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EXAMINING THE IMPACT OF SELF-REGULATED LEARNING STRATEGIES ON STUDENTS' MOTIVATIONAL BELIEFS TOWARD MATHEMATICS

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Abstract
The purpose of this study was to examine the effect of self-regulated learning strategies training on students' motivational beliefs toward mathematics. The authors argue self-regulated learning strategies training could positively effect the students' motivational beliefs toward mathematics. For this a pre-test & post-test experimental design were conducted. The subjects were 66 Iranian ninth grade female students divided into two equal sized groups. At first, both an experimental and a control groups completed self-motivated strategies questionnaire for learning scale. The experimental group then participated in a self-regulated learning strategies training program for 16 hours. Next, both groups again completed questioners. MANOVA analyses of the resulting data showed self-regulated strategies training improve significantly students' motivational beliefs toward mathematics. Moreover, the use of self-regulated strategies not only can increase engagement in mathematics assignments but also leads to deeper information processing, greater academic achievement and, in turn, increased motivation.
Key Words: *self-regulated learning, motivational beliefs, mathematics.*

1. Introduction

Knowing the factors that influence college students' academic performance is necessary to improve their learning. During the last 30 years there has been abundant evidence stressing the importance of multiple affective variables in educational settings and particularly in the context of students' learning, such as motivational beliefs or self-beliefs about the reasons that encourage a student to work on a task. Motivational beliefs are frequently found in the literature to be associated with the theory of self-regulated learning (SRL) [e.g. 1], one of the flourishing areas of research, since it redistributes and transmits the responsibility and control from the teacher to the students and provides tools for lifelong learning. Research demonstrates that students' motivational beliefs of self-regulated learning are directly related to their academic performance [i.e., 2; 3]. Zimmerman [4] suggested that self-regulated learning has become an important topic in educational and psychological research. One reason for this is that the extend to which learners are capable of regulating their own learning greatly enhances their learning outcomes. Pintrich [5] defined self-regulated learning as, "an active, constructive process whereby learners set goal for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and contextual features of the environment". Pintrich [1] described the model of self regulated learning that includes three general categories of strategies; (1) Cognitive learning strategies (rehearsal, elaboration and organization strategies). (2) Self-regulated learning strategies to control (planning, monitoring and regulating strategies). (3) Resource management strategies (managing and controlling time, effort and their environment). Wolters [6] supported Pintrich's definition and he pointed that one of the most important issues in self-regulated learning is that students can select, combine and use cognitive strategies effectively.

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Zimmerman [4] depicted graphically the theory of SRL as a cyclical procedure that incorporates the SRL strategies, task strategies and motivational beliefs. The "will" component refers to the notion of motivational beliefs such as self-efficacy, task value and goal orientation beliefs [1]. The motivational beliefs have been assumed to support and be supported by the use of the SRL strategies [7].

Zimmerman [8] defined comprehensively the characteristics of self-regulated learners as follow: They are meta-cognitively motivationally and behaviorally active in their own learning process. In this sense, self-regulation refers to different students' thoughts and behaviors to reach their learning goals. Self-regulated learning follow activities such as a tending to instruction, processing information, relating new knowledge to prior knowledge, making rehearsal, improving social relation and arranging environment in order to achieve learning goals. These aspects of self-regulation can be observed in the model suggested by Zimmerman, Bonner and Kovach [9]. This model involves four interrelated processes that are defined below: (a) self-evaluation and monitoring, (b) goal setting and strategic planning, (c) Strategy-implementation monitoring, and (d) strategic-outcome monitoring. In the model, students monitor and evaluate their learning performance on a task. Self-evaluation improves and includes keeping performance record. Secondly, students analyze the learning task, set goals, plan and refine a learning strategy. If students have little knowledge about a task and they cannot set goals or use effective learning strategies. Thirdly, students implement the strategies they select and task feedback from peers, teachers and themselves. Students use new strategies when their strategies are ineffective. Finally, students evaluate their performance outcome and effectiveness of their strategies. They change their strategies if they are ineffective [10].

The model of self-regulation including self-evaluation and monitoring, goal setting and strategic planning, strategy implementation, strategy outcome monitoring can be embedded within mathematics instruction in schools in order to improve student's motivational beliefs towards mathematics. In the social cognitive theoretical framework, learners do not use self-regulation strategies equally in an all domains. Although self-regulation processes (e.g. monitoring, planning and goal setting) are general, learners must adapt these processes to specific domains such as mathematics and use them effectively. Moreover, self-regulation is related to context of the learning materials [11]. This situational specificity is pointed in Zimmerman's [12] conceptual framework comprising six areas in which one can use self-regulatory processes; motives, methods, time, outcomes, physical environment, and social environment. Self-regulated learners can choose one or more of these areas. Students can learn a task when they use this process. Also, they benefit from some external factors (i.e. teachers, parents, and computers).

Mathematic, as an important aspect of academic education that demands the application of multiple skills [13], seems to be a potentially rich domain to study self-regulated learning (SRL) [e.g. 1; 4], and motivational beliefs since it requires the application of cognitive and metacognitive skills [14]. Students should examine their mathematics thinking, analyze mathematics situations, explain and justify their mathematics reasoning so that they can develop deep mathematics understanding. Students can learn more deeply when they take control of their own learning. Knowing cognitive processes and using self-regulated learning strategies may have an important role in that student can see the relational understanding in mathematics [10].

Mathematics improves critical thinking skills; helps in solving real life problems and understanding the facts of the life. Most students, during their elementary school education, think that mathematics is very complex. As a result, they cannot benefit from the advantages of the learning of mathematics throughout and long after their education [15]. Students' mathematical beliefs have powerful impacts on their engagement and achievement. Much research has been conducted on the essential role of beliefs in mathematics learning [14; 16]. Students' beliefs about the nature of mathematical knowledge and skills, about mathematical problem-solving, and about their own mathematical capability, often determine their level of attendance and learning [17]. Their beliefs and behaviors derive from students' previous classroom experiences, both positive and negative; they are highly stable and difficult to change [e.g., 18]. Nota, Soresi and

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Zimmerman [19] examined self-regulation and academic achievement of high school student. They found that the cognitive self-regulation strategies of organizing and transforming proved to be a significant predictor of the student's course grades in mathematics. The study revealed that the students in experimental groups made more improvement in self-efficacy, effort to learn and handling distractions compared with students in the control group. Furthermore, teaching self-regulated learning strategies can increase not only academic achievement but also self-regulated learning skills of students. Arsal [10] supported the results of the study. These theoretical views and empirical findings suggest that when learning is self-regulated may yield better-enhanced motivational beliefs. In summary, our aim in this article is to examine the effect of self-regulated learning strategies training program on students' motivational beliefs in mathematics.

2. Method

2.1. Participants

The sample contained 66 Iranian ninth grade female students divided into two equal sized groups, experimental and control group. Sampling was conducted using multi-stage cluster sampling method. (Age: M = 14.51, SD = 0.75).

2.2. Measures

Self-motivated strategy questionnaire for learning. Students' motivational beliefs were assessed using Pintrich and De Groot's [2], Motivated Strategies for Learning Questionnaire (MSLQ). The students in the present study responded to 44 items measured on scales ranging from 1 (strongly disagree) to 7 (strongly agree). Pintrich & De Groot [2] reported the reliability coefficient of this instrument (Cronbach's alpha) α=0.89.

2.3. Procedure

The students and mathematic teachers obtained permission for the study. The study lasted for six weeks. First author attended in participants' regular classes and administered the questionnaire during in their regular classrooms. The administrator used standardized instructions. Subjects were assured about the confidentially of their answers. The questionnaire was administrated with the absence of teacher. After answering students' questions, the administrators asked the students to complete the questionnaire, and later thanked them for their participation. After pre-test, subjects were randomly placed in control or experimental groups. Then experimental group participated in the SRL training program fourteen sessions in six-week period. In the study, the training program developed by Zimmerman etc. al., [9] was conducted within the framework of regular classroom instruction on the subject of mathematics over a six-week period. Control group did not receive instruction. At the end of the six week, students in the two groups took the post-test.

3. Results

The data collected were analyzed in two parts. Firstly, descriptive statistics were computed. In addition, descriptive statistics were computed followed by t test. Table 1 presents the means and standard deviations of subjects.

Table 1. The means and standard deviations of subjects' motivational beliefs scores in pre-test

Group	Motivational beliefs toward mathematics		
Experimental	*M:* 3.42	*S:* 1.89	*n* : 33
Control	*M:* 5.24	*S:* 1.78	*n* : 33

Table 2. The means and standard deviations of subjects' motivational beliefs scores in post-test

Group	Motivational beliefs toward mathematics		
Experimental	*M:* 3.42	*S:* 1.89	*n* : 33
Control	*M:* 5.24	*S:* 1.78	*n* : 33

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The analysis of co-variance was used to analysis of data.

Table 3. Study of interact ional effect of two groups in motivational belief pre-test.

Sources of change	SS	d. f	MS	F	P
Group	15/33	1	15/33	2/41	0/13
Pre-test	5615/77	1	5615/77	17/883	0/000
Group & pre-test Interaction	2/49	1	2/49	0/39	0/53
Error	394/23	62	6/36		

A significant difference is observed between two groups in pre-test scores of motivational beliefs ($F_{(1.63)}$=0.39, P=0.53) so the data do not support the hypothesis of regression gradient homogeneous. Therefore, we can use co-variance analysis.

Table 4. Summary of co-variance for the test of hypotheses

Sources of change	SS	d. f	M.S	F	P
Modified model	8923/89	2	4461/95	708/55	0/000
Separate effect	36/07	1	36/07	5/73	0/02
pre-test	8578/42	1	8578/42	1/36	0/000
Group	826/97	1	826/97	131/32	0/000
Error	396/73	63	6/30		
Total	1012021	66			

The results of co-variance analysis test demonstrate that SLR program has a significant effect on student's motivational beliefs ($E_{1,63}$ = 131.32, p < 0/01). Table 4 indicated that participants who received SLR training program reported more effective motivational beliefs compared with participants who did not.

4. Discussion

The aim of this study was to find out the effect of self-regulated training on motivational beliefs toward mathematics. Results supported the hypothesis. Results indicated that experimental group reported more effective motivational beliefs. Self-regulated learning can help enhance motivational beliefs, a finding important to those concerned with promoting motivational beliefs. These findings are consistent with Pintrich & De Groot [2], Schank [11], Rafeeyan [20], Shirazitehrani [21], kajbaf, Mowlavi and shirazitehrani [22].

Zimmerman's self-regulated learning strategies were applied in the study. The result showed that there was significant improvement in the mathematics attitude and motivational beliefs and use of self-regulation strategies of the students in the experimental group after six weeks of training on the use of self-regulation learning strategies. This study supports Zimmerman's theory that when students are given opportunities to self-regulate and are explicitly taught self-regulated learning strategies, academic achievement is more likely to be positively affected. In the study, students in the experimental group selected and implemented study strategies such as cognitive and meta-cognitive according to the context of the homework. Selecting and implementing cognitive and meta-cognitive learning strategies can be considered as the reasons for the academic achievement of those in the experimental group.

In the light of the result of this investigation, it was revealed that using self–regulative cognitive strategies not only help students make more attempts in regard with doing assignments but also results in deep processing of information. This leads to academic improvement and results in an increase in motivation and in this case the internal motivation of the individual is affected and increased. As a whole, investigation revealed that the internal motivation of the individual is influenced and increased and that internal motivation is associated with the widespread use of self – regulative strategies.

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5. Conclusion

Despite the limitations, the findings from the present study have important implications. They suggest that how students' SRL affects their motivational beliefs. From a practical point of view, In order to increase students' mathematics achievement, teachers should conduct effective mathematics teaching activities and provide instruction on self-regulated learning strategies. Teachers and mathematics teachers should instruct their students in such a way that enable them to monitor, control and evaluate their own learning. Students should become autonomous learners in learning mathematics. Finally, there is no reason why students should not be successful in mathematics in their school life and effectively benefit from mathematics throughout their lives.

Limitations and Future Research

The current study is not without its limitations. First, we did not have male subjects. Second, we used a single measure of motivational beliefs. Third, we just studied motivational beliefs toward mathematic. Fourth, the cross-sectional nature of research design which only allowed for a slice-in-time study. Hence, future research might examine whether the present findings among female adolescents and about mathematic could be generalized across male students and different types of activities and different situations. Moreover, Future studies can look at the influence of other variable like as attitude toward subjects that seems could affect on motivational beliefs.

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