Effectiveness of Self-Regulation Strategies on Learning Mathematics in Students with Learning Disability in Mathematics Case Study (Sixth Grade Students, Marvdasht County)

Dr. Zohreh Esmaeili
Assistant professor of department of educational science and psychology, Payamenoor University, Iran
esmaeilyir@yahoo.com

Soraya Ghasemi
MA of Curriculum, Department of Education, Shahriyar, Iran
Gh_sori@yahoo.com

Roqiyeh Alizadeh
MA of Curriculum, Payamenoor University, Tehran, Iran
Roqiyeh1212@yahoo.com

Abstract
The purpose of this study was to determine effectiveness of self-regulation on mathematical performance of girl students with learning disability in mathematics in sixth grade. The method of this research was quasi-experimental. Research instruments included the KImat test for measuring mathematical learning disability in students. The tests reliability using the Cronbach’s alpha method in five subscales was 0/80 to 0/86. Additionally, the mathematical performance test of girl students in sixth grade was used. The Marvdasht sixth grade math teaching group has prepared this test for evaluating mathematical academic performance. The content of this test has been confirmed by five experts and the reliability by the Cronbach’s alpha method was equal to 0/85. Statistical population consisted of girl students with mathematical learning disability in sixth grade of Marvdasht County education and development department from which 30 individuals of those achieving lower than the cutoff score on the KImat examination were selected by multi-stage cluster sampling and were randomly assigned to two groups of 15 experimental and 15 control individuals. Participants in the experimental group received 12 sessions, each 45 minutes, of attention teaching. For data collection, the KImat and mathematical performance for sixth grade tests were used. Results of the research showed that self-regulation teaching is effective on mathematical performance of students with learning disability in mathematics. Therefore, teachers of various areas such as mathematics should in the first place gain awareness of self-regulation strategies, understand their importance and use them.

Keywords: Self-Regulation, Mathematical Learning Disability, KImat Exam.

Introduction
Self-regulation has valuable consequences on the process of learning, teaching and even success in life and is one of the concepts considered in contemporary education and development. The main framework of self-regulation learning theory is based on how individuals with regards to metacognitive, motivational and behavioral beliefs organize their learning. Self-regulated learning means the capacity of an individual in moderation of appropriate behavior with conditions and changes in the external and internal world and includes individual’s ability in organization and self-management of his or her behaviors in order to reach various learning goals and consists of two constituents of motivational and learning strategies (Hassani et al, 2008).

In the social cognitive theory, a picture of human behavior is presented where the most important element is self-efficacy. Self-efficacy has been defined as individual’s belief in ability to perform desired performances. In the academic environment, self-efficacy refers to a student’s beliefs in relation with ability to perform designated school assignments. Students with higher self-efficiency use increased interest, endeavor and endurance in performing their school assignments and have confidence in their abilities. Learning strategies have defined self-regulation as a kind of learning in which learners instead of relying on teachers, parents and other academic individuals, begin and guide their endeavors personally. In other words, self-regulation in learning refers to active participation of the learner with regards to behavior, motivation, cognition and metacognition in the process of learning for its maximization (Nokhosti et al, 2009).

Self-regulation has been defined as the ability of the child in acquisition of control over physical functions, management of emotions and maintenance of attention and focus and it is believed that growth of self-regulation is the basis for primary childhood growth and is evident in all behavioral aspects (Shonkoff and Phillips, 2007). According to Bandura, self-regulation is correlated with health promotion and has special importance in control of health (Bandura, 2005). Cognitive strategies are mainly used in reference to mental activities such as thinking, perception and reasoning. In fact, these kinds of strategies are used for facilitation of learning and completion of tasks and help students to prepare new information for combining with previous ones and storing them in long term memory. These strategies which are learning tools include: repetition or review, extension and expansion of meaning and organization strategies. Meta cognitive strategies are tools for guiding cognitive strategies and regulating them. Among these strategies, we can refer to determination of goals of learning, design of question about a topic being read, evaluation of what is being read and regulation of the speed of study and learning. In other words, the learner with the help of metacognitive strategies makes maximum use of his or her cognitive strategy (Nokhosti et al, 2009).

Self-regulating learners are skilled in metacognitive knowledge and know how to advance their mental processes in the direction of progress and individual goals. Additionally, in the various stages of learning, they attempt to plan, self-regulate, self-control and self-evaluate. With regards to motivation, this kind of learning tremendously helps having adaptive beliefs and outlooks that are appropriate in the academic domain particularly interest in performing academic assignments and necessary endeavor and perseveration in this context and lead the person into considering him or herself qualified, self-efficient and independent. Additionally, behaviorally, these learners are able to select, plan and create environments...
for best learning (Wolters, 2006). Zimmerman (2005) has described self-regulation as active metacognitive, motivational and behavioral participation of learners in the process of learning. Self-regulating learners set specific goals for themselves and use strategies for achieving them. These learners begin learning themselves and supervise the progress of their learning and evaluate it. Internal motivation and self-motivation in practice is another characteristic of self-regulating learners. Use of technologies enables learners to select innovation in action instead of passive reactions in the process of learning and to pursue goal directed and meaningful learning with selection of appropriate educational material. Electronic contents provide the opportunity for learners to make decisions in cases such as participation in learning, method of applying tools, time needed for learning, level and degree of learning, location of learning and the teacher (Kadivar, 2009).

Among various curricular topics in the educational system that students often find difficulty with is the field of mathematics which leads them into lack of learning concepts well and acquiring a negative outlook towards it (Akbari et al, 2014). Weakness of students in solving problems and particularly math problems is among topics that has in recent years gained the attention of specialists in education and development. Skills of students with mathematical difficulty are less than regular students in use of self-regulated learning strategies (Mohammadi, 2007). Reports by Lester (1999), Manouchehri and Goodman (1998) show that weakness in learning at all levels of mathematical education, from primary school to university, is correlated with their weakness in problem solving. These studies led mathematical teaching experts such as Shofield (1958), Chai (1998) and Montague (1992) to engage in pathologic evaluation of this phenomenon.

Among characteristics of these self-regulation strategies is that they are teachable. According to Montague (1999), the cognitive strategies model of problem solving includes reading problems, reiteration of the question, translation of the problem with picture drawing, problem diagram, symbols, operations or any other method that demonstrates the problem with clearer and more understandable approaches, hypothesis building and planning, predicting, calculating and evaluating. Metacognitive processes also include self-teaching, self-questioning and self-reevaluation. By self-reevaluation it is meant that the student evaluates his or her level of understanding and progress in problem solving and correctness of method of problem solving and ultimately time, place and behavior strategies of managing the same time, resource and place. Perels, Gurtle and Schmitz (2005) showed that use of self-regulation strategies leads to improvement of mathematical problem solving ability and self-regulation in students. The research by Mdikana and Cronk (2008) in the context of effect of teaching cognitive and self-perceptive strategies showed that such teachings can increase self-perception and self-respect of students. With these teachings, students are accepted by their peers, their social skills are increased and the possibility of them being labeled decreases. Dignath and Buttner (2008) in a meta-analytical study with participation of primary and high school students reached the conclusion that meta-analytical strategies show more effectiveness on reading and writing. At both primary and high school levels, these strategies can be effective. Perels, Dickens and Schmitz (2009) in evaluation of effectiveness of self-regulation strategies on mathematical progress reached the conclusion that with educational intervention of self-regulation strategies, self-regulation strategies and mathematical progress in sixth grade is supported. Gregory in a research evaluated the role of self-control and learning self-regulation on academic
progress. In his opinion, individuals who have appropriate self-control perform well in most tasks and show appropriate endeavor and overcome distractions (Gregory, 2007). Research by Mirhosseini, Hejazi and Davoudi (2011) has shown that teaching self-regulating learning strategies has meaningful effect on educational motivation and self-efficacy of students. Tavakolizadeh and Ebrahimighavam (2011) in a research found out that teaching self-regulation learning strategies significantly increases levels of self-efficacy in the experimental compared to the control group. Soleimannejad and Hosseininasab (2013) in a research showed that mathematical problem solving performance increases in students with teaching self-regulation strategies. Since a considerate portion of problems of students with disability in mathematics is related to acquisition and application of metacognitive and self-regulatory strategies and on the other hand, few researches and studies have been performed in relation with effectiveness of teaching self-regulation on student learning disorder, the performance of this research is very important. Cazan (2012) in a research reached the conclusion that self-regulation learning strategies, educational self-efficacy and examination anxiety are predictors of educational adaptation and the strongest predictors of metacognitive self-regulation strategies. Manavi (2013) has evaluated the relationship between child rearing styles with educational self-regulation and self-efficacy in high school students in the city of Yazd. Research has shown that positive correlation exists between the two variables of self-efficacy and self-regulation. In other words, with increased self-efficacy in participants, their self-regulation increases. The correlation between the two variables of educational self-efficacy with parental warmth in students is positive and the relationship between the two variables of self-regulation and parental warmth is also positive. In other words, with increased parental warmth towards children, their self-regulation increases. Results of research show that predicting variables (parental involvement, warmth, support and self-regulation) can explain 49 percent of the changes in the criteria variable of self-efficacy. Karimi (2011) has evaluated the relationship between emotional self-regulation and study skills with academic performance of students in the University of Medical Sciences, Isfahan Province. Results have shown that emotional self-regulation and study skills are correlated with academic performance. The variable of emotional self-regulation has the largest share in explaining level of academic performance. Meaningful correlation exists between the constituents of emotional self-regulation and study skills with academic performance of students and it is necessary that for multi lateral promotion of students, teaching self-regulation strategies is performed. Attention and planning in the direction of improving study skills and increasing emotional self-regulation of students is important. Tavakolizadeh (2014) has evaluated the effectiveness of teaching self-regulatory learning strategies on psychological health of boy students in second year of junior high school in the city of Mashad in the 2008-2009 academic years. Results showed that significant difference does not exist between means of scores of change in psychological health and its constituents namely physical complaints, anxiety, poor social performance and depression in two groups of experimental and control. Aboulghasemi (2014) has evaluated the effectiveness of teaching self-regulation learning on self-efficacy and life satisfaction in students with mathematical disability. The results of analysis of covariance have shown that teaching self-regulation significantly increases self-efficacy and life satisfaction in students with mathematical disability. These results show that teaching self-regulation in learning is an effective method for promotion of learning in students with mathematical disability. Since a significant portion of problems of students with mathematical disability is related to acquisition and application of metacognitive and self-
regulation strategies and on the other hand few studies and researches have been performed in relation with effectiveness of teaching self-regulation on learning disability of students, the performance of this research has great importance. Therefore, the purpose of this research was determination of effectiveness of self-regulation strategies on learning mathematics in students disabled in learning math.

**Research Hypothesis**

Intervention (performance of self-regulation teaching sessions) is influential on learning math in sixth grade students in experimental compared to control groups.

**Method of Research**

The research design included two groups with control and pre and post test. Statistical population of this research included all sixth grade students in Marvdasht County in the 2014-2015 academic year. Research sample included 30 students with mathematical disability who were randomly selected from among 12 public primary schools in Marvdasht County after interview and diagnosis using the KImat examination in 2015. Regarding sample selection, it should be noted that in experimental method, each sub group needs to consist of at least 15 individuals and for the sample selected to be representative of real society and the research to have high external validity, sample size of 30 individuals (15 for each group) was selected (Delavar, 2011). In this research, data collection was performed using the following tools:

The KImat examination: was used for measuring disability in learning mathematics which has been developed by Canoli (1998) and prepared for implementation. This test has great application in identifying students with disability in learning mathematics and regarding content and sequence includes three sections of fundamental concepts (three subtests of counting, quotients and geometry), operations (addition, subtraction, multiplication, division and mental calculation) and application (measuring, time, money, estimation, data interpretation and problem solving). In Iran, the psychometry of this examination has been evaluated by Mohammad Esmail and Houman in (2002). Validity of this examination has been evaluated using content validity, differentiating validity, predicting validity and its concurrent validity has been obtained at 0.55 to 0.67. Examination reliability has been assessed using the Cronbach’s alpha method in five subscales to be 0.80 to 0.86 (Mohammad Esmail & Houman, 2002).

Mathematical performance test for sixth grade students: has been prepared by sixth grade teaching group in Marvdasht County for testing mathematical academic performance. This examination has 20 questions in the domains of addition, subtraction, multiplication, division, counting, quotients, geometry, money, time, problem solving and estimation. The method of responding is descriptive in 70 minutes. Content validity of this test has been confirmed by five experts and its reliability using Cronbach’s alpha is equal to 0.85.

**Method of Implementation**
The program of teaching attention has been taken from the book of learning disabilities from diagnosis to intervention written by Fletcher and colleagues (2007) and Abedi, Ghaderi, Shoushtari, Abdi and colleagues (2011). Among candidate students, 30 individuals who scored below cut off in the Klmat examination were selected randomly and placed in two groups of 15 individuals, experimental and control. Participants in the experimental group participated in 12 sessions each 45 minutes one a week, where they received attention teaching. Control group participants received only regular classroom teaching during the intervention period. The main points of the topics and contents of self-regulation strategies have been reported in tabular format.

First session: familiarity with the method. In this session, initially explanation was given to parents regarding learning disability and next about goals and necessity for teaching attention. Subsequently, pre test for academic mathematical performance was completed by the students.

Second session: teaching constituents of motivation and resource management strategies.
Third session: review of activities in session two.
Fourth session: teaching strategies of repetition and review.
Fifth session: review of previous session activities and teaching modeling strategies for acceptance of risk in academic matters and conceptual expansion.
Sixth session: review of previous session activities, teaching organizational strategies and acceptance of success.
Seventh session: review of activities of previous sessions.
Eighth session: teaching planning strategies and helping students in selection of appropriate award and punishment.
Ninth session: review of previous session activities, teaching control and supervision strategies and acceptance of academic risk.
Tenth session: review of previous session activities, teaching organizational strategies.
Eleventh session: review of previous session activities, students’ previous session assignments.

Twelfth session: mathematical academic performance test was implemented. Additionally, no drop out of participants in the experimental and control groups happened. The program of teaching attention was implemented in 12 sessions by two Master’s specialists in psychology in the Shenakht specialty center for counseling and psychiatric services. Collected information was analyzed using analysis of covariance.

Data Description and Analysis

Considering Table (1), results of t-test showed that meaningful difference did not exist between mean scores of pretest among the two groups (1) and (2). Therefore, the two selected groups were at one level.

<table>
<thead>
<tr>
<th>Statistical Difference</th>
<th>Difference</th>
<th>Degrees of freedom</th>
<th>Significance</th>
</tr>
</thead>
</table>

Table (1): t-test analysis for pre-test for experimental and control groups (1) and (2).
Considering the statistics in Table (2), mean scores of pre and post tests in the experimental group (1) who underwent self-regulation teaching was compared using the dependent t-test and significance level in the control group was 0.076 and since this value is higher than 0.005, meaningful difference was not observed.

Table (3) Indices of descriptive statistics for pre and post test scores in the self-regulation education group

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Mean standard error</th>
<th>Degrees of freedom</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>16/75</td>
<td>2/29569</td>
<td>0/42548</td>
<td>58</td>
<td>0/004</td>
</tr>
<tr>
<td>Post-test</td>
<td>16/32</td>
<td>1/15311</td>
<td>0/34585</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Considering Table (3) the post test of mathematics knowledge and concepts for the experimental group was improved compared to mean scores of pretest in this group and this difference was statistically significant (Table 3). Therefore, the hypothesis is accepted at a significance level of 0.05. In other words, the group that had received self-regulation teaching had better performance in the post test and the mentioned method has significant influence on student learning.

**Discussion and Conclusion**

In this research where the purpose was determination of effectiveness of teaching self-regulation on learning mathematics in girl sixth grade students, in summary the results obtained were: this teaching had positive effect on learning the course of mathematics and student performance. Results of this research are in the direction of research by Graziano and colleagues (1993), Reid, Trout and Shwartz (2005), Ryan and Deci (2006), Marsh, Steinglass, Gerber, Graziano and colleagues (2009). These findings agreed with the research by Lou Conegli and colleagues (1997), Fouladchang (2003), Boekaerts and Corno (2005). In their study, these researchers found out that teaching self-regulation strategy inclusive of cognitive, metacognitive and motivational constituents promotes student performance in handling all situations particularly complex ones and solving mathematical problems.
Handling various situations is simplified for them and this promotion is stable in time. Among reasons for explaining this finding is that solving mathematical problems is a complex mental task and if this complex activity is taught in an atmosphere combined with analytical reasoning, planning, supervision and evaluation, we can be hopeful that instead of memorizing formulas, math is understood and they learn how to learn. They learn how to use those skills in real situations. In explanation of these findings, it can be noted that children with disability in learning math, even though they know the operations well, due to lack of attention, commit errors such as lack of attention to symbols, column of ones, tens and hundreds, lack of attention to complete inscription of numbers, not calculating and missing some numbers. These difficulties arise from lack of attention. Zimmerman (2000) believes that students who benefit from self-regulation strategies are those who are aware of such strategies and use their ability in the reaching desired goals or part of specified objectives in the activity of learning. Also, they supervise themselves while performing assignments and interpret the present level of their progress, select strategies that help them in reaching successful results. The necessity for reaching this goal is evolution in teacher education and development system in the domain of math. Therefore, it is suggested that policies are defined in training of human resources in the education and development department in such a way that teachers in various domains such as mathematics in the first place gain awareness regarding self-regulation strategies, acknowledge their importance and use them.

Lack of pursuit, lack of clinical sampling and specificity of the sample to girls with math disability were among limitations of this study. Since the results of this research showed that learning self-regulation leads to progress in scores of students with disability in math, this skill can be taught as learning techniques or study skills in schools to students so the sense of qualification, self-efficacy and life satisfaction is promoted among them. It is suggested that future research is performed with the purpose of evaluating self-regulatory learning with attention to gender and different educational levels. Additionally, effectiveness of this method is evaluated to other learning disabilities such as writing and reading.
References

[In Persian]

Abedi, Ahmad; Ghaderi Najafabadi, Maryam; Shoushtari, Mojghan; Golshani, Fereshteh (2011). Effect of teaching metacognitive program of Panora and Philipo on improvement of performance in solving the problem of metacognitive knowledge and skills of students with special disability in math. Special Individuals’ Psychology Journal; 125-145.


