suitable aids that enable illustration and solutions. The teacher must create a learning environment that supports and encourages the student according to his abilities (Kashti, Arieli and Shlansky, 1997).

As mentioned before, the level of creativity in unique mathematical problem solving is closely related to motivation for learning. Motivation for learning is the force that arouses and pushes the student towards the achievement of his goal. That is why he has to behave adequately and purposefully, persistently and continually (Mymon, 2008; Pintrich & DeGroot, 1990).

In conclusion, many educational aspects reside in the teaching of Mathematics to special education children. In addition to the variance in the characteristics of special education students, there is also the issue of the various environmental factors that influence the teaching of Mathematics to students with learning disabilities. Hence the need to establish what methods will bring the best results within the shortest period of time. This study will investigate the method of creativity in unique mathematical problem solving and its relation to the increase of motivation for learning among students with learning disabilities in junior high schools in the Arab Sector in Israel, thing that will contribute also to the improvement of results in the acquisition of Mathematics. We may presuppose that the use of creativity in unusual mathematical problem solving will cause a rise in the levels of motivation for learning and in the improvement of students' achievements (Agran & Wehmeyer, 1999; Avisar, 2004; Bishara, 2005; Margalit, 2003).

6.1 Hypotheses

1. Differences will be found in solutions to unique mathematical problems between number series and non-number series, such as letter series and geometric series.
2. A positive relation will be found between the quantity of correct solutions to unique mathematical problems and the level of motivation for learning of the students with learning disabilities in junior high schools in the Arab Sector, i.e. the bigger the quantity of correct answers, the higher the motivation for learning.

7. Methodology

7.1 The participants

Five mixed 7th grade junior high school classes were sampled. Each included approximately 10 students with learning disabilities who studied together with

regular students. Hence, the sum total of the sample was about 50 students from the junior high school population in the Arab Sector (30 males – 60% and 20 females – 40%; aged 12 – 13).

All the students who were diagnosed with learning disabilities study in various regular junior high school institutions in the Central Area in the Arab Sector. Within the framework of this psychological diagnosis, the psychologist determined the type of learning disability and the I.Q. of the participants by the means of the Wecsler Test. In addition, the students were subjected to a test administered by authorized staff, a didactic specialized in the domains of reading, reading comprehension, Mathematics, English and development: viso-motoric, audio, linguistic, memory, cognitive and attention skills.

They were all within the normal range of intelligence, but had difficulties with carrying out or finishing tasks. These children suffered from memory, understanding and carrying out directions difficulties. They displayed problems of orientation in space, directions and spatial relationships. In the language skills aspect, their vocabulary was poor and limited, they knew letters and short words, but couldn't master the combination table (compound nouns, prefixes and suffixes, etc.). They had difficulties with expressing themselves orally and in writing; they were impulsive in their answers and actions. In Mathematics, they mastered the addition and subtraction operations, but had difficulties with multiplying and division. They also found abstract thinking and solving verbal problems difficult, as well as terms of measurement and quantity. The socio-economic background of the subjects' families was average, most of their mothers were homemakers and their fathers earn an average salary.

7.2 Research Tools

The data was collected via two tools: a worksheet with challenging problems in mathematical series (Hakim & Gazit, 2011) and a questionnaire entitled "Motivation for Learning to the Student" ((Roeser, Midgley & Urdan, 1996).

1. The worksheet for solving challenging problems in Mathematics

   The worksheet for solving challenging problems in Mathematics was taken from the research study of Hakim & Gazit (2011); it was based on the worksheet that served Gazit & Patkin in their 2009 research study.

   The worksheet (Hakim & Gazit, 2011) included five challenging, unusual problems from the domain of mathematical series, which were intended to test the ability of students to solve unique mathematical problems. The students were requested to fill in the next number in the blank (a n+1) of each series. They were also given the option of drawing or writing the answer with words.

   The five series were divided into four types:

   a. Numerical series which are neither arithmetic nor geometric:

      The first series: 1, 3, 7, 15, 31, ___

      The next number is 63. This is a series where the differences between parts grow twice as the series proceeds (2, 4, 8, 16…). On the surface, the problem looks simple, but it requires changing patterns of thinking and looking for another model of relations between numbers.

   b. Numerical series:

      Second series: 1, 3, 4, 7, 11, _____.

      The next number is 18. It is a series in the style of a Fibonaci Series, when each part is equal to the sum of the two numbers before it. In this series one can calculate the differences like in the first one, and check if the differences between two following numbers, starting from the second and the third number are equal the previous number. However, in contrast to the previous series, the difference between the first and the second number is not important, only the addition of each two numbers that equals the next (1+3=4; 3+4=7; 4+7=11; 7+11=18). Here too, breaking old thinking patterns is necessary.

c. Letter Series:

Third series: S, M, T, W, T, F, _____

The next letter in the series is "S". The letters are the initials of the days of the week: Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, and Saturday. This is an unusual series because it doesn't deal with numbers. There is only one solution, but the series requires to change thinking habits related to numeric series and to look for a pattern suitable for letters. We need to think associatively on a high level, and even bi-associatively, in order to find remote connections, and this is identified with creative thinking.

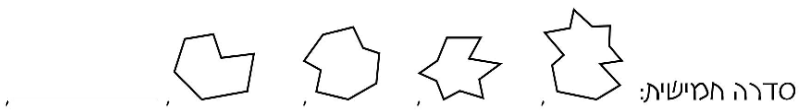
d. Series that combines geometrical forms with words:

Forth series: Circle, Ellipse, Parallelogram, Rhombus, _____

The next shape should be anything with a letter that follows after 'R' in the Alphabet (such as Square or Trapeze). This is not a usual series either because it is formed of geometrical shapes and their names. It requires divergent thinking that seeks new patterns of relations between shapes and words. In addition, this series has several possible answers that enable fluency, variety and originality, which are features of creativity.

e. Series of geometrical shapes

Fifth series:



The next shape has 5 sides, because the number of sides decreases by 2 from one to the next. This series is unusual because it contains shapes and not numbers, but it has still got a numerical component. But the series demands the discovery of a pattern that is not mentioned explicitly.

2. The questionnaire of motivation for learning to the student

The questionnaire of motivation for learning to the student (Roeser, Midgley & Urdan, 1996) was processed for Hebrew by Mevarech, Kremersky and Ritz (1997). The questionnaire is composed of questions based on mastery of tasks and questions based on performance level of avoidance or approaching. The questionnaire includes 17 questions that check motivation for learning, 5 on the Likert Scale (1= Disagree; 5= Agree).

In the test of reliability of internal consistency (Cronbach's Alpha) that was carried out for the present study for the 17 items of the scale in general and for the three sub-scales of the Test of Motivation for Learning, the scales were found reliable: general scale (items 1-17), (Alpha=0.76), mastery of tasks (items 1, 4, 7, 10, 15), (Alpha=0.58), performance – avoidance, (items 9, 12, 13) (Alpha=0.62), performance – approaching, (items 8, 11, 14, 16) (Alpha=0.58). A number of items were taken out of the avoidance and the approaching scales in order to raise the Alpha values.

Based on these findings, grades were calculated for every student, one for every item, one for the general scale, and three grades for the sub-scales. The grades were calculated by working out the average of every item included in each category. The range of the grades of the measures is between 1 and 5 and the higher the grade, the higher is the motivation for learning.

7.3 Procedure

The study was conducted during the 2012-2013 academic year in five mixed classes of 7th grade, that include students with learning disabilities, in junior high schools in the Arab Sector in the center of Israel. The researcher visited each school separately and approached the students by first asking them to solve the worksheet of series and then by filling out the motivation for learning questionnaire.

8. Findings

In order to check the relation between creativity in unique mathematical problem solving and the level of motivation for learning among students of learning disabilities of junior high school mixed classes in the Arab Sector in Israel, averages, standard deviations, Cochran's Q Test and Pearson values were calculated.

8.1 Differences in unique mathematical problem solving between numerical series and non-numerical series

The first hypothesis was that there would be differences in the solving of unique mathematical problems between numerical and non-numerical series, such as letter series and geometrical series. Table 1 shows averages and standard deviations for the correct answers on the 5 series.

Table 1 Averages and Standard Deviations for each series separately (N=50)

Number of the Series	Type of Series	Average	Standard Deviation
1	Numeric	0.84	0.37
2	Numeric	0.92	0.27
3	Verbal	0.52	0.50
4	Verbal	0.66	0.48
5	Geometric	0.76	0.43

Comment: For each series, grade 1 means correct and 0 means fail. Therefore, the average number represents the extent of correct answers (for example, 0.84=84% of correct answers).

The averages of the numerical series 1 and 2 show a very high level of performance (0.84 and 0.92); in contrast, the verbal series, 3 and 4, shows low results (0.52 and 0.66); the formal series, 5, presents average performance level (0.76).

In order to check whether the correct answers divide up equally, a Cochran's Q Test was performed. This a-parametric test compares the division in dependent samples. This test checks whether the division of values is identical in terms of dichotomy dependent variables. The test is also suitable for binary variables where, number 1 means success and 0 means failure.

The findings indicate that, as hypothesized, there is a statistically significant difference among the division of values in the 5 series. Cochran's Q (4)= 27.73 $p<0.001$.

In order to find out the source of the difference, a series of McNemar Tests was conducted between pairs of dependent samples.

The findings showed significant differences between 4 out of 10 comparisons of series in the division of correct answers:

Between series 1&3, McNemar's X square ((1)=8.04; $p<0.01$)

Between series 2&3, McNemar's X square ((1)=15.04; $p<0.001$)

And 4, McNemar's X square ((1)=6.86; $p<0.01$)

Between series 3&5 X square ((1)=6.05; $p<0.05$)

In the numeric series, (1&2), the number of correct answers was significantly higher than in the verbal series, (3&4), and in the formal series, (5), the number of correct answers was significantly higher than in the verbal series (3).

In conclusion, the pattern of findings proves true in Hypothesis 1 that predicts differences in solving unique mathematical problems between numeric and non-numeric series.

According to the hypothesis, the number of correct answers in numeric series problems was significantly higher in comparison to the verbal series. In addition, it was found that the number of correct answers in the formal series was significantly higher than in the verbal series. However, no significant difference was found between the numeric and the formal series.

8.2 Correlations between creativity in solutions to unique mathematical problems and motivation for learning

The second hypothesis examined the correlation between the amount of correct answers to unique mathematical problems and the level of motivation for learning of students with learning disabilities in junior high mixed classes in the Arab Sector in Israel. According to the hypothesis, the higher the amount of correct answers, the higher the level of motivation and interest.

Pearson Correlations. The amount of correct answers on each series and the general index of motivation for learning were calculated in order to verify the second hypothesis. In addition, correlations were calculated between the amount of correct answers for each of the five series and the three sub-measures for motivation for learning. Table 2 shows the results.

Table 2: Pearson Correlations between the grades of the series and the measures of motivation for learning (n=50)

	Motivation for Learning			
Series	**Mo General Grade**	**Ti Mastery Of Task**	**Va Avoiding**	**Tion Approaching**
1 - numeric	0.24**	0.27*	0.12	0.22
2 - numeric	0.29*	0.23*	0.42***	0.31*
3 - verbal	0.36**	0.27*	0.25*	0.26*
4 - verbal	0.43***	0.38**	0.24*	0.24*
5 - formal	0.58***	0.40**	0.32*	0.45***

*p<0.05 **p<0.01 ***p<0.001 (1 tailed)

Table 2 shows significant positive correlations between the grades on the series and the general grade on motivation for learning, exactly as expected in the hypothesis (the range of the significant correlations was 0.24- 0.48).

Likewise, according to the hypothesis, positive correlations were found between the grades of the five series and the grades of the three sub-divisions of motivation for learning: Mastery of Task, the significant correlations range between 0.23 to 0.40; Avoidance, 0.24-0.42; Approaching, 0.24-0.45.

In the Steiger's Z Test for the calculation of significant differences between correlations, it was found that the correlation between series five (formal) and the general measure of motivation for learning ($r=0.58$; $p<0.001$) was significantly higher than the correlation between series 1 (formal) and the general measure of motivation for learning ($r=0.24$; $p<0.05$); $z=-2.07$.

In conclusion, the patterns of the findings confirmed the second hypothesis. The hypothesis says the higher the number of correct answers to unique mathematical problems, the higher the levels of motivation for learning. This was found in the general measure of motivation for learning and in the three subdivisions, Mastery of Tasks, Avoidance and Approaching. It must be mentioned that the correlation between the formal series five and the general measure of motivation for learning is significantly higher than the correlation between the numeric series 1 and the general measure of motivation for learning.

9. Discussion and Conclusion

The aim of the study was to check the connection between the ability to solve challenging mathematical problems in the domain of numerical and non-numerical series and the level of motivation for learning among students with learning disabilities in mixed classes of junior high school in the Arab Sector of Israel in the central area.

The first hypothesis predicted differences in results between numerical and non-numerical series' such as letters and geometrical shapes.

The findings confirmed the first hypothesis: it was found that the number of correct answers on the numerical series was significantly higher than the one on the verbal series. In addition, the number of correct answers on the geometrical series was also significantly higher than the ones on the verbal series. However, contrary to the prediction of the hypothesis, there was no significant difference between the correct answers of the numerical series and the geometrical ones.

In general, mathematical thinking is identified with numbers and shapes, while language belongs to directions and questions, and it is perceived as a separate component of the problem. Therefore, in the series domain, only the numeric ones are being taught.

One may say that the more usual the series is and more identified with regular mathematical thinking, the higher percentage of success it will generate. On the other hand, the less usual the series is, it will require creative thinking that will decrease the percentage of success. In solving such problems, there is need to break usual patterns of thinking and seek more original ways of solution.

Also in research literature, creative thinking in Mathematics is ascribed as of a great importance. One of the ways of generating creative thinking is the presentation of problems with open answers. For example, if you ask students how they would divide 12 apples in three bowls the solution is clear cut, but if you ask, how to divide 12 apples equally, there is more than one solution, and the student will have to make presuppositions before producing an answer (Yee, 2005).

The researchers Hakim & Gazit (2011) point out the fact that the more unusual the series and the more creative thinking is required, the number of correct answers decreases and so does the ability to cope with the problems. But the students who do succeed in solving the problem gain a high sense of competence, satisfaction and motivation. Students with Learning Disabilities

need this type of questions that raise their personal morale and strengthen their motivation to learn on.

Problem solving is the core of Mathematics and part of the problems are exercises that do not have an agreed algorithm in their solution. Mathematical riddles are challenging and people seek challenges and enjoy coping with them.

The second hypothesis predicted correlation between the amount of correct answers to unique mathematical problems and the level of motivation for learning of students with learning difficulties in mixed classes of junior high schools in the Arab Sector in Israel. For example, the higher the amount of correct answers to unique problems, the higher the level of motivation for learning will be.

The findings confirmed the second hypothesis, as well. It was found, according to the hypothesis that the rise in the amount of correct answers correlated with a rise in the level of motivation for learning. It was true about the general measure for the grade on the problems and the three sub-grades on control of the task, avoidance and approaching. It should be mentioned that the correlation between the fifth formal series and the general grade on motivation for learning was significantly higher than the correlation between the 1st numerical series and the general grade on motivation for learning.

In the research literature, the problem is described as a verbal situation that entails different data. A problem includes mathematical factors such as numbers' shapes and structures that repeat themselves. In order to reach a solution in the case of a usual mathematical problem, the student should present it in a well-known mathematical model. In contrast, an unusual problem enables implementation of the learning material in a way that does not recycle an algorithm or a procedure practiced in class. According to Gazit (2004), mathematical riddles and challenges for the brain in school will enhance the

development of thinking processes and represent a factor that increases motivation and interest for all students on both levels: regular and with LD.

Motivation for learning arouses, directs and preserves a behavior of people destined to attain a goal; it reflects the sum total of causes that make a man behave in a certain way in a certain situation. Therefore, students who are motivated to learn Mathematics, will realize the need to understand the learning material and to solve the problems. Studies show that LD students who set themselves the goal to master the tasks, who perceive the task as interesting, challenging and important, tend more than others to deal with meta-cognitive activities, to activate more cognitive strategies and to invest more efforts into the task (Mymon, 2008; Pintrich & DeGroot, 1990).

In conclusion, one may say that the more unusual the series and the more creativity it requires, the smaller the amount of correct answers and attempts to cope with. This phenomenon can be attributed mainly to the fact that in the school curriculum there is not enough space for problem solving strategies, so that the students would use them in unusual problem solving like the case of problems with series. The inevitable conclusion is the need to broaden the use of unusual mathematical problems on all levels in school and the need to dedicate more time to the development of creative thinking. Success in unusual tasks raises the morale and the motivation for learning among LD students.

10. Pedagogical Consequences and Recommendations

What was tested in the framework of this study was the ability of students to cope with solving of challenging unusual problems from the field of series, and not only numerical, as opposed to the levels of motivation for learning among students with learning disabilities in junior high schools in the Arab Sector in Israel.

One of the methodological conclusions that emerges from this study is the need to take into account the pedagogical characterization of the contents of the

learning material in order to stress the importance of the unusual ones, to follow the progress of the LD student vis-à-vis himself, and to develop varied and flexible materials. All of the above are meant to serve as facilitators for the teaching of the field of Mathematics and for the increase in motivation for learning other subject matters as well.

Moreover, from the pedagogical point of view, it is recommended to use the method of unusual challenging problem solving in school for LD students, since our findings show that this method increases motivation for learning and hence it can reduce the number of dropouts, increase achievements and improve social relations among the students.

11. Limitations of the Study

Due to the limitation of the scope of this study, not all organizational variables have been checked; they might have been connected to characteristics of mathematical content that might influence the increase of motivation for learning.

Another limitation of our study is that the main method that was used was quantitative. It would have been desirable to use a qualitative aspect as well, based on interviews that would have offered a deeper and broader view of the contents of study in Mathematics, the motivation for learning among students with learning disabilities and the ideological views of these variables.

It is also necessary to draw comparisons between the various sectors in Israeli society that represent essentially different socio-cultural world views that might reflect upon perceptions of challenging problems in Mathematics and motivation for learning.

References

Agran, M., & Wehmeyer, M. (1999). Teaching problem solving to students with mental retardation. *Innovations*. *15*, 1-30.

Avisar, G. (2004). Needs assessment and surveying achievements of learners with disabilities in the classroom combines. In: Reiter, S., Laser, Y. and Avissar, J. (eds.). Combination: learning with Disabilities in Education (197-223). Haifa: Publishing fraternity (In Hebrew).

Ben - Tov, S. (2000). Examining the effect of the method of upgrading mathematics teaching social relationships, self-image and motivation of students. M.A. thesis.

Ramat Gan: Department of Education, Bar-Ilan University (In Hebrew).

Berg, D. (2000). Make realistic mathematics, a multi - sensory generic term sensory development - cognitive with the teaching procedures. Perspective - the journal of Orton Dyslexia Israel, No. 18, 83-85 (In Hebrew).

Bishara, S. (2005). Characteristics of the school and improved learning achievements in the areas of basic reading comprehension and mathematics of students in special education in the Jewish and Arab. Ph.D. thesis. Ramat Gan: School of Education, Bar Ilan University (In Hebrew).

Clarke, D.M., & Clarke, B.A. (2003). Encouraging Perseverance in Elementary Mathematics: Tale of Two Problems. *Teaching Children Mathematics, 10(4)*, 204-209.

Eylon, B. & Linn, M. C. (1988). Learning and instruction: an examination of four research perspectives in science education. *Review of Education Research, 58(3)*, 251-301.

Fischbein, E. (1997). *Intuition in Science and Mathematics: An Educational Approach.* Dordrecht, Netherlands: Reidel.

Gazit, E. (2000). Mathematics teaching dyslexic students - teaching remediation. Perspective - the journal of Orton Dyslexia Israel, No. 18, 44-53 (In Hebrew).

Gazit, E. (2004). Teaching mathematics, interest and beauty - walked together and maybe not designed? In: S. Phelps - Rosenblatt (Ed.), Teachers in a Changing World - Trends and Challenges, (pp. 356-389). Raanana: The Open University (In Hebrew).

Gazit, E. and Patkin, D. (2009). The role of creativity in solving unique problems in series with mathematics teachers and elementary school students talented in teaching and other fields of knowledge. Strong number 2000, Issue 17. Haifa: issuing a national mathematics teachers in primary education, the University of Haifa (In Hebrew).

Geary, D. G. (2004). Mathematics and Learning Disabilities. *Journal of Learning Disabilities*, *37(1)*, 4-15.

Giron, T. (2009). The contribution of unusual problems. Strong number 2000, Issue 17. Haifa: issuing a national mathematics teachers in primary education, the University of Haifa (In Hebrew).

Hakim, G., Gazit, E. (2011). The role of creativity in solving unique problems in series with the students - seventh compared mathematics teachers in elementary school, and student teachers to other fields of knowledge. Strong number 2000, Issue 20. (P. 40-48). Haifa: issuing a national mathematics teachers in primary education, the University of Haifa (In Hebrew).

Israeli, T. (2008). Relationship between alternative evaluation through research projects, and the motivation and achievement in science - in state primary schools – religious. MA thesis Ramat - Gan: Home - School of Education, Bar - Ilan University (In Hebrew).

Kashti, Y., Arieli, M. and Shlansky, S. (1997). Lexicon of education and teaching. Tel Aviv: Ramot, Tel Aviv University (In Hebrew).

Littlewood, J. E. (1953). A Mathematician's Miscellany. London: Methuen & Co. Margalit, M. (2003). Resilience model among individuals with learning disabilities: proximal and distal influences. *Learning Disabilities Reasearch & Practice*. *18*, 82-86.

Ministry of Education (2004). Circular of the Director General. Special Circular Tss"d 4. Jerusalem: Ministry of Education (In Hebrew).

Ministry of Education (2006). Mathematics curriculum in elementary school all the sectors. Jerusalem: Ministry of Education (In Hebrew).

Mymon, K. (2008). Effect of training on the task interpretation task achievement, instructional self-efficacy and motivation in learning among student teachers. M.A. thesis. Ramat Gan: School of Education, Bar Ilan University (In Hebrew).

Nevo, B. (1997). Human intelligence. Raanana: The Open University (In Hebrew).

Pintrich, P. R. & DeGroot, E. V. (1990). Motivational and self regulated learning components of classroom academic performance. *Journal of Educational Psycholoy, 82*, 33-40.

Roeser, R., Midgley, C., & Urdan, T. (1996). Perceptions of the school psychological environment and early adolescent's psychological and behavioral functioning in school: The mediating role of goals and belonging. *Journal of Educational Psychology, 88*, 408-422.

Yee, F.P. (2005). Developing creativity in the Singapore primary mathematics Classes: Factors that support and inhibit .*Thinking Classroom, 6(4),* 14-46.

الإبداع في حل قضايا غير اعتيادية في الرياضيات
وتأثيره على مستوى الدافعية للتعلم عند طلاب ذوي عسر تعلم

تلخيص:

في هذه الدراسة فحصت القدرات الإبداعية لطلاب ذوي عسر تعلم في المدارس الإعدادية في الوسط العربي للتعامل مع حل قضايا غير اعتيادية في الرياضيات في مجال المتواليات العددية، الكلامية والشكلية، وتأثيرها على الإبداع وعلى دافعيّة التعلم.

كانت فرضية البحث أن تعلم مضامين محفزة في الرياضيات تثير الإبداع وتحسّن الدافعية للتعلم عند الطلاب. إنّ تدريس موضوع الرياضيات لطلاب ذوي عسر تعلم هو مهمة صعبة، والحاجة لتدريس المضامين المطلوبة حسب برنامج وزارة المعارف يثقل المهمة أكثر. من هنا يتطلب استعمال وسائل إيضاح واسعة وطرق تدريس ملائمة، لكي تسهل على الطلاب تعلم المادة (גזית, 2000; מרולדה ודוידסון, 2000; Geary, 2004).

شارك في البحث 50 طالبا ذوي عسر تعلم يدرسون في خمسة صفوف دمج في التعليم العادي في المدارس الإعدادية في الوسط العربي. تمّ جمع معطيات البحث بواسطة أداتين: (أ) متواليات رياضية – تمّ فحصها بواسطة ورقة عمل لحل قضايا تحدّ في الرياضيات (חכים וגזית, 2011)؛ (ب) دافعيّة التعلم – تمّ فحصها بواسطة استمارة "دافعية التعلم لدى الطالب" (Roeser, Midgley & Urdan, 1996) .

أكدت النتائج تماما فرضية البحث والتي افترضت وجود اختلاف بين المتواليات من ناحية تحصيل الطلاب: في حالة كون مضمون المتواليات في موضوع الرياضيات، تكون نسبة النجاح فيها أعلى من المتواليات التي مضمونها في مجال الكلام. ومع ذلك، ليس وفقا للفرضية، لم يكن هناك اختلاف كبير بين المتواليات العددية وبين المتواليات الشكلية في نسبة الإجابات الصحيحة. وعلاوة على ذلك، أكدت بالكامل فرضية البحث الثانية، والتي بحثت العلاقة بين نسبة الإجابات الصحيحة في حل قضايا غير اعتيادية في الرياضيات وبين مستوى الدافعية للتعلم. النجاح في التعامل مع المتواليات ذوي مضمون شكلي، والتي تعتبر متواليات تحد في نظر الطلاب، ترتبط مع الارتفاع في مستوى الدافعية للتعلم.

فمن المستحسن استخدام مهام تحد في مجال المهام الرياضية – الكلامية والشكلية – مع التأكيد على المجال الشكلي، حيث في البحث الحالي وجد أن استخدام هذه المضامين يمكن أن يساهم في تحسين مستوى الدافعية للتعلم، ونتيجة لذلك – أن ينعكس على ظواهر متنوعة لها علاقة مع المجال التربوي، مثل: الحد من ظاهرة التسرب، تعزيز التحصيل العلمي للطلاب وتحسين العلاقات الاجتماعية.

יצירתיות בפתרון בעיות לא שגרתיות במתמטיקה והשפעתה על רמת המוטיבציה ללמידה בקרב תלמידים לקויי למידה

תקציר

במחקר זה נבדקו יכולתם היצירתית של תלמידים לקויי למידה בחטיבות ביניים במגזר הערבי להתמודד עם פתרון בעיות לא שגרתיות במתמטיקה בתחום הסדרות המספריות, המילוליות והצורניות, והשפעתה של יצירתיות זו על המוטיבציה שלהם ללמידה.

הנחת המחקר הייתה כי לימוד תכנים מאתגרים במתמטיקה המעוררים יצירתיות ישפר את המוטיבציה ללמידה של התלמידים. הוראת מקצוע המתמטיקה לתלמידים לקויי למידה קשה במיוחד, והצורך ללמד את התכנים הנדרשים על פי תכנית הלימודים של משרד החינוך מכביד עוד יותר. מכאן מתחייב השימוש באמצעי המחשה נרחבים ובדרכי הוראה מותאמות, שיקלו על התלמידים את לימוד החומר (גזית, 2000; מרולדה ודוידסון, 2000; Geary, 2004).

במחקר השתתפו 50 תלמידים לקויי למידה מחמש כיתות שילוב בחינוך הרגיל בחטיבות ביניים במגזר הערבי. נתוני המחקר נאספו באמצעות שני כלים: (א) סדרות מתמטיות – נבדקו באמצעות דף עבודה לפתרון בעיות אתגר במתמטיקה (חכים וגזית, 2011); (ב) מוטיבציה ללמידה -- נבדקה באמצעות השאלון "מוטיבציה ללמידה לתלמיד" (Roeser, Midgley & Urdan, 1996).

הממצאים איששו באופן מלא את השערת המחקר, שקיימת שונות בין הסדרות מבחינת הישגי התלמידים: כאשר הסדרות עוסקות בתוכן מתמטי, שיעורי ההצלחה בהן גבוהים יותר מאשר בסדרות שעוסקות בנושאים מילוליים. עם זאת, שלא בהתאם להשערה, לא נמצא הבדל מובהק בין הסדרות המספריות לבין הסדרה הצורנית בשיעור התשובות הנכונות. נוסף על כך, אוששה במלואה השערת המחקר השנייה, שבמסגרתה נבדק הקשר בין שיעור התשובות הנכונות בפתרון בעיות לא שגרתיות במתמטיקה לבין רמת המוטיבציה ללמידה. הצלחה בהתמודדות בסדרות, בעיקר באלה שעניינן תוכן צורני, שנחשבות לסדרות אתגר בעיני התלמידים, קשורה לעלייה ברמת המוטיבציה ללמידה.

מומלץ להשתמש במשימות אתגר בתחום המתמטי -- המילולי והצורני -- תוך שימת דגש על התחום הצורני, שכן במחקר הנוכחי נמצא כי שימוש בתכנים אלו עשוי לתרום לשיפור ברמת המוטיבציה ללמידה, וכתוצאה מכך -- להשליך על מגוון תופעות המתקשרות לתחום הפדגוגי, כגון: צמצום תופעת הנשירה, קידום הישגי התלמידים ושיפור יחסים חברתיים.