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# The effects of diaries on self-regulation strategies of preservice science teachers

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**Аннотация**

This study examined the effect of diaries on self-regulation strategies of the pre-service science teachers. The participants of the study were 60 pre-service science teachers, 30 of which were in the experimental and the remaining 30 were in the control group. The Pintrich's self-regulation model was taken as a basis in the study. The Pintrich's model of self-regulation includes 3 general categories of strategies: (a) cognitive learning strategies, (b) metacognitive or self-regulatory strategies to control cognition, and (c) resource management strategies. In the study, the pre-service science teachers in the experimental group reported the self-regulation strategies they used for daily learning activities by writing the diary-report form for fourteen weeks. The data of the study were collected by the motivated strategies for learning questionnaire. At the end of the study, the intrinsic motivation, task value, metacognition, time management strategy usage status of the experimental group which reported their self-regulation strategies were significantly different from those of the control group.

**Ключевые слова:** metacognition, pre-service science teachers, Kself-regulation, diaries

# Introduction

Self-regulation is defined as individual's being active in his own learning process behaviorally, metacognitively, and motivationally, which is one of the most commonly accepted definition (Zimmerman, 1989; Zimmerman & Martinez-Pons, 1986). According to Pintrich (2000) selfregulated learning is an active, applicable process that learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior. All theorists interested in self-regulation share the idea that students regulating their own learning are actively involved in the process of learning and thus can guide their thoughts, emotions, and actions in a way to positively affect their learning and motivation (Boekaerts & Como, 2005). In the literature, different models were improved regarding self- regulation (Zimmerman, 2000; Pintrich, 1999; Borkowski, 1996; Boekaerts, 1997).

Pintrich's (1999) self-regulation definition and self-regulation model constitutes the theoretical basis of this study. In this study, the reasons for taking the self-regulation model developed by Pintrich (1999) as a basis are as follows: The models formed by Zimmerman (2000), Zimmerman, Bonner and Kovach (1996) used most of the self-regulation training studies. The studies showed that Zimmerman's self-regulation training model was effective in increasing self-regulation strategies and also academic achievement of the students (Stoeger & Ziegler, 2005; Camahalan, 2006; Schmitz &Wiese, 2006). However, it can be seen that the self-regulation model developed by Pintrich (1999) did not become a subject of studies related with selfregulation too much (Zusho & Pintrich, 2003). In this study, performing self-regulated teaching according to Pintrich's model can contribute to the development and generalization of the model. Secondly, the Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich, Smith, Garcia, and McKeachie (1993) are used in many studies related with self regulation (Neber & Schommer-Aikins, 2002; Chang, 2005). When MSLQ is examined, it can be seen that the sub dimensions are associated with the model developed by Pintrich (1999, 2000). For this reason, it may be more convenient to use MSLQ in the studies which take the self-regulation model of Pintrich as a basis.

The Pintrich's model of self-regulation includes 3 general categories of strategies: (a) cognitive learning strategies, (b) metacognitive or self-regulatory strategies to control cognition, and

(c) resource management strategies. The model includes such cognitive strategies as rehearsal and elaboration and organizational strategies connected with academic performance. Rehearsal strategies cover repeating the learned knowledge or words and underlining important parts in a text. Rehearsal strategies help students select the important knowledge and keep them in short-term memory. Elaborative strategies include paraphrasing or summarizing the learned knowledge, correlating, asking and answering questions himself. Organizational strategies include selecting and underlining important information in a text, and using techniques to select and organize ideas in a material (Weinstein & Mayer, 1986). According to Boekaerts (1999), cognitive strategies include the strategies necessary for data processing such as attention, coding, elaboration and organization.

Metacognition is defined as an individual's self thinking, self learning and his knowledge about cognitive strategies and products (Flavell, 1979). Metacognition has two main structures: knowledge of cognition which implies how much students know about their strategies and the cases in which these strategies are very important; regulation of cognition which implies how students plan and apply their strategies and how they monitor and evaluate their learning (Schraw & Moshman, 1995; Schraw & Dennison, 1994). According to Pintrich (1999), metacognitive or self-regulating strategies include 3 general types of strategies: planning, monitoring, and regulating. Planning activities help a student plan the cognitive strategies he uses and also includes activation of his previous knowledge, easier regulation and interpretation of a material. Monitoring consists of awareness and monitoring of cognition, motivation, effect, time use, effort and task and context conditions. Monitoring implies keeping the attention awake while reading a text or listening to a presentation, asking questions related with the text himself to control if he understands the subject, interpretation of what is listened and using test-taking techniques. Regulation strategies are in close relation with monitoring strategies. When students monitor their learning and performance in relation with a learning objective, this monitoring process ensures occurrence of a regulation process which will help to attain the learning objective. Pintrich (2000) emphasizes that cognitive control and regulation includes the cognitive and metacognitive activities the student carries out to change his own cognition.

Resource management strategies include managing and controlling time, effort, study environment, and other people,

including teachers and peers through the use of help-seeking strategies. Pintrich (1999) emphasizes these motivational beliefs in his model: Self-efficacy beliefs, task value, goal orientation and interest. Self-efficacy has been defined as individuals' beliefs about their performance capabilities in a particular domain (Bandura, 1986). According to Zimmerman (2000), self-efficacy beliefs help students motivate to learning through the use of self-regulatory processes such as goal setting, self-monitoring, self-evaluation, and strategy use. Task value implies the perception of students about the importance of the subject they are studying on. Goal orientation refers to a concern with learning and mastering the task using self set standards and self-improvement. Self-regulated learning students start the learning process by setting the goals (Zimmerman & Martinez-Pons, 1986). Interest refers to a student's general attitude or positive emotion towards the task (Pintrich, 1999, 2000). Consequently, Pintrich's (2000) point of view towards self-regulation implies not only cognitive but also motivational, affective, environmental and social factors.

In this study, diaries were used to develop the self-regulation strategies of pre-service science teachers. Research carried out on self-regulation, diaries are mostly used for measuring the self-regulation behaviors of students or monitoring the self-regulation development process (Schmitz & Wiese, 2006; Neber & Schommer-Aikins, 2002). For example, Zimmerman et al. (1996) suggested a daily form for self-regulation measuring purpose. Winne (2005) emphasizes that self-reports such as diaries are important for self-regulation. Schmitz and Skinner (1993) used diaries for measuring the learning behaviors of students in a lesson. Neber and Schommer-Aikins (2002) used self-reports to define both the self-regulatory strategies used by the students in science and the environmental and individual preconditions (motivational beliefs, goal orientation, epistemological beliefs and intentions). Besides, the studies carried out are associated with effects of diary usage on development of student self-regulation behaviors and increase in their academic success because the researches on this subject show that there is a relation between self-regulation and academic success (Chan & Moore, 2006; Sundre & Kitsantas, 2004; Esler & Kohavi, 2003). Schmitz and Wiese (2006) pointed out that the students can monitor and evaluate their self-regulation behaviors by means of diaries. Webber, Scheuermann, McCall, and Coleman (1993) stated that keeping a diary may enhance all self-regulated learning behaviors of students. Moreover, Webber et al. (1993) imply that diaries enable

relationships between selfregulation cycle (i.e., students are asked for their goals, their strategies and their results) and the learning goals of the students. This study differs from other related studies on this issue and their contribution to self-regulation field in that it is basically used as a tool in self-regulation training to increase learning behaviors of pre-service science teachers by using diaries.

Teachers have significant roles to promote self-regulated learning behaviors of the students. Contrary to previous ideas, it is judged that self-regulation process such as goal setting, using strategy and self-evaluation can be taught by parents, friends and teachers (Zimmerman, 2002). For this reason, it is important for teachers to have behaviors related with self-regulation training. Bringing in this capability to pre-service science teachers can be achieved by self-regulation training with pre-service teachers. Accordingly, they will learn self-regulation training by experiencing it themselves through the studies made on them and will be able to apply methods related with self-regulation training to their students in the future. Much research has been made regarding teacher candidate self-regulated learning behaviors (Hayon & Tillema, 1999; Ommundsen, Haugen & Lund, 2005; Taylor & Corrigan, 2005). However, there are not many experimental studies carried out on pre-service science teachers. Pre-service science teachers having self-regulated learning behavior may also contribute to their self-improvement in science teaching. For example, Taylor and Corrigan (2005) made a self-regulated learning program application with a small group of pre-service science teachers. The results revealed that the selfregulated learning application program advanced self-confidence on science and science learning of the pre-service teachers.

Teacher education programs are essential to develop the self-regulation strategies of the preservice science teachers. Niemi (2002) pointed that the goals in European educational scenarios and the teacher education programs have included self-regulated learning skills and cognitive strategies. In order to reach this goal, pre-service science teachers should have a good command of self-regulation strategies and teach them to all of their students. Awareness of teachers of their own learning processes may contribute to development of students' self-regulation strategies and science learning. Teachers may help their students use self-regulation strategies as a tool in learning different subjects and recognize self-regulated learning abilities (Boekaerts, 1997). Selfregulation, as a conception of teaching and learning within science teacher education, calls for providing pre-service science

teachers with suitable learning environments and introducing teaching methods, which will lead ultimately to the development of pupils' self-regulated learning skills and science learning (Taylor & Corrigan, 2005). Students and pre-service teachers having self-regulated learning behaviors will be more successful in their science education.

Having been carried out in Turkey makes this study unique as it aims to fill the gap on such an issue. Although some studies are on self-regulated learning in Turkey (Yumu§ak, Sungur & Cakiroglu, 2007; Has I am an & Askar. 2007) there are not many experimental studies especially about self-regulation and the participants of these studies were not pre-service science teachers. It is expected that the findings to be obtained from self-regulation concept, models and teaching will contribute to generalizability of the findings related to self-regulation studies in the USA and European countries. Conducting researches on different populations may contribute to generalizability of motivational and self-regulation principles. Furthermore, more research is needed to show the relation between self-regulation and the ethnic identity variable (Pintrich & Zusho, 2002).

## Aim of the Study

Firstly, this study is significant in that it is based on self-regulation model developed by Pintrich (1999); secondly, diaries are used to advance self-regulation strategies; thirdly, the participants of this experimental study are pre-service science teachers; fourthly, it will contribute to science teacher education and fifthly, it is made in such a different culture and country as Turkey. Finally, it is expected that the study will contribute to science teaching and self-regulation field. As a result, the main purpose of this study is to determine the effect of diaries on the self regulation strategies and academic achievement of pre-service science teachers. The research seeks an answer to the question, is there a significant difference between the self-regulation strategies and academic achievement of the experimental and control groups?

# Method

## Participants

The participants of this study were 60 pre-service science teachers studying in faculty of education, science-teaching department of a university in the northern city of Turkey with a population of 100.000. 30 of the participants were in the experimental and the remaining 30 were in the control group. 70% of the participant pre-service science teachers were female (n=42) while 30% of the participants were male (n=18). The age of the participants in the experimental and control group ranged from 18 to 23. The age average of the pre-service science teachers was 20.46 and the standard deviation was 1.22. The socio-cultural backgrounds of pre-service science teachers in the experimental and control groups were similar. The participants in the experimental and control groups did not have any training about self-regulation before. All pre-service science teachers voluntarily participated in the research.

## Instruments

## The Motivated Strategies for Learning Questionnaire (MSLQ)

The Motivated Strategies for Learning Questionnaire (MSLQ) was used as a pre-questionnaire and post-questionnaire for collecting data on the self-regulation strategies, which are referred by pre-service science teachers. The original version of the Motivated Strategies for Learning Questionnaire (MSLQ) with motivation and learning strategies subscales was developed and finalized by Pintrich, Smith, Garcia, and McKeachie (1993). The motivation subscale (MS) consists of 31 items which measure students' goals, value beliefs about the course, their beliefs in their efficiency to succeed in the course and concerns regarding the tests related with the course. The learning strategies subscale (LSS) includes 31 items measuring the different cognitive and metacognitive strategies of students. Additionally, learning strategies subscale includes 19 items which measure resource management strategies. The MSLQ consists of 81 items totally. The items of original version of MSLQ are scored on a 7-point Likert-type scale, from 1 (not at all true of me) to 7 (very true of me).

For measuring self-regulation strategies of the pre-service science teachers, the Turkish version of MSLQ translated to Turkish language and adapted by Büyüköztürk, Akgün, Özkahveci and Demirel (2004) was used in this study. Büyüköztürk et al. (2004) reported that the factor structure of the Turkish verison of the MSLQ is examined by exploratory and confirmatory factor analyses. The exploratory factor analysis (EFA) was performed to examine the factor structure of the scale with the data taken from the Turkish students. The confirmatory factor analysis (CFA) was performed to investigate the original scale's structure approved by Turkish experts in Turkish culture. The correlations between the total scores of component-factor were calculated. The confirmatory factor analyses (CFA) results showed that the scales of the MS consist of 7 factors and the scales of LSS consists of 9 factors. Büyüköztürk et al. (2004) found that the correlations between the English and Turkish versions are found to be .85 for MS and .86 for LSS. ANOVA results revealed that the differences between the mean scores of the students in two applications were not significant at $p = .01$. These results confirm that Turkish and English versions of the scales might be regarded equivalent. The structural model of MS consisting of 6 factors is well fit to the Turkish culture. The Cronbach alpha values calculated for the 6 factors of the scale vary between 0.86 and 0.52. The differences between items mean scores, and factor means of the upper 27% and lover 27% were examined by the t-test. For each factor and each item, the differences between mean scores of upper 27% and lover 27% groups are significant ($p < .01$).

The Cronbach alpha calculated for the LSS, examined by CFA vary between 0.41 and 0.75. All the differences between the item mean-scores and the factor scores of the upper 27% and lover 27% groups are found to be significant. The LSS that consists of 9 factors of the MSLQ are at an acceptable degree of goodness of fit for Turkish university students. The Turkish version of MSLQ is at an acceptable degree of goodness of fit for Turkish university students. Büyüköztürk et al. (2004) emphasized that the Turkish version of the MSLQ needs to be improved. Although the alpha values of some factor are low, the alpha values of the other factors of the Turkish version of the MSLQ are acceptable when the complexity of the structure of the scale is considered.

As a result, Büyüköztürk et al. (2004) stated that the Turkish version of the MSLQ can be used to examine the effects of various methods and applications on motivation and learning strategies in experimental research. The qualitative data on self-regulation

strategies of the preservice science teachers were collected by the Diary-Report Form (see Appendix A). The Diary- Report Form was designed based on the self-regulation model developed by Pintrich (1999). The
form included 10 open-ended questions on planning, monitoring and regulating the selfregulation strategies regarding cognitive, metacognitive, motivation and resource management. The qualitative data examples in the diaries were randomly selected and presented in the results section of the study.

## The Academic Achievement Test

The Academic Achievement Test was preferred to collect data on the academic achievement of the pre-service science teachers. The pre-test and post-test were the same instrument administered at the beginning and end of the study. The test developed by researcher consists of fifty-five items. The test items measure the objectives of The Instructional Planning and Evaluation Course in the science teacher education program in Turkey. This course was a compulsory course for all the pre-service science teachers enrolled in science teacher education program. This course consists of basic curriculum development concepts and processes, strategies in content selection and organization, teaching methods and strategies, basic characteristics of teaching and learning materials. After the pilot study, the test and item statistics of the test were computed. The items with discrimination score higher than 0.30 were selected for the test. The Kuder-Richardson 20 (KR-20) reliability value of the academic achievement test was 84.15.

## Procedure

In the study, an experimental model with pre-questionnaire / post-questionnaire control group was used to determine the effect of keeping a diary on self-regulation strategies of pre-service science teachers.

## Determining and Equalizing the Experimental and Control Groups

In the beginning of the study, two groups were randomly selected out of the second grade pre- service science teachers at the faculty of education, science teaching department. Pre-service science

teachers in the experimental and control groups took part in a pre-test session. The Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich et al. (1993) was applied to both groups. A significant difference between the self-regulation strategy usage levels of pre-service science teachers in the experimental and control groups was not observed (See Table 1). In addition, there was no significant difference between experimental and control groups in terms of academic achievement (See Table 2). The results in Table 1 and Table 2 indicated that the pre-service science teachers in the experimental group and control group used all the self-regulation strategies at the same level and had similar academic achievement in the beginning of the study. The pre-service science teachers in the experimental and control groups took the same courses in the teacher education program from the same lecturers who planned similar activities, used similar teaching methods, materials and homework activities for the courses. Accordingly, the effects of in-class teaching activities on research results are aimed to be taken under control.

## The Process in the Experimental Group

The 4-hours training about the purposes of the application, when and how to fill the Diary Report Forms, how to take advantage of feedback and suggestions were implemented to the pre-service science teachers in the experimental group. The diary usage for self-regulation strategies were
implemented within the framework of regular classroom instruction of the subject of courses in the science teacher education program over a period of fourteen weeks (one semester).

In the study, the purpose is to increase the self-regulation strategies by diaries within the model defined by Pintrich (1999). To this end, the pre-service science teachers in the relevant experimental group reported the self-regulation strategies they used for daily learning activities as a diary. The main reasons for the usage of diaries are as follows: Initially, diaries help the preservice science teachers observe their learning activities in time. Secondly, as pre-service science teachers fill the diaries within the natural learning environment, the self-regulated learning behaviors used by them will be determined more easily and they will be able to control these behaviors. Thirdly, as the learning activities will be performed at home, the factors affecting learning will be better analyzed. Finally, with the diary usage, pre-service science teachers can

monitor and evaluate the metacognitive, cognitive and motivational strategies related with the science learning activities.

The pre-service science teachers in the experimental group filled the Diary Report Forms after they studied for their homework linked with the courses. The researcher weekly distributed the Diary Report Forms and replaced them with new forms for the following week during the spring semester. The researcher collected and evaluated the diaries filled by pre-service science teachers every week, and gave each student feedback and suggestions about the self-regulation strategies they used. (For example, "Your study period is insufficient, you need to spare more time.''; "You should underline the important information.''; "You need to remove the preventing factors before starting to study"). The pre-service science teachers monitored and rearranged their daily studies, self-regulation strategies and performances according to the feedback and suggestions given by the researchers and by the grades they got from weekly quizzes. The preservice science teachers monitored the increase in their learning performances and determined the new cognitive, metacognitive, motivational and resource management strategies themselves. The researcher only provided guidance to them for using convenient strategies.

The roles of lecturers in the experimental group are as follows: they applied the teaching activities and methods they planned about their courses; they used the relevant materials and gave homework to the pre-service science teachers. They helped the students fill the Diary Report Forms distributed by the researcher regularly, collected them every week and forwarded them to the researcher. The lecturer helped them solve the problems they faced during reporting their self-regulation strategies to diaries. The lecturers primarily told pre-service science teachers to monitor their own self-regulation strategies. Secondly, they helped the pre-service science teachers analyze the data about themselves individually or in small groups. Finally, probably the most importantly, they encouraged the pre-service science teachers to monitor themselves so that the students could gain self-regulatory strategies.

## The Process in the Control Group

In the research, the lecturers in the experimental group also took part in the control group. The teaching activities, methods, homework, materials and quizzes in the control group were conducted parallel to the experimental group. However, no activity about diary usage of selfregulation strategies was applied to the pre-

service science teachers. The pre-service science teachers in the control group did not report their self-regulation strategies by writing the Diary Report Form after they studied for their courses and finished their homework. After fourteen weeks, experimental and control group took part in post-questionnaire and posttest sessions.

# Results

Research Question: Is there a significant difference between the self-regulation strategies and academic achievement of the experimental and control groups? The pre- questionnaire and postquestionnaire results of the experimental and control groups can be seen in Table 1.

The pre- questionnaire results in Table 1 illustrated that there was no significant difference between the experimental group and control group in terms of intrinsic motivation, extrinsic motivation, task value, control of beliefs, self-efficacy, test anxiety and effort. The postquestionnaire results in Table 1 showed that there was no significant difference between the experimental group and the control group in terms of extrinsic motivation, control of beliefs, self-efficacy, test anxiety, effort. These results suggested that the pre-service science teachers in the experimental group and control group used motivation strategies at the same level in the

Table 1. Means, standard deviations and t-test scores for the pre-questionnaire and postquestionnaire

| | | Pre-questionnaire | | | | Post-questionnaire | | | |
|---|---|---|---|---|---|---|---|---|---|
| Factors | Groups | *M* | *S.D.* | *t* | *p* | *M* | *S.D.* | *t* | *p* |
| Intrinsic Motivation | Control | 5.30 | 0.67 | 0.36 | .713 | 4.62 | 0.95 | 2.16 | .034 |
| | Experimental | 5.36 | 0.72 | | | 5.19 | 1.10 | | |
| Extrinsic Motivation | Control | 4.40 | 1.41 | 1.82 | .206 | 4.55 | 1.26 | 0.53 | .592 |
| | Experimental | 3.91 | 1.50 | | | 4.80 | 0.91 | | |
| Task Value | Control | 5.26 | 0.68 | 0.77 | .439 | 4.97 | 0.82 | 2.04 | .046 |
| | Experimental | 5.43 | 0.99 | | | 5.38 | 1.03 | | |
| Control of Beliefs | Control | 5.09 | 0.84 | 0.25 | .798 | 5.30 | 0.98 | 0.67 | .502 |
| | Experimental | 5.03 | 0.90 | | | 5.10 | 0.84 | | |
| Self-efficacy | Control | 5.20 | 0.57 | 1.63 | .107 | 5.03 | 0.81 | 1.98 | .052 |
| | Experimental | 5.50 | 0.84 | | | 5.28 | 0.88 | | |
| Test Anxiety | Control | 3.34 | 0.94 | 0.30 | .765 | 4.21 | 0.89 | 0.89 | .377 |
| | Experimental | 3.42 | 1.26 | | | 4.46 | 0.96 | | |
| Rehearsal | Control | 4.85 | 0.98 | 0.88 | .378 | 5.01 | 1.15 | 1.03 | .306 |
| | Experimental | 5.10 | 1.25 | | | 5.15 | 1.03 | | |
| Elaboration | Control | 5.50 | 0.84 | 1.34 | .184 | 5.33 | 0.64 | 1.92 | .060 |
| | Experimental | 5.77 | 0.72 | | | 5.55 | 0.81 | | |
| Organization | Control | 5.86 | 0.77 | 0.86 | .390 | 5.28 | 1.12 | 1.39 | .168 |
| | Experimental | 5.67 | 0.93 | | | 5.54 | 0.85 | | |
| Critical Thinking | Control | 5.67 | 0.93 | 0.86 | .390 | 4.77 | 0.68 | 1.30 | .198 |
| | Experimental | 5.86 | 0.77 | | | 4.98 | 1.11 | | |
| Metacognition | Control | 4.86 | 0.58 | 1.32 | .189 | 4.89 | 0.71 | 2.17 | .034 |
| | Experimental | 5.08 | 0.67 | | | 5.17 | 0.73 | | |
| Time Management | Control | 4.29 | 0.64 | 0.99 | .326 | 4.25 | 0.68 | 2.36 | .022 |
| | Experimental | 4.47 | 0.78 | | | 4.70 | 0.78 | | |
| Effort | Control | 4.05 | 0.79 | 0.03 | .970 | 4.23 | 0.71 | 1.71 | .091 |
| | Experimental | 4.05 | 0.90 | | | 4.73 | 0.76 | | |
| Peer Learning | Control | 3.85 | 1.09 | 0.23 | .812 | 3.80 | 1.29 | 0.93 | .356 |
| | Experimental | 3.77 | 1.41 | | | 4.30 | 1.24 | | |
| Help Seeking | Control | 4.43 | 0.85 | 1.06 | .293 | 4.52 | 0.92 | 1.43 | .150 |
| | Experimental | 4.66 | 0.84 | | | 4.73 | 1.09 | | |

p< .05

beginning and end of the study. However, the post-questionnaire results showed that there was significant difference between the experimental group and control group in terms of intrinsic motivation (t=2.16, p= .034/ task value (t=2.04, p .046/ These results suggested that the preservice science teachers in the experimental group used the motivation strategies such as intrinsic motivation, task value more than the pre-service science teachers in the control group did. A decrease was observed in intrinsic motivation and task value in science teacher candidate strategies in the post- questionnaire in both experimental and control groups. However, it was observed that the decrease in the control group was much more and the experimental group preservice science teachers used their intrinsic motivation and task value strategies much more. The results suggested that the diaries about motivation strategies

may positively affect the intrinsic and task value strategies of the pre-service science teachers. Examples from the diaries of the preservice science teachers on motivation related questions are given below.

The pre-service science teachers in the experimental group described learning goals before they begin science learning. The examples of pre-service science teachers' responses about their learning goals are as follows:

> Question: What are your learning goals?
> Answer 1: “To be able to solve the problems about electricity. ”
> Answer 2: “To sufficiently learn the environment related subjects. "
> Answer 3: “To get a high grade in the final exam ”

The pre-service science teachers in the experimental group reported their self-efficacy beliefs by compiling the diaries. The following are examples of pre-service science teachers' responses about self-efficacy beliefs:

> Question: Do you believe that you will be able to achieve this task?
> Answer 1: “I believe I can design an electrical circuit
> Answer 2: “I trust myself about science
> Answer 3: “I believe I can solve problems of electrical circuit. ”

The pre-service science teachers in the experimental group stated the importance of the task for their science learning. The examples of pre-service science teachers' responses about task value strategies are given below:

> Question: What is the importance of this topic to you?
> Answer 1: “The issues about electricity are important in my life
> Answer 2: “I feel myself responsible in showing effort for preventing environmental pollution. ”
> Answer 3: “I think tasks about global warming are very important for the future of universe. ”

The pre-service science teachers declared their interest to the participants during the science learning. The examples of pre-service science teachers' responses about interest to the task are as follows:

Question: What is the level of your interest in this learning?
Answer 1: “My interest in electricity is low
Answer 2: “I am interested in issues about environment. ”
Answer 3: “lam interested in the subjects on physical condition of substances. ”

The pre-service science teachers reported their test-anxiety after they take a test about the science. The examples of pre-service science teachers' responses on test-anxiety are given below:

Question: Do you get nervous a lot before and during you take a test?
Answer 1: “I worry a great deal before taking an important exam. ”
Answer 2: “I worry before the test because I do not know what to expect. ”
Answer 3: “During tests I feel very tense. ”

Both the pre and post- questionnaire results in Table 1 illustrated that there was no significant difference between the experimental group and control group in terms of cognitive strategies such as rehearsal, elaboration, organization, critical thinking. These results suggested that the pre-service science teachers in the experimental group and control group used all the cognitive strategies at the same level in the beginning and end of the study. The diaries about cognitive strategies did not affect the cognitive strategies of the pre-service science teachers. The qualitative data examples reported in the diaries on the cognitive strategies of the pre-service science teachers are as follows:

Question: What are the strategies I used in this learning?
Answer 1: “I underline the important concepts about electricity. ”
Answer 2: “I am showing the things I’ve learned about electricity, with a scheme or figure. ”
Answer 3: “lam summarizing the things I’ve learned about global warming. ”

The pre-questionnaire results in Table 1 that there was no significant difference between the experimental group and control

group in terms of metacognition, time management, peer learning, help seeking. Also, the post-questionnaire results in Table 1 revealed that there was no significant difference between the experimental group and the control group in terms of peer learning, help seeking. However, the post-questionnaire results showed that there was significant difference between the experimental group and control group in terms of metacognition (t=2.Yl, p=.034) and time management (i 2.36, p .022) strategies. The increase in the metacognition strategies of the experimental group was significantly more than that of the control group. Use of time management strategy decreased in the control group in post- questionnaire while it significantly increased in the experimental group. Accordingly, diary usage affected metacognition and time management strategies of pre-service science teachers positively. The qualitative data examples on the metacognition and resource management strategies of the preservice science teachers were given below:

The pre-service teachers reported their time management strategies by diaries. The examples of responses of pre-service science teachers about time management strategies were given below:

> Question: How much time did you devote to studying today?
> Answer 1: “Today, I studied about electricity for one hour”:
> Answer 2: “I studied for 3 hours to prepare an electricity circuit. ”
> Answer 3: “I studied for 2 hours to prepare an electricity circuit. ”

The pre-service teachers mentioned about where they studied in their diaries. The examples of pre-service science teachers' responses about their study environment are as following:

> Question: Where did you study? What were the distractors that prevented your study?
> Answer 1: “I studied in my study room. The noise coming from outside abstracted me. ”
> Answer 2: “I studied in the library. There were no factors that prevented my study. ”
> Answer 3: "I studied in the school. There were no distractors factors. ”

The pre-service teachers reported their peer learning strategies by diaries. The examples of preservice science teachers' responses about peer learning strategies are as follows:

Question: Who did you study with?
Answer 1: “I studied alone. ”
Answer 2: “I studied with my friends. ”
Answer 3: “I studied with my parents. ”

The pre-service teachers reported their help seeking strategies by diaries. The examples of responses of pre-service science teachers about help seeking strategies are as follows:

Question: Who helped you about your studies when you needed?
Answer 1: “I got help from my friends when I needed. ”
Answer 2: “I got help from my teacher when I needed. ”
Answer 3: “I got help from my parents. ”

The pre-test results in Table 2 illustrated that there was no significant difference between the experimental and the control group in terms of academic achievement (i 0.20, p= .840/ However, the post-test results showed that there was a significant difference in terms of academic achievement between the experimental and control group /=7.20, p .000/ It means that the experimental group had higher academic achievement levels than the control group did. This result indicated that reporting self-regulation strategies by diaries may have affected academic achievement in the Instructional Planning and Evaluation Course positively.

Table 2. Means, standard deviations and t-test scores for the pre-test and post-test

| | | Pre-test | | | | Post-test | | | |
|---|---|---|---|---|---|---|---|---|---|
| Factor | Groups | *M* | *S.D.* | *t* | *p* | *M* | *S.D.* | *t* | *p* |
| Academic | Control | 17.60 | 3.74 | 0.20 | .840 | 28.56 | 4.92 | 7.20 | .000 |
| Achievement | Experimental | 17.41 | 3.58 | | | 37.14 | 1.40 | | |

p< .05

# Discussion

This study aimed to determine the effect of pre-service science teachers' keeping diaries of their study activities on their usage level of self-regulation strategies. At the end of the study, no significant difference was found between the experimental and control groups

regarding usage of extrinsic motivation, control of beliefs, self-efficacy, test anxiety, rehearsal, elaboration, organization, critical thinking, peer learning, help seeking strategies. On the other hand, a significant difference in favor of the experimental group was observed, which reported their selfregulation strategies by keeping a diary, regarding the usage of intrinsic motivation, task value, metacognition, time management strategies.

One of the most interesting results of this study is that the motivation strategies such as intrinsic motivation and task value usage levels of pre-service science teachers in both the experimental and control groups decreased in post-test. However, it is understood that motivation strategy usage levels of pre-service science teachers in the experimental group keeping diaries about intrinsic motivation and task value, decrease less and are affected less by time. Furthermore, the results of this study revealed that pre-service science teachers in the experimental group used their intrinsic motivation and task value strategies more. The pre-service science teachers in the experimental group described their learning goals by writing diaries before they begin science learning. During the study, pre-service science teachers in the experimental group declared their motivation level and the importance of the task for their learning goals by keeping diaries. For example, pre-service science teachers in the experimental group noted that the materials were useful, and they could apply what they have learned in this class in other classes by diaries.

Keeping diaries about the learning goals, task value and interest to the task may have affected the intrinsic motivation and task value strategies of the pre-service science teachers in the experimental group. The reason of this decrease may be the fatigue of the pre-service science teachers towards the end of the period. Zusho and Pintrich (2003) investigated how students' level of motivation strategies changed over time. The results showed an overall decline in students' motivational levels over time. This general trend of decreasing motivation has been well documented in the literature (Pintrich & Schunk, 2002). It can be said that fourteen weeks diary-keeping period is not enough to enhance the motivation strategies. Besides, it is known that there are many factors affecting the task value and intrinsic motivation levels of pre-service science teachers. Eggen and Kauchak (1994) stated that the learning motivations of students are related with many variables including their past experiences in school, teacher and content. Besides, Eccles (1983) pointed out 3 structures of task value which is important in academic

achievement: individuals' perception of the importance of task; their interest in task; and their perception of the importance of the related task in their future objectives. Husman, Derryberry and Crowsen (2004) implied that utility value seems to be the only aspects of task value. As a result of these literature reviews, intrinsic motivation and task value depends on many factors such as interest in task, perception and utility of the task, past academic achievement of the students. This can be the reason why diary keeping causes no significant change between the experimental and control groups in terms of other motivation strategies such as self-efficacy, extrinsic motivation and control of beliefs.

The results of the study showed that the pre-service science teachers' levels of metacognitive and time management strategy use increased significantly. These pre-service teachers selfobserved and reported their metacognitive and time management strategies they referred during their own study activities, According to the qualitative data examples in the diaries, pre-service science teachers in the experimental group self-monitored and evaluated their learning strategies and tried to find effective learning strategies. In light of this result, it can be concluded that keeping a diary may have affected metacognitive strategies of pre-service science teachers positively. Parallel to this finding of the research, Schmitz and Wiese (2006) stated that the use of metacognitive strategies by the experimental group students keeping a diary increased significantly after the study. Likewise, Taylor and Corrigan (2005) explored the implementation of a program of self-regulated learning with a small group of pre-service teachers in an elementary science course. The results revealed that diaries about self-regulation raised the metacognition awareness of pre-service teachers. All in all, metacognitive strategies may positively affect the science learning of the pre-service science teachers. Zimmerman (1994) pointed that the learning outcomes of students who are taught metacognitive strategies may increase. Additionally, Zimmerman (1994) emphasizes that learning organizational techniques is important in making students become independent and self-regulated learners.

The reason of the metacognition strategy improvement of pre-service science teachers may be their reporting the strategies they used during learning by keeping a diary, following the academic progress, and their self-evaluation. Sperling, Howard, Staley and DuBois (2004) found that measurement of metacognition with self-report has a meaningful relation with metacognition, academic monitoring and strategy use. As a results of the literature review,

this finding reveals that high level of metacognitive awareness has a meaningful relation with more frequent diary reporting. Besides, in the study, the researcher collected the diaries every week and provided feedback and suggestions (e.g. "You should plan your study'', You should change your study strategies, You had better get/ ask help from your teachers and parents) on metacognitive strategies to pre-service science teachers. This can also be the reason why the metacognitive strategies increased significantly in the experimental group. Nicol and Macfarhane-Dick (2006) state that the feedback given by the teacher helps students regulate their self-regulation strategies. In this study, it is observed that keeping a diary affects the metacognitive strategies of the pre-service science teachers positively. However, self-regulation includes more than the metacognitive knowledge and ability. Self-regulation also includes effects from behavioral, social-environmental resources and personal effects such as emotional processes (Zimmerman, 1995).

The results of the research show that keeping a diary has positive effects on time management strategies of pre-service science teachers such as time planning and using the time efficiently. This is one of the expected results of the research because the pre-service science teachers also reported their study times in their diaries they kept about their learning activities. Reporting the study time may have caused them to make time planning and may have increased their time management strategies. This positive development in time management strategies may also increase the academic achievements of the students. For example, George, Dixon, Stansal, Gelb, and Pheri (2008) found that time management strategies are the greatest predictor of the academic achievement of the students. They also pointed that the power of time management skills as a predictor of personal success suggests its importance in the wider domain of life success. Plant, Ericsson and Asberg (2005) stated that the quality of the study is more important than the study period in terms of increasing academic performance. For this reason, the pre-service science teachers should recognize that using time efficiently is more important than time spent for planning their academic performance in science learning and they should focus on activities related with time efficiency.

The findings of this study revealed that diary usage affected the metacognitive strategies of the pre-service science teachers positively while it had no significant effect on cognitive strategies such as rehearsal, elaboration and organization. During the study pre-service science teachers in the experimental group reported

their cognitive strategies they selected and used for science learning by the diaries themselves, researcher and teachers did not give any specific training about cognitive strategies. This can also be the reason why there is no significant difference between the control and experimental groups in terms of usage level of cognitive strategies. Additional cognitive strategy training activities such as reasoning, summarizing, organizing and critical thinking should be organized and examples should be introduced to achieve an improvement in cognitive strategies by keeping diaries. Besides, the researcher and lecturer provided guidance for pre-service science teachers' process of monitoring the usage of their strategies, they gave feedback to them about the results of their studies but they left the students free about the selection of their cognitive strategies. The pre-service science teachers identified and used their own appropriate cognitive strategies such as rehearsal, elaboration and organization. It seems that the feedback given by the researcher or lecturer are effective on metacognitive strategies such as planning and monitoring their own learning process but they are not effective in the improvement of their cognitive strategies.

The results in the study indicated that pre-service teachers in the experimental group had higher academic achievement level than that of the control group in the Instructional Planning and Evaluation Course in the science teacher education program. The pre-service science teachers in the experimental group reported their learning goals, interest to the task, and importance of the task by writing diaries. The diaries on motivation strategies such as intrinsic motivation, task value could positively affect academic achievement of the pre-service science teachers in the experimental group. The results are consistent with the literature on the relationship between motivation strategies such as intrinsic motivation, task value and goal orientation and academic achievement (Bong, 2004; Gutman, 2006; Esler & Kohavi, 2003). For example, Zusho and Pintrich (2003) found that the motivational component of task value was one of the best predictors of final course performance even after controlling prior achievement.

The diaries about metacognition and time management strategies may have positively affected the academic achievement of the pre-service science teachers. These results are supported by the literature on the relationship between metacognition, time management strategies and academic achievement ( Zimmerman, 1994; Sperling et al., 2004; Mousoulides & Philippen, 2005; Chan & Moore, 2006). These results contribute to current theories of

selfregulation and motivation, because self-regulation was shown to be a strong predictor of academic achievement (Stoeger & Ziegler, 2005; Camahalan, 2006; Schmitz & Wiese, 2006). For instance, Chan and Moore (2006) found that greater strategic knowledge and use are likely to lead subsequent higher achievements. Similarly, Sundre and Kitsantas (2004) supported the results of the study; they found that self-regulation strategy use significantly increased the test performance of the students. The increased academic achievement of the pre-service science teachers in the Instructional Planning and Evaluation Course in the science teacher education program implies that pre-service science teachers will transfer their self-regulation strategies to learn and teach science. Moreover, they can support their students to learn science.

# Limitations and Implications of the Study

In this study, the pre-service science teachers were asked to report their self-regulation strategies daily and the researcher only provided guidance to them for using convenient strategies. However, no additional training program was applied to them regarding self-regulation strategies. Pre-service science teachers in the experimental group used only the self-regulation strategies they know. This phenomenon is one of the most important restraints of the research. In order to achieve improvement in self-regulation strategies by using diaries, the pre-service science teachers should not be only asked to report their learning activities daily but also some additional training program should be applied to them regarding self-regulation strategies. This way, the diaries will be more efficiently used in improving the self-regulation strategies of the pre-service science teachers. Another restraint of this study is that the researcher did not monitor the academic achievement of the pre-service science teachers. In the study the pre-service science teachers monitored and evaluated the effect of diary keeping on their academic achievement in the lessons themselves. In this case, the students might have associated their academic achievement and failure with factors other than diaries. Researchers should monitor and evaluate the academic achievement of the students and give feedback about the results of self-regulation strategies reported by diaries.

This study was carried out with pre-service science teachers. The self-regulation strategies of the science teachers on duty should be investigated and in-service training programs for the science

teachers should be arranged for improving their self-regulation strategies. Science teachers should be a model in teaching of self-regulation strategies. Teacher educators in the faculties should also be a model to the pre-service science teachers by using the self-regulation strategies. Science teachers and pre-service teachers should be trained on how to teach the selfregulation strategies to their students. Science teachers should engage students in complex, open ended activities, offer them choices and opportunities to control challenge and involve them in evaluating their own and other's work. The improvement of self-regulation strategies will also contribute to science knowledge of the students. Neber and Schommer-Aikins (2002) emphasized that science learning environment correlates significantly and positively with self-regulatory activities, the intrinsic value of science, and task goal orientation of the elementary school pupils. For this reason, the effects of self-regulation strategies increase of primary and secondary school students on science education should be investigated by the researchers.

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