Effectiveness of Self-regulation Components Training Specific in Mathematics on Self-regulation and Mathematical Performance of Female High School Students

Khadijeh Hamidyan, Faezhe Haghighi, Azam Noori

INTRODUCTION

Experts in the field of mathematics education believe that living in today complex world requires creative and productive thinking and so the effective learning mathematics can contribute to the formation and development of critical thinking skills [3]. Accordingly, students’ performance in mathematics is important for the directors of education [7]. In the 1980s, research is concentrated in the field of interaction of factors that can influence performance and learning concurrently. Mathematics education professionals, including Chi, Montague began their studies on the pathology of mathematics performance; they found that mathematical success requires equipped with a self-regulatory strategies in addition to mathematics concepts acquisition. Self-regulation is a structural introduced by Bandura in 1960. Also, many psychological theories related to math education, emphasized on information organizing and mental processes controlling through formation of the schemas by the students [4].

In the past decade, individual differences have been considered the main factor in the differences between students’ math performance. But in recent years, especially by presenting the perspectives of cognitive and news building new comments on pupils’ learning difficulties and failures are presented, which are somewhat on the importance of learning and how to use learning strategies. The difference on pupils is not in the inherent capabilities of students, but also is in information processing. Hence, using appropriate methods of teaching, resolving learning problems students' academic performance can be enhanced and improved. Self-regulated learning strategies is one of the variables gained interest of researchers and experts in recent decades. Today that consensus has been formed that student in order to show good mathematics performance need to gain self-regulation, cognitive and motivational skills [15]. Andreassen & Braten [9] in their study expressed that teachers need instructions to use self-regulation strategies to enhance the effectiveness of their teaching and facilitate student learning and success.

Keywords: Components of self-regulation, Self-regulated learning strategies, High school students

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A B S T R A C T

This article is drawn from a research that aims to evaluate the effectiveness of self-regulated learning strategies to teach students to pursue the study. This research was conducted in 2012-2013 academic year. This quasi-experimental method with pre-test - re-test control group was applied. The study population consisted of 4583 female high school students in Qarchak County of which 54 were selected by multistage random sampling. They were randomly assigned to two experimental and control groups. Self-regulation test questionnaire and mathematical performance test were used as pretest. Then, the experimental group attended ten one- hour session training for self-regulation specific in mathematics; however, the control group received none. Three weeks later, both groups were retested on self-regulation and mathematics performance. Data were analyzed using descriptive statistics (standard deviation, mean) and inferential analysis using ANOVA and Tukey’s test. The results indicate that training components of self-regulation strategies affects positively on mathematics performance. Also the results indicate training components of self-regulation strategies affects positively on self-regulation and mathematics performance.

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Pintrich [14] considered self-regulated learning an active and structured process in which students are selecting learning objectives, and then try to regulate, control and monitor their cognition, motivation and behavior. Self-regulation synonyms include self-direction and self-discipline. Self-regulation has several synonyms, so is with several different definitions that result from different theoretical perspectives, although these views are relatively with high overlap. But the term self-regulation is not limited to cognitive-social theory because behaviorists have added behavioral strategies into the self-regulation definition, they think overt responses, self-monitoring self-instruction and self-reinforcing are elements behavior self-regulation [17].

Researchers and theorists have proposed various models for self-regulation that Zimmerman self-regulation model is an explanation of self-regulation training effects is of theoretical basis (2000), he proposes a model based on cognitive-social theory believing in rotational mode of self-regulation in the study process that occurs in four stages: self—evaluation monitoring, goal setting and strategic planning, strategy implementation and monitoring and strategic outcome monitoring. More self-regulated students are theoretically more aware of their needs and can meet them adequately with more impact on their learning. Also they can control better the results, and having a treasury of learning strategies is more appropriate for different learning situations.

**Self-regulation Cognitive - Social Theory:**

The self-regulation was first proposed by cognitive-social psychologists and researchers including Bandura since 1960s. According to the cognitive-social perspective, it is assumed that self-regulated learning forms in a three-way interaction, the person, the environment, and the behavior (Fig. 1). According to this approach, self-regulation is not determined solely by personal factors but also is influenced by environmental and behavioral factors. Effects of these three factors are not used equally. Rather, each factor may be more effective deepening on the situation or the specific conditions may affect the results. However, self-regulated learning occurs when a person is able to utilize personal processes for regulating behavioral strategies and learning environment [18].

![Fig. 1: The determinants of self-regulation and learning from a cognitive-social perspective.](image)

**Self-regulation Components:**

Theorists agree with each other in that the self-regulated learning contains basic components and resource management components. These components include cognition, Meta cognition, motivation and management of resources.

A) Cognitive strategies (surface and deep) can be seen as processes or practices relating to the acquisition, maintenance or use of the information.

B) Meta-cognitive is defined strategies as conscious awareness and reviewed whether the learning objectives have been achieved or not. Meta cognition is also the choice of appropriate strategies for achieving the objectives. Metacognitive strategies help individuals increase learning efficiency, students can track their learning process with the development of meta-cognitive learning capacities and can start learning how to hold learning in their educational agenda.

C) Resource management strategies help students adapt to their environment and alter their environment to meet their needs and their goals [16,7].

D) Motivational strategies: (2000) argues that motivation can encourage the learner in goal setting and selecting learning strategies, monitoring and evaluating their progress and the implementation of self-enhancement. In fact, motivation is the driving force for of successful implementation of the other three strategies of self-regulation.

**Characteristic of self-regulated learners:**

Van Wyk states five characteristics of self-regulated learners as self-regulated, self-regulated learner, knowledge possessor, knowledge utilizing, spontaneous, critical thinker (established switchin learning) and feel committed to learning. Self-regulated learners do not necessarily have all these features, although they can be helped to achieve all these characteristics. Therefore, in recent years the study of the relationship between self-regulated learning strategies on mathematics performance is one of important areas of research. We aimed to determine the effectiveness of self-regulation components on mathematical performance.
Studies on self-regulation strategies and academic performance, especially in mathematics, are considered by many scholars and experts. Chatzistamatiou, M [10] states that regarding the complex interplay of factors related to learning self-regulated learning strategies should also be included in other areas of cognitive and teachers educational setting. The model should be similar to that of the relationships between self regulated learning strategies and student’s individual factors, including reference to the elementary school’s mathematics that confirmed self-efficacy, academic values beliefs and sense of fun. 

(2010) showed that individuals who make use of better strategies to study are more inclined toward basic, significant and long-lasting subjects study. They manage their behaviors to facilitate learning and avoid thoughts and behaviors that hinder academic performance promotion. They know appropriate strategies in any learning situation, and they are capable of forming personal skills in learning. They, when faced with a challenge to learn, know and understand that what strategy to use to increase the performance and stability of the material in their mind. They use metacognitive strategies purposefully. Krista Muis [7] in study examined the relationship between cognitive self-regulation and mathematical problems solving. 264 students participated in this study in mathematics and statistics and completed questionnaire on self-regulation of learning strategies. Some of these students participated in two sessions of problem solving classes, and have received training on planning, awareness, control and use of rational and empirical arguments. Students who received the training were different prominently in solving mathematical problems from other students and solved problems better than others.

Notae in a research studied the relationship between the use of self-regulation strategies and academic achievement and academic mutation in their next tests. His sample consisted of students in the last years of high school in Italy. In this study, an interview program on cognition, motivation and self-regulated learning strategies in the classroom and non-classroom behavior was used. The results show that these strategies in Italian language, mathematics, and technology courses had a significant effect on learning lessons and university exams could mean of other classes. Motivational self-regulation strategies have been significant predictor of success in the final examinations for obtaining a high school diploma.

et al (2001) found that females perform better than males assignment performance strategies and environment organization. The results indicate that females are better than males regarding re learning cognitive strategies [5].

(1998) reported a number of studies with the results of that the teachers can teach study skills and learning strategies to help students to be better learners and take more active roles in their academic studies [5].

Zimmerman [18] in the analysis of gender differences observed that females pay more significant attention to taking note, self-monitoring, environment organization and planning strategies than males.

Pintrich and [14] also showed that females and males use different types of strategies for learning.

Karami et al found that metacognitive strategies and their use may impact academic performance. Since the metacognitive strategies meant to guide and monitor cognitive strategies, the skilled learner is one who is aware of the correct methods and strategies and to use them properly.

The study by Folad Chang [6] concluded that the program to teach students meta-cognitive skills has a positive effect on academic achievement in mathematics. Folad Chang [6] in another study showed that cognitive processing has a positive effect on problem solving. Students with higher cognitive skills have better math performance than other students [4]. Samadi [5] referred to the role of metacognitive strategy training on reading comprehension and speed of learning and solving math problems, and concluded that, the metacognitive skills are important failures in the failure of learners.

Samadi [5] in a research studying the role of metacognitive knowledge in solving mathematical problems showed that training in metacognitive knowledge leads to better performance and earn better grades in school math.

The overall objective of the study: To determine the effectiveness of self-regulated learning strategies on self regulation and mathematics performance of highschool students.

Hypothesis:

Research methodology:
The study design and methods: This study examined self-regulated learning strategies impact on mathematic performance using causal relations of research variables based on a model presented by 2008. The quasi-experimental, pretest - retest experimental and control groups were used. Finally, this study was conducted in three stages. 1) The pretest, 2) The experimental group students training session (self-regulated
learning strategies were taught in ten one-hour sessions to the experimental group), and 3) the re-test. After pretesting both groups on mathematics performance, students in the experimental group attended ten one-hour sessions to be trained method of self-regulated learning strategies specific in mathematics by the research, further research to evaluate the effectiveness of the training, re-test of mathematic performance was conducted on both experimental and control groups.

The population and sampling method: Subjects are 54 female high school students in Qarchak County in the academic year 2012-2013. They were selected by multistage random sampling. First a list of public high school in Qarchak County has been provided. The list consisted of 14 schools. One high school with 402 students at 12 classes in four grades was randomly selected. Then a grade (grade 3 studying at science field) was randomly selected and then two classes were selected as experimental and control groups (Table 1).

Table 1: Demographic features of experimental and control groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>IQ mean</th>
<th>IQ standard deviation</th>
<th>IQ mean error</th>
<th>size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>109.79</td>
<td>11.35</td>
<td>1.98</td>
<td>27</td>
</tr>
<tr>
<td>Experimental</td>
<td>110.05</td>
<td>10.93</td>
<td>1.79</td>
<td>27</td>
</tr>
</tbody>
</table>

Table 1 shows that both groups are nearly the same regarding IQ standard deviation observed and IQ mean without a significant difference between the two groups in terms of IQ.

Data collection tools:

Mathematic performance tests: pre-test and re-test developed by the researchers was used as mathematical tools to measure performance. Test validity is of the content validity method that was evaluated, judged and confirmed using ideas from four high school math teachers (average 15 years of mathematics teaching experience). To evaluate the reliability of both tests (14 questions) the tests were conducted on 26 students out of the samples. The statistics show eliminating any question in the pretest causes changes in the level of reliability in the range of 0.81 to 0.83. The alpha coefficient equal to 0.83 indicates the internal consistency of the test. Two questions of the test were eliminated at this stage, and the questions statistics show that eliminating any remaining questions the reliability of the remaining 12 questions changed on a range of 0.74 to 0.79. The alpha coefficient equal to 0.79 indicates the internal consistency of the test.

Self-regulation questionnaire: In order to measure student use of strategies for self-regulation a self-regulation questionnaire by Pintrich and [14] based on Likert scale ranging from completely agree (score 7) to strongly disagree (score 1), the results show each student perception of their self-regulation. The questionnaire included 44 items and 14 strategies with the validity with a correlation coefficient equal to 7.0. The content validity of the test questionnaire was conducted by three professors with doctorates in psychology, statistics and research methodology and was approved. Test-retest reliability study was conducted, the questionnaire test was conducted on a group of 35 subjects, and the reliability of 0.68 and the internal consistency (Cronbach alpha coefficient) of 0.65 were obtained, respectively.

Results:

Kalmogorov-Smirnov -Test was used to investigate the normal distribution of the components of self-regulation and mathematics performance. Levene Statistic was used to assess the consistency of variance, and ANOVA and Tukey (HSD) tests were used to test research hypotheses and evaluate the difference between variance.

Table 2: Normally distributed variables parameters.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre- test</th>
<th></th>
<th>Re- test</th>
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<tbody>
<tr>
<td></td>
<td>Experimental</td>
<td>Control</td>
<td>Experimental</td>
<td>Control</td>
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<tr>
<td>Self-regulation</td>
<td>Z value</td>
<td>0.637</td>
<td>1.168</td>
<td>0.412</td>
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<tr>
<td></td>
<td>Significance</td>
<td>0.825</td>
<td>0.126</td>
<td>0.995</td>
</tr>
<tr>
<td>Mathematics performance</td>
<td>Z value</td>
<td>0.927</td>
<td>1.037</td>
<td>0.679</td>
</tr>
<tr>
<td></td>
<td>Significance</td>
<td>0.357</td>
<td>0.233</td>
<td>0.745</td>
</tr>
</tbody>
</table>

Table 2 shows the normal distribution of variables regarding Z values, and obtained significance level in both components of pretest and re tests in both experimental and control groups.

Table 3 indicates that there were significant differences between Mathematics performance component and self-regulation in mean and standard deviation indicators in re-test in experimental group.

Research hypothesis 1: self-regulation strategies specific in mathematics training directly impacts on students’ self-regulation.
cal value, with the significance.
erformance regarding the selected goal, accurate planning and
le students did not spend more time learning math and class
uced from the findings that
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during the study to achieve higher performance. In this respect, independence in learning, training and
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getting help from others, control anxiety and avoid procrastination or neglect and taking notes highlighting and reviewing as well as combinations of the strategies causes improved mathematical performance. At the same time meaningful information gathering makes them control their learning process and set programs that seem in long term improves mathematics performance. They, when study or when the teacher teaches try to make information meaningful, establish a logical connection with the previous data, control this process and create a suitable learning environment appropriate for learning to learn and increase in their math performance. Constant reviewing and thinking about how to study, study conditions and other information related to learning force people to react and change the circumstances that those with high metacognitive capacities being aware of their learning capabilities when not achieved desired results try to find the causes and welcome circumstances that lead to success and better performance. Mostly, the lack of expertise in applying study skills leads to failure in study courses which is problem in educational system. The student may be studying for a test without a deep understanding of new and important matters, the way to act in strange situation due to lack of self-regulatory strategies so they don’t achieved effective and sustainable outcomes in spite of the time spent in learning. Therefore, regarding the importance of mathematics in all educational systems and its impact on the development of students’ thinking and creativity as well as the impact of self-regulation on mathematics performance of students in the educational process, undoubtedly teachers believing in teaching students self-regulation strategies would help in improving mathematics performance (1998) sees lack of self-regulated learning strategies knowledge by teachers as one of the important reasons for the in the classroom failure.

REFERENCES


