MODELING THE STRUCTURAL RELATIONS AMONG LEARNING STRATEGIES, SELF-EFFICACY BELIEFS, AND EFFORT REGULATION

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Abstract

This research examined the relations among students' learning strategies (elaboration, organization, critical thinking and metacognitive learning strategies), self-efficacy beliefs, and effort regulation. The Motivated Strategies for Learning Questionnaire (MSLQ) was used to measure students' learning strategies, self-efficacy beliefs, and effort regulation. A total of 227 high school students participated in the research. Confirmatory factor analysis and path analysis were performed to examine the relations among the variables of the research. Results revealed that students' metacognitive learning strategies and self-efficacy beliefs statistically and significantly predicted their effort regulation. In addition, the students' self-efficacy beliefs directly affected deep cognitive learning strategies and effort regulation but indirectly affected metacognitive learning strategies. Furthermore, 88.6 % of the variance in effort regulation was explained by metacognitive learning strategies and self-efficacy beliefs.

Key words: *effort regulation, high school students, learning strategies, self-efficacy beliefs, structural equation modeling.*

Introduction

Self-regulated learning is a critical and important component of student academic performance and achievement in classroom. Various definitions of self-regulated learning are available in the literature (Driscoll, 2005; Pintrich, 2000; Zimmerman, 2000; Zusho, Pintrich & Coppola, 2003). Yet, a close examination of those definitions makes it clear that three basic components are essential in self-regulated learners' achievement. The first component is metacognitive learning strategies enabling learners to plan, monitor and regulate their cognition. The second is learners' controlling and managing their efforts to perform their academic tasks. The students who can do this, for instance, tend to fulfill their tasks when they encounter difficult tasks or even if they face negative distractors (such as problematic study environments). The third component is the cognitive strategies enabling learners to learn, remember and understand a subject (Corno, 1986, as cited in Pintrich & De Groot, 1990; Corno & Mandinach, 1983, as cited in Pintrich & De Groot, 1990). The scope of this research includes self-regulated learning skills such as effort regulation, self-efficacy beliefs and cognitive and metacognitive learning strategies.

Cognitive learning strategies can be considered in two categories – namely, surface and deep cognitive learning strategies. Surface cognitive learning strategies ensure that knowledge is learnt through revision and memorization. They help to transfer the learnt knowledge into the short term memory. Deep cognitive learning strategies, on the other hand, involve elaboration, organization and critical thinking strategies. Elaboration strategies help to integrate the newly learnt knowledge into the pre-knowledge, and to assist learners to encode the knowledge in the long term memory. Learners having these strategies interpret, make summaries, make analogies and take notes in order to learn. Organization strategies involve the processes of selecting the appropriate knowledge, associating the knowledge to be learnt with the pre-knowledge and thus structuring it. Learners having these strategies form groups, make classifications, make outlines and thus learn the main ideas of what they read. Critical thinking strategies involve learners applying their prior knowledge to new situations and making critical evaluations associated with the standards of decision-making and being perfect in problem solving processes (Pintrich, Smith, Garcia, & McKeachie, 1991).

Metacognitive learning strategies help learners control, monitor, plan and regulate their cognition. Planning activities such as target setting and task analyzing help to activate prior knowledge, which will ensure better understanding of a topic. Planning activities include such processes as target setting, task analysis, strategy choice, and decision-making. Monitoring activities, however contain individuals' monitoring their own attention while reading, experimenting with themselves and asking themselves questions. Such activities ensure that learners understand the learnt materials and that they integrate the newly learnt knowledge into the pre-knowledge. Regulation activities involve learners' making corrections to cognitive activities based on the monitoring stage. These activities help learners to correct and to control their behaviors in this process, and thus they raise learners' performance (Pintrich et al., 1991; Zusho et al., 2003).

Another important component of this research is effort regulation. Effort regulation can be defined as students' continuity in performing their task when they encounter a difficult task. Effort regulation depends on task value and on commitment to the target. Self-regulated learners tend to keep their efforts and attention when they face uninteresting tasks and distractors. Effort regulation reflects learners' determination to achieve their targets, and it also affects their use of learning strategies. Therefore, effort regulation is substantially influential in academic achievement (Pintrich et al., 1991).

Pintrich (1988, 1989) points out that cognitive knowledge and metacognitive strategies are not sufficient in raising students' achievement, and that students should be motivated to regulate their efforts and their cognition and to use strategies (as cited in Pintrich & De Groot, 1990). For this reason, self-regulated skills involve motivational and behavioral components beside cognitive and metacognitive components (Zimmerman, 2000). Self-regulated learners wish to take on cognitively, motivationally and behaviorally active tasks during their learning; and they tend to set their own learning objectives and to control this process. If learners do not have sufficient motivation in terms of using their cognitive and metacognitive skills, these skills do not have important functions (Pintrich & De Groot, 1990). One of the basic factors of having adequate motivation is high level of self-efficacy beliefs because in many studies concerning self-regulation brings students' self-efficacy beliefs into prominence as the basic motivational factor in the learning process (Zimmerman, 2002). High levels of self-efficacy beliefs are important in the development of effective self-regulation skills (Zimmerman, 2000). Self-regulation is individuals' self-consideration that they can achieve in regulating the activities necessary for performing a certain task (Bandura, 1997). Self-efficacy affects all of the self-regulation processes- namely, planning, displaying performance and assessing. Students with self-regulation skills believe that they will achieve the targets that they have set. The self-efficacy beliefs of students who monitor their performance and their progress by making evaluations in their learning process and who are satisfied with their evaluation they make in this process will increase. The students with increased self-efficacy beliefs have positive views of the learning strategies they use, and they employ those strategies. The successfully completed tasks cause the formation of positive self-efficacy beliefs in performing prospective similar tasks (Schunk & Ertner, 2000). Students with high levels of self-efficacy beliefs set more challenging tasks for themselves, and have more commitment to their tasks to achieve those targets (Schunk, 2000). Besides, those students use self-regulated learning strategies more than students who have doubts about their abilities, they make more efforts and they are more insistent in completing their task when encountered difficulties (Schraw, Crippen & Hartley, 2006).

Problem of Research

A review of the literature shows that various studies examining the relations between effort regulation, self-efficacy beliefs and cognitive and metacognitive learning strategies are available. It was found in those studies that self-efficacy beliefs were associated with metacognitive learning strategies (Bouffard-Bouchard, Parent, & Larivee, 1993; Johnson, 2013; Kanfer & Ackerman, 1989; Nbina & Viko, 2010; Ocak & Yamaç, 2013; Pajares, 2002; Sungur, 2007; Sungur & Tekkaya, 2006), cognitive learning strategies (Berger & Karabenick, 2011; Pajares, 2002; Ocak & Yamaç, 2013) and effort regulation (Bong, 1997a; Chen, 2003; Johnson, 2013; Komarraju & Nadler, 2013; Pajares & Graham, 1999; Sungur, 2007; Sungur & Tekkaya, 2006). Studies available also show that there are significant correlations between self-regulation and effort regulation (Al-Harthy, Was, & Isaacson, 2010; Sungur, 2007). Cheung (2015) found correlations between 590 high school students' deep learning strategies (elaboration, metacognitive control strategies, critical thinking and organization strategies) and their self-efficacy in chemistry. Zusho et al. (2003) found that students with high self-efficacy in chemistry course used elaboration and organization strategies more. Kayan, Fadlelmula, Çakıroğlu and Sungur (2015) examined the relations between seventh graders' achievement in mathematics, their motivational beliefs and self-regulated learning strategies. Consequently, it was found that while self-efficacy had direct effects on cognitive learning strategies such as organization and elaboration, it had indirect effects on metacognitive learning strategies. Another research conducted by Alpaslan (2016), on the other hand, found that students' self-efficacy was a significant predictor of their cognitive and metacognitive learning strategies. It is clear from those studies that correlations between students' self-efficacy beliefs, their effort regulation and their deep cognitive and metacognitive learning strategies have been exhibited separately. Yet, the number of studies considering the correlations between these variables together is quite small. For this reason, this research sets out to analyze the correlations between these variables in one structural equation modelling. In addition, the indirect effects were examined in this research. The theoretical model and hypotheses constructed on the basis of theoretical and experimental studies available in the literature are shown in Figure 1.

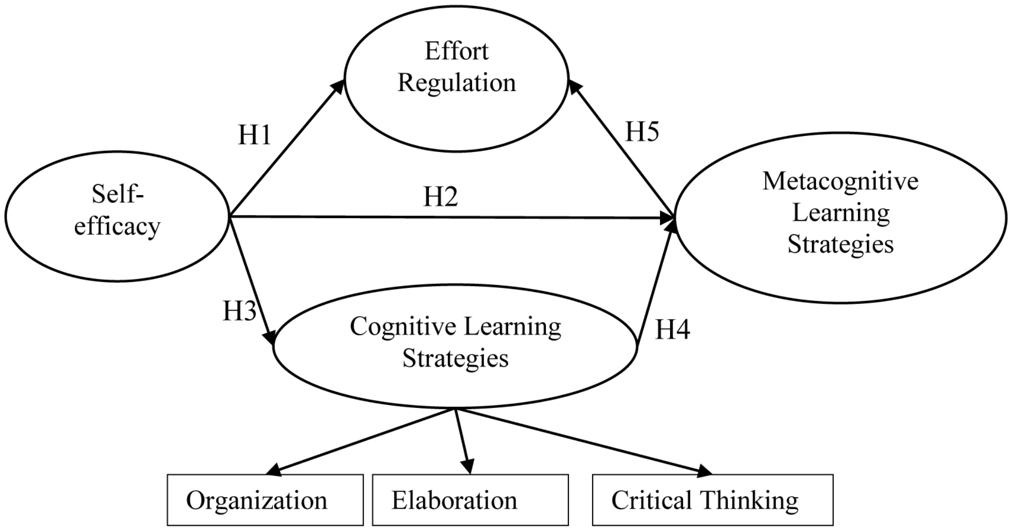

Figure 1: The theoretical model and hypotheses of the research.

H1, H2 and H3: students' self-efficacy beliefs predict their effort regulation, and their deep cognitive and metacognitive learning strategies significantly.

H4: students' deep cognitive learning strategies predict their metacognitive learning strategies significantly.

H5: students' metacognitive learning strategies predict effort regulation significantly.

H6: students 'cognitive learning strategies mediate the correlations between self-efficacy beliefs and their metacognitive learning strategies.

Methodology of Research

This research was conducted through correlational research. Correlational research is a research approach aiming to examine the relations between two or more variables without any manipulation to affect them (Fraenkel & Wallen, 2000). In addition, this research was carried out in the 2015-2016 academic year. Motivated Strategies for Learning Questionnaire was employed to determine the students' learning strategies, self-efficacy beliefs, and effort regulation. The study group was also composed of high school students.

Sample of Research

In this study, convenience sampling was used to determine the sample of this current research. A total of 227 students were included in the research and 115 of the participants were male, whereas 108 of them were female students. Also, four students did not state their gender. Age average for the participants was *16.36 (SS=1.18)*, and three students did not mention their age. The socioeconomic status of the students was similar and the majority of the students come from middle- to high-class families.

Instrument

Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich et al. (1991) and adapted into Turkish by Sungur (2004) and Büyüköztürk, Akgün, Demirel and Özkahveci (2004) was employed in this research. Since the data were collected based on the chemistry course, the questionnaire form in which validation and reliability analyses for chemistry course and for high school students was used (Şen, 2015). The statements included in the questionnaire are in the 7-pointed Likert type ranging between "not at all true of me" (1), and "very true of me" (7). The questionnaire is composed of two parts: motivation and learning strategies. The motivation part contains 31 items and six sub-scales while the learning strategies part contains 50 items and nine sub-scales. This research uses the sub-scales of self-efficacy for learning and performance (SELP) in the motivation part and organization, elaboration, critical thinking, metacognitive self-regulation (MSR), and effort regulation (ER) in the learning strategies part. Table 1 shows the sample items and the Cronbach Alpha reliability coefficients for the sub-scales used in this research.

On examining the sub-scales used in this research, it is evident that the ones apart from organization have Cronbach Alpha coefficients above .70, which are acceptable (Kline, 2011). Cronbach Alpha coefficient for the sub-scale of organization was found as .64 by Pintrich et al. (1991), as .61 by Büyüköztürk et al. (2004), as .71 by Sungur (2004), and as .68 by Şen (2015). Because Cronbach Alpha value obtained in this research for the sub-scale of organization was very close to the ones in the adaptation and the development work, it was regarded that reliability was attained in this research for this sub-scale. Furthermore, Kline (1999) also points out that Cronbach Alpha value for psychological structures might be below .70.

Table 1: Sample Items and the Cronbach Alpha Coefficients of the Sub-scales in the MSLQ.

Subscales	Sample Item	Cronbach Alfa
SELP	I expect to do well in chemistry class.	.79
Organization	I make simple charts, diagrams, or tables to help me organize course material.	.65
Elaboration	When reading for chemistry class, I try to relate the material to what I already know	.77
Critical Thinking	I try to play around with ideas of my own related to what I am learning in chemistry course.	.71
MSR	When reading for chemistry course, I make up questions to help focus my reading.	.90
Effort Regulation	I work hard to do well in chemistry class even if I don't like what we are doing.	.77
DCLS*	Organization (O), Elaboration (E) and Critical Thinking (CT)	.71

* Deep cognitive learning strategies (DCLS) were composed of the sub-scales of organization, elaboration and critical thinking included in the MSLQ.

Data Analysis

The obtained data was analyzed using confirmatory factor analysis and path analysis. Confirmatory factor analysis was performed to test the measurement models. In addition, path analysis was applied to test the theoretical and alternative structural equation models and to examine the relations between the variables of the research.

Results of Research

The Results for Confirmatory Factor Analysis

Firstly, the measurement models for all variables were tested in one structural equation model, and fit indices were examined. In consequence of the analyses, the program recommended modifications for items 11 and 12- which were in the sub-scale of metacognitive learning strategies and for items 7 and 8 -which were in the sub-scale of self-efficacy. Table 2 shows the fit indices which were obtained after step by step making the modifications which were suggested by the program and which were theoretically significant.

Table 2: Fit indices for the measurement models.

Chi-square	df	Chi-square /df	RMSEA	CFI	GFI	NFI	NNFI	SRMR
585.26	291	2.01	.067	.98	.83	.95	.97	0.056

In consequence of confirmatory factor analysis, it is clear that the fit indices apart from GFI have acceptable values. Kline (2011) states that the GFI value is influenced by the number of observations. Therefore, it was regarded in this research that the model fitted the data because the chi-square/df value was smaller than 5 (Marsh & Hocevar, 1985), CFI bigger than .90 (Bentler, 1990), RMSEA was smaller than .08 (Browne & Cudeck, 1993), and SRMR was smaller than .05 (Hu & Bentler, 1995). It is also stressed in terms of model fit in the literature that the NNFI (>.08 indicates good fit), CFI (>.90 indicates good fit) and RMSEA values (<.08 indicates acceptable fit) can be analyzed and that model-data fit can be considered to exist when the values are acceptable (Garver & Mentzer, 1999).

The Results for Path Analysis

A theoretical model has been shown based on the theory and on the studies available in the literature. Four latent variables in total were included in the model. In consequence of the path analysis performed for the theoretical structure exhibiting the relations between students' self-efficacy beliefs, effort regulation, cognitive and metacognitive learning strategies, it was found that the predicted path coefficient between self-efficacy beliefs and metacognitive learning strategies was not statistically significant (Hypothesis 2 is rejected). For this reason, an alternative model was constructed instead of the theoretical model, and it was tested. The alternative model was developed by considering the studies in the literature, by trying different structural equation models and by considering the chi-square, standard error, t values and standard coefficients. While making here the modifications recommended during confirmatory factor analysis, no modifications were made at this stage for latent variables. Table 3 shows the fit indices obtained for the alternative model.

Table 3: Fit indices for the alternative model.

Chi-square	df	Chi-square /df	RMSEA	CFI	GFI	NFI	NNFI	SRMR
592.7	293	2.02	.067	.97	.83	.95	.97	0.056

Since - of the fit indices for the alternative model (chi-square= 592.7 Chi-square/df=2.02 RMSEA=.067, CFI=.97, GFI=.83, NFI=.95, and NNFI=.97)- NNFI, CFI, RMSEA and the χ^2/df ratio had acceptable values, it was regarded that the model yielded results fitting all the data (Garver & Mentzer, 1999; Hoe, 2008; Kline, 2011; Schermelleh-Engel, Moosbrugger, & Müller, 2003). The standard coefficients for the alternative model are shown in Figure 2.

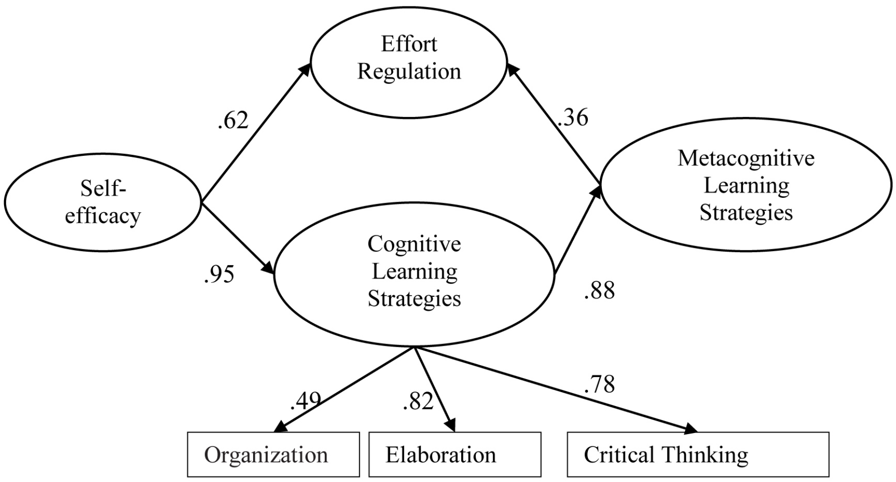

Figure 2: Standard coefficients for the alternative model.

As is clear from Figure 2, the correlations between self-efficacy beliefs and effort regulation are positive and are significant (β=.62; t=4.65), (Hypothesis 1 is accepted). It was found that students' self-efficacy beliefs predicted significantly and positively their deep cognitive learning strategies (β=.95; t=7.34), (Hypothesis 3 is accepted). The correlations between cognitive learning strategies and metacognitive learning strategies were also found to be positive and significant (β=.88; t=6.90), (Hypothesis 4 is accepted). And finally, it was found that the correlations between metacognitive learning strategies and effort regulation were positive and significant (β=.36; t=2.91), (Hypothesis 5 is accepted). According to the results of Path analysis, 88.6% of the variance in effort regulation is explained by metacognitive learning strategies and by self-efficacy beliefs. In addition to that, deep cognitive learning strategies explain 77.6% of the variance in metacognitive learning strategies. Lastly, 89.6% of the variance in cognitive learning strategies is explained by students' self-efficacy beliefs. Direct, indirect and total effect standard coefficients were calculated for each latent variable in the alternative model. Table 4 shows the values obtained from the analyses.

Table 4. Direct, indirect and total standard effects for the alternative model.

Variables	SELP			DCLS		
	Direct	Indirect	Total	Direct	Indirect	Total
MSR	-	.83	.83	.88	-	.88
Effort Regulation	.62	.30	.92	-	.31	.31
DCLS	.95	-	.95			

Table 4 shows the direct, indirect and total standard effects for the variables in the model. In consequence of the analyses, it was found that self-efficacy beliefs did not have direct effects on metacognitive learning strategies, but that they mediated and thus had indirect effects (β=.83; t=10.59), (Hypothesis 6 is accepted). In a similar vein, it was also found that self-efficacy beliefs had indirect as well as direct effects on effort regulation (β=.30; t=2.99).

Discussion

This research examined the relations between high school students' effort regulation, self-efficacy beliefs, and deep cognitive and metacognitive learning strategies. A model composed of four latent variables was constructed for this purpose. Prior to the path analysis, the measurement models in the model were assessed with confirmatory factor analysis. The measurement models for all variables in the model were tested in a single model, and the fit indices were evaluated. Due to the fact that all parameter values for the models were found significant, the models were evaluated as a whole by looking at the fit indices of the models. The modifications recommended after the analyses were reviewed in order to obtain better fit indices. First, the modifications contributing to the model most were taken into consideration. Since more than one modification were recommended and each contributed substantially to the chi-square, each modification was separately evaluated in the analyses. In consequence, it was regarded that the fit indices obtained by making modifications in items 11 and 12 included in the sub-scale of metacognitive learning strategies and in items 7 and 8 included in the sub-scale of self-efficacy beliefs were within acceptable intervals (Chi-square= 585.26, Chi-square /df=2.01, RMSEA=.067, CFI=.97, GFI=.83, NFI=.95 and NNFI=.97). After analyzing the theoretical model which was constructed on the basis of the theory following the confirmatory factor analysis with structural equation model, it was found that the path between students' self-efficacy beliefs and their metacognitive learning strategies was not significant. Therefore,

PROBLEMS
OF EDUCATION
IN THE 21st CENTURY
Volume 71, 2016

the alternative model in which self-efficacy beliefs did not have direct effects on metacognitive learning strategies was tested. Fit indices were analyzed so as to determine the model-data fit of the alternative model constructed. It was found that the error and fit indices other than the GFI were in the acceptable interval of values. Because the other indices were within acceptable intervals, it was regarded that the model-data fit was attained.

It was found in this research that students' self-efficacy beliefs did not have direct effects on their metacognitive learning strategies. Yet, it was found that there were strong indirect effects by mediating role of cognitive learning strategies (β=.83; t=10.59). This is a result different from the ones available in the literature. In several studies in the literature, it was found that there were significant correlations between self-efficacy and metacognitive learning strategies (Al-Harthy vd., 2010; Alpaslan, 2016; Bandura, 1993; Bouffard-Bouchard et al., 1993; Johnson, 2013; Kanfer & Ackerman, 1989; Nbina & Viko, 2010; Ocak & Yamaç, 2013; Pajares, 2002; Sungur, 2007; Sungur & Tekkaya, 2006). One of the causes for this is that students' motivational attitudes and strategy use may differ according to their individual differences, teachers' properties, the structure of the course, and teachers' desires (Pintrich et al., 1991). Another reason is that self-efficacy may be domain-specific. Bong (1997b) says that students' self-efficacy in a subject is better than their self-efficacy in general and that their academic performance is better. For this reason, students' self-efficacy beliefs in chemistry course might have directly predicted the metacognitive learning strategies that they employed in the Chemistry course. If students believe that they can perform their academic tasks, they wish to attain their learning goals by using cognitive and metacognitive learning strategies more. Yet, students who have doubts about their own capabilities achieve less success (Berger & Karabenick, 2011; Schunk & Ertmer, 2000). Zimmerman (2000) points out that strategy use is an activity requiring time and effort. Therefore, students having task value employ cognitive and metacognitive learning strategies to be successful. They need to have more concentration, efforts, self-reflection and high motivation to use these strategies. Sungur (2007) examines the relations between high school students' motivational beliefs, metacognitive learning strategies and effort regulation. The research found that self-efficacy had direct effects on metacognitive learning strategies but that it had indirect effects by mediating role of learning goals. Sadi and Uyar (2013), on the other hand, found that high school students' self-efficacy beliefs were directly associated with their cognitive learning strategies, metacognitive learning strategies, effort regulation, and with time and study environment management. It was shown in Kayan Fadlelmula et al. (2015) that self-efficacy did not have direct effects on metacognitive learning strategies but that it had indirect effects by mediating role of cognitive learning strategies such as organization and elaboration.

It was found in this research that self-efficacy was related with students' deep learning strategies and effort regulation. This is a result parallel to the ones reported in the literature (Berger & Karabenick, 2011; Johnson, 2013; Komarraju & Nadler, 2013; Ocak & Yamaç, 2013; Pajares, 2002; Sungur, 2007; Sungur & Tekkaya, 2006). Kayan Fadlelmula et al. (2015) found that self-efficacy was directly related with such cognitive learning strategies as organization and elaboration. The researchers also found that elaboration predicted metacognitive learning strategies directly and that organization learning strategies predicted metacognitive learning strategies by mediating role of elaboration. Pintrich and De Groot (1990), however, found that the self-efficacy of seventh graders attending English and Science classes was associated with their use of cognitive strategies. Cho and Shen (2013) exhibited that university students' metacognitive learning strategies directly influenced their effort regulation in online learning environments. They also found that self-efficacy did not have direct effects on effort regulation but that it had indirect effects by mediation of metacognitive learning strategies. Liem, Lam and Nie (2008) studied the correlations between secondary school students' achievement, task value, self-efficacy, achievement goals, deep and surface learning strategies in English classes. In consequence, they found that students' self-efficacy had positive correlations with deep learning strategies.

Another result obtained at the end of the research was that metacognitive learning strategies predicted effort regulation significantly. Literature review showed that Al-Harthy et al (2010) and Sungur (2007) had also obtained similar results. Kassab, Al-Shafei, Salem and Otoom (2015) found that university students' metacognitive learning strategies had direct effects on effort regulation and also indirect effects by mediating role of time and study environment management. Effort regulation is the capacity to ensure continuity on encountering a difficult and uninteresting learning task. Individuals should plan, monitor and assess their learning experiences in order to be able to organize the process. Therefore, learners also need to use metacognitive strategies (Pintrich & McKeachie, 2000).

Conclusions

In conclusion, it was found that self-efficacy beliefs had direct effects on effort regulation and on cognitive learning strategies while it had indirect effects on metacognitive learning strategies. Therefore, it is necessary to develop students' self-efficacy beliefs. To do this, teachers should organize the classroom environment to meet their students' needs and should manage the classroom accordingly. Teachers should ensure that students discuss and share their opinions, and they should also encourage their students to do so. With teachers' positive feedback, students' beliefs in themselves and in their capabilities can be increased. Besides, teachers setting attainable targets for their students can ensure that students' self-efficacy develops. The reason for this is that students are encouraged in terms of the next difficult but attainable targets if they attain the targets in this way. Moreover, they make great efforts and they spare more time to achieve the targets. Thus, students use more cognitive and metacognitive learning strategies during their research.

The data in this research were collected for chemistry course. Therefore, in the future studies data can be collected for other courses such as biology, physics and mathematics. The correlations between those variables could be analyzed because domain-based self-efficacy is more effective in students' academic performance. Thus, there will be differences in the data concerning different domains and in the correlations between the variables. This research analyzed the correlations between high school students' self-efficacy beliefs, effort regulation, and their cognitive and metacognitive learning strategies. Differing research groups such as university students or primary school students can be used in the studies to be performed in the future. No manipulations were made in this research, nor was an experimental research performed. Therefore, the correlations between the variables can be analyzed with data collected from participants in an experimental process in prospective studies. Besides, the variable of gender could also be added to the models to be constructed in the prospective studies.

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