Pre-service science teachers’ use of self-regulation strategies

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Abstract

The aim of this study was twofold: first, to examine the relationship between use of self-regulation strategies and academic performance; and second, to analyze gender differences in use of self-regulation strategies. For the specified purposes, 1794 senior pre-service science teachers (876 males, 905 females, and 13 no response) participated in the study. Results showed that GPA was significantly but not strongly associated with task value, metacognitive self-regulation, effort regulation, peer learning, mastery approach, performance approach, and mastery avoidance. It was also found that pre-service science teachers’ scores of task value, metacognitive self-regulation, effort regulation, mastery approach, and mastery avoidance differ in terms of their gender.

Keywords: pre-service science teachers; self-regulation; GPA; gender

1. Introduction

Self-regulation has received considerable attention in educational research (e.g. Neber & Schommer-Aikins, 2002; VanderStoep, Pintrich, & Fagerlin, 1996; Sungur, 2007; Meece, Blumenfeld, & Hoyle, 1988; Wolters & Pintrich, 1998). Broadly defined, self-regulation refers to the process whereby students activate and sustain cognitions, behaviors, and affects, which are oriented toward the attainment of their goals, and involves cognitive processing, motivational beliefs, and metacognitive thinking (Pintrich & Linnenbrink, 2000; Schunk & Zimmerman, 1997; Zimmerman, 1989). Therefore, academic self-regulation is more than metacognition, it involves motivational and behavioral components as well as cognitive and metacognitive components (Zimmerman, 2000). In other words,

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recent models of self-regulation based on the social-cognitive theory suggest that use of cognitive and metacognitive strategies are of little value if individuals cannot motivate themselves to use them. Relevant studies have shown that self-regulation is a very important predictor of future behaviors including academic performance (Corno, 1986, 1989; Pintrich and De Groot, 1990; Yumusak, Sungur, & Cakiroglu, 2007; Zimmerman, 1990). For example, the study of Zimmerman and Martinez-Pons (1986) displayed that students who used self-regulation strategies effectively were high achievers. Additionally, many studies have indicated that self-regulation is related to gender (e.g. Bidjerano 2005; Hargittai & Shafer, 2006; Lee, 2002; Zimmerman & Martinez-Pons, 1990) and generally females use self-regulation strategies more than males.

Although there is significant research on student self-regulation at different grade levels, there has been little research focusing on pre-service or in-service teachers’ use of self-regulatory strategies in their own learning. The studies of pre-service or in-service teachers have demonstrated that they often do not use self-regulatory strategies as effectively as students and it was suggested that if teachers become self-regulated in their own learning, their experience in self-regulatory processes can help them to develop strategies for teaching self-regulation to their students (Gordon, Dembo & Hocevar, 2007). In addition, it was proposed that pre-service teachers who value self-regulatory skills and teach them to their students are likely to create learning environments supporting student autonomy. In fact, according to Dembo (2001), learning how to teach is not sufficient; rather teachers should learn how to learn to improve their classroom practices.

The aim of the present study was twofold. First, it examined the relationship between academic performance and use of self-regulation strategies using correlational analysis. Second, this study investigated whether there is a gender difference in pre-service science teachers’ use of self-regulation strategies using multivariate analyses of variance.

2. Method

2.1. Participants

Participants of the study were 1794 senior pre-service elementary science teachers (876 males, 905 females, and 13 no response) from 27 universities in Turkey. All of the universities involved in the study were public universities that follow the same teacher education program, which had been restructured for all disciplines by the Higher Education Council (YOK). This restructured program contains courses in different branches of science, namely biology, physics, and chemistry and several courses related to special subject training and pedagogy. The pedagogical domain includes method courses and field experience courses in which pre-service teachers observe teaching environments and teach in actual classes.

2.2. Instruments

The Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, Smith, Garcia, & McKeachie, 1991) was used to assess pre-service science teachers’ self-regulation in terms of their motivation and learning strategy use. The MSLQ is comprised of 81 items grouped into two sections: motivation section and learning strategies section. Motivation section consists of six subscales namely Intrinsic Goal Orientation, Extrinsic Goal Orientation, Task Value, Control of Learning Beliefs, Self-Efficacy for Learning and Performance, and Test Anxiety. Learning Strategies section, on the other hand, includes nine subscales which are Rehearsal, Elaboration, Organization, Critical Thinking, Metacognitive Self-Regulation, Time and Study Environment Management, Effort Regulation, Peer Learning, and Help Seeking. The MSLQ was translated and adapted into Turkish by Sungur (2004).

In this study, Task Value, Control of Learning Beliefs, and Test Anxiety sub-scales of the MSLQ were used motivational aspects of self-regulated learning while Effort Regulation, Peer Learning, and Metacognitive Self-Regulation subscales used to assess cognitive and behavioral aspects of the self-regulated learning. The remaining sub-scales were not used for the following reasons: Firstly, sub-scales assessing achievement goals in the motivation section of the MSLQ do not make a distinction between approach and avoidance goals. Since recent research suggests making such a distinction, an additional instrument was used to assess pre-service science teachers’ achievement goals as one of the motivational aspects of self-regulated learning. Secondly, some of the sub-scale
scores (e.g. help seeking) intended to be used were removed from analysis due to low reliability coefficients. Finally, since metacognitive self-regulation sub-scale measures individuals’ use of various strategies involving planning, monitoring, and evaluation which result in deep processing of information, for the sake of simplicity of interpretations, only this sub-scale was used to assess cognitive component of self-regulation. The reliability coefficients of this study were found .84, .60, .63, .77, .57, and .56 for task value, control of learning beliefs, test anxiety, metacognitive self-regulation, effort regulation, and peer learning respectively.

The Achievement Goal Questionnaire (Elliot & McGregor, 2001) was used to assess pre-service science teachers’ achievement goals. It consists of 15 items in four sub-scales namely mastery approach goals, performance approach, mastery avoidance goals, and performance avoidance goals. While mastery approach goals emphasize learning and understanding, performance approach goals focus on showing abilities to others. Mastery avoidance goals, on the other hand, are characterized by intention to avoid misunderstanding and making mistakes and performance avoidance goals are characterized by striving to avoid failure relative to others. The instrument was translated and adapted into Turkish by Senler and Sungur (2007). The reliability coefficients of this study were found .74, .77, .73, and .70 for mastery approach, performance approach, mastery avoidance, and performance avoidance respectively.

Academic Performance. Pre-service science teachers’ average GPA out of 4 was an indicator of their academic performance.

3. Results

3.1. Descriptive statistics

Descriptive statistics for the pre-service science teachers’ scores on the scales are displayed in Table 1. As shown in the table, the highest mean score was obtained for metacognitive self-regulation ($M = 45.24, SD = 7.92$) while the lowest mean score was obtained for peer learning ($M = 8.84, SD = 2.80$) on the Motivated Strategies for Learning Questionnaire. Additionally, the highest mean score was gained for mastery approach ($M = 12.30, SD = 2.27$) while the lowest mean score was performance avoidance ($M = 7.66, SD = 2.95$) on the Achievement Goal Questionnaire.

| Variables                      | Female     | Male       | Total      |
|--------------------------------|------------|------------|------------|
|                                | $M$        | $SD$       | $M$        | $SD$       | $M$        | $SD$       |
| Task value                     | 33.92      | 6.09       | 31.78      | 7.01       | 32.83      | 6.66       |
| Control of learning beliefs    | 21.39      | 3.83       | 21.00      | 4.18       | 21.19      | 4.01       |
| Test anxiety                   | 21.43      | 5.81       | 21.14      | 5.87       | 21.28      | 5.84       |
| Metacognitive self-regulation  | 46.67      | 7.63       | 43.83      | 7.95       | 45.24      | 7.92       |
| Effort regulation              | 20.20      | 4.32       | 18.78      | 4.36       | 19.48      | 4.40       |
| Peer learning                  | 8.93       | 2.77       | 8.74       | 2.82       | 8.84       | 2.80       |
| Mastery approach               | 12.72      | 2.05       | 11.89      | 2.40       | 12.30      | 2.27       |
| Performance approach           | 9.55       | 3.03       | 9.61       | 3.00       | 9.58       | 3.00       |
| Mastery avoidance              | 8.65       | 2.79       | 8.39       | 2.79       | 8.52       | 2.80       |
| Performance avoidance          | 7.31       | 2.89       | 7.98       | 2.97       | 7.66       | 2.95       |

3.2. Correlational analysis

In order to examine the bivariate relationships among pre-service science teachers’ academic self-regulation and academic performance correlation analyses were conducted. As seen at Table 2, regarding the motivational variables, GPA was significantly related only to task value ($r = .16$) with small correlation. On the other hand, GPA was significantly associated with learning strategy variables in the study namely metacognitive self-regulation ($r = .21$), effort regulation ($r = .23$), and peer learning ($r = .15$) suggesting that metacognitive self-regulation showed
medium correlation whereas effort regulation and peer learning showed small correlation. Concerning achievement goals, GPA was significantly related mastery approach \((r = .19)\), performance approach \((r = .16)\), and mastery avoidance \((r = .08)\) indicating small correlation.

### Table 2. Pearson correlations (N = 1794)

|        | 1  | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  |
|--------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1. GPA | -- |     |     |     |     |     |     |     |     |     |     |
| 2. Task value | .16** | -- |     |     |     |     |     |     |     |     |     |
| 3. Control of learning beliefs | .01 | .52** | -- |     |     |     |     |     |     |     |     |
| 4. Test anxiety | .04 | .07** | .14** | -- |     |     |     |     |     |     |     |
| 5. Metacognitive self-regulation | .21** | .60** | .39** | .04 | -- |     |     |     |     |     |     |
| 6. Effort regulation | .23** | .47** | .28** | -.11** | .58** | -- |     |     |     |     |     |
| 7. Peer learning | .15** | .35** | .20** | .19** | .36** | .19** | -- |     |     |     |     |
| 8. Mastery approach | .19** | .49** | .20** | -.05* | .40** | .21** | .36** | -- |     |     |     |
| 9. Performance approach | .16** | .10** | .10** | .26** | .10** | .14** | .10** | .21** | -- |     |     |
| 10. Mastery avoidance | .08** | .16** | .08** | .28** | .06* | .16** | .02 | .26** | .30** | -- |     |
| 11. Performance avoidance | .01 | -.11** | -.01 | .30** | -.13** | .04 | -.15** | -.04 | .52** | .33** | -- |

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

### 3.3. Multivariate analyses

To address the second aim of the study, one-way multivariate analyses of variance (MANOVA) were conducted with all of the dependent variables in the study. The independent variable was gender (males=1, females=2). The dependent variables were task value, control of learning beliefs, test anxiety, metacognitive self-regulation, effort regulation, and peer learning. Preliminary assumption testing was conducted to check for normality and outliers with no serious violation was noted. The homogeneity of variance assumption was checked by using the Levene's test. Levene's test was significant for some variables namely, task value, control of learning beliefs, and mastery approach; thus the results of these variables were interpreted with caution. Since the F values were not large for these variables, MANOVA was carried out. The homogeneity of the covariance matrices assumption was checked by using the Box's M value. The Box's M value indicated this assumption was violated \((Box M = 119.40, F = 2.16, p<.05)\). Because the assumption of homogeneity of the covariance matrices was not met, Pillai’s trace was employed to determine the multivariate significance of the main effect (Tabachnick & Fidell, 2001).

The results of the MANOVA indicated a significant effect for gender, \([Pillai’s Trace = .06, F (10, 1519) = 10.20, p<.05, η²=.06]\). These results indicated that pre-service science teachers’ use of self-regulation strategies were different in terms of their gender. The results for the set of dependent variables were considered separately by using a Bonferroni adjusted α level of .005 to control for Type I error across. As Table 3 displays, there is a significant difference for task value \([F (1,1528) = 42.77, p<.005, η²=.03]\), for metacognitive self-regulation \([F (1,1528) = 50.05, p<.005, η²=.03]\), for effort regulation \([F (1,1528) = 43.05, p<.005, η²=.03]\), for mastery approach \([F (1,1528) = 50.41, p<.005, η²=.03]\), and for performance avoidance \([F (1,1528) = 14.15, p<.005, η²=.01]\).

### Table 3. Tests of between-subjects Effects

| Source     | DV                        | SS     | df  | F       | η²  |
|------------|---------------------------|--------|-----|---------|-----|
| Gender     | Task value                | 1792.82| 1   | 42.77   | .03 |
An inspection of the mean scores indicated that females reported higher levels of task value \( (M = 33.92, SD = 6.09) \) than males \( (M = 31.78, SD = 7.01) \). Females had higher metacognitive self-regulation scores \( (M = 46.67, SD = 7.63) \) than males \( (M = 43.83, SD = 7.95) \). Similarly females had higher effort regulation scores \( (M = 20.20, SD = 4.32) \) than males \( (M = 18.78, SD = 4.36) \). However, effort regulation of both genders was quite low indicating that pre-service science teachers tend to give up easily in the face of distracters and difficulties. Concerning achievement goals female had higher mastery approach scores \( (M = 12.72, SD = 2.05) \) than males \( (M = 11.89, SD = 2.40) \) whereas males had higher performance avoidance score \( (M = 7.98, SD = 2.97) \) than females \( (M = 7.31, SD = 2.89) \).

4. Discussion and conclusion

The results of the first aim of the study suggested that pre-service science teachers’ GPA was significantly but not strongly associated with task value, metacognitive self-regulation, effort regulation, peer learning, mastery approach, performance approach, and mastery avoidance. Pre-service science teachers’ perception of task’s interest, importance or utility, and costs was related to their academic performance suggesting that pre-service science teachers who considered learning task of value to their professional careers had higher GPA.

Regarding metacognitive self-regulation, pre-service science teachers who used deep processing strategies including planning, monitoring and regulating that assist students in control and regulation of cognition had higher academic performance. In addition, pre-service science teachers who persist longer in the face of a difficult or challenging task and also preferred working with other participants had higher GPA. What is more, pre-service science teachers whose aim is to mastering task, besting others, and avoiding not learning had higher GPA.

The results of the MANOVA indicated that pre-service science teachers’ scores of task value, metacognitive self-regulation, effort regulation, mastery approach, and mastery avoidance differ in terms of their gender. Female pre-service science teachers gave greater value to task, used metacognitive skills like planning, monitoring, and evaluating in their own learning, and managed their effort more. These particular results are in congruence with the findings in the literature which demonstrated that females used greater self-regulation strategies comparing to males especially for verbal learning tasks (Ablard and Libschuts, 1998; Zimmerman and Martinez-Pons, 1990). On the other hand, female pre-service science teachers focused on improvement and deep understanding where male pre-service science teachers avoided being erroneous and doing incorrectly relative to task.

It is suggested that teacher education programs are structured so that pre-service science teachers as learners become aware of their own learning and use effective metacognitive strategies. In order to achieve this end, pre-service science teachers should experience learning environments where they deal with open-ended and challenging tasks (Paris and Paris, 2001). Instructors can integrate teaching tools such as prompts, regulatory check-list to their instruction or/and use problem based learning as a method to enhance metacognitive strategy use. Additionally, instructors can be trained in using and demonstrating self-regulatory strategies to serve as social models for the pre-service science teachers (Dembo, 2001).

There are some limitations of the current study that should be considered while interpreting the result. The first limitation is related to the measurement of the constructs. This study relies solely on the self-report data. This can lead to common method bias about verifying consistency and accuracy of the findings. In order to get an in-depth understanding of the relationships and provide better explanations, qualitative approach may be employed in future.
studies. Such an approach can help determine to what extent the unexpected findings can be explained by culture. In line with this idea, the study can be replicated in different cultures. The second limitation concerns the generalizability of findings. The subject of this study was limited to the senior pre-service science teachers from selected universities in Turkey. Therefore, results may not be generalized to other countries and cultural contexts. Finally, cognitive strategies such as rehearsal, elaboration, and organization were not included to this study. In order to gain comprehensive picture, these variables can be integrated in the future studies.

References

Ablard, K.E. & Lipschultz, R.E., (1998). Self-regulated learning in high achieving students: Relations to advanced reasoning, achievement goals, and gender. *Journal of Educational Psychology, 90*(1), 94-101.

Bidjerano, T. (2005). *Gender differences in self-regulated learning*. Paper presented at the Annual Meeting of the Northeastern Educational Research Association, October 19-21, Kerhonkson, NY, USA.

Corno, L. (1986). The metacognitive control components of self-regulated learning. *Contemporary Educational Psychology, 11*, 333-346.

Corno, L. (1989). Self-regulated learning: A volitional analysis. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-Regulated Learning and Academic Achievement* (pp.111-142). New York, USA: Springer-Verlag.

Dembo, M. H. (2001). Learning to teach is not enough—Future teachers also need to learn how to learn. *Teacher Education Quarterly, 28*, 23-35.

Elliott, A. J., & McGregor, H. A. (2001). A 2X2 achievement goal framework. *Journal of Personality and Social Psychology, 80*, 501–519.

Gordon, S. C., Dembo, M. H., & Hocevar, D. (2007). Do teacher's own learning behaviors influence their classroom goal orientation and control ideology? *Teaching and Teacher Education, 23*, 36-46.

Hargittai, E. & Shafer, S. (2006). Differences in actual and perceived online skills: The role of gender. *Social Science Quarterly, 82* (2), 432-448.

Lee, I.-S. (2002). Gender differences in self-regulated on-line learning strategies within Korea’s University context. *Educational Technology Research and Development, 50*(1), 101-109.

Meece, J., Blumenfeld, P.C., & Hoyle, R. (1988). Students' goal orientations and cognitive engagement in classroom activities. *Journal of Educational Psychology, 80*, 514-523.

Neber, H., & Schommer-Aikins, M. (2002). Self-regulated science learning with highly gifted students: The role of cognitive, motivational, epistemological, and environmental variables. *High Ability Studies, 13*, 59 – 74.

Paris, S. C., & Paris, A. H. (2001). Classroom applications of research on self-regulated learning. *Educational Psychologist, 36*, 89 – 101.

Pintrich, P. R., & De Groot, E. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33-40.

Pintrich P. R., & Linnenbrink, E. (2000). *The role of motivation in intentional learning*. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA.

Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1991). *A Manual for the Use of the Motivated Strategies for Learning Questionnaire (MSLQ)*. Ann Arbor, MI: National Centre for Research to Improve Postsecondary Teaching and Learning, The University of Michigan.

Schunk, D. H. & Zimmerman, B. J. (1997). Social origins of self-regulatory competence. *Educational Psychologist, 32*(4), 195-208.

Senler, B. & Sungur (2007). *Translation and adaptation of goal orientation scale into Turkish*. A paper presented at the meeting of the 1st National Elementary Education Conference, Ankara, Turkey, November.

Sungur, S. (2004). *The implementation of problem-based learning in secondary school biology courses*. Unpublished dissertation, Middle East Technical University, Ankara, Turkey.

Sungur, S. (2007). Modeling the relationships among students’ motivational beliefs, metacognitive strategy use, and effort regulation. *Scandinavian Journal of Educational Research, 51*, 315-326.

Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (4th ed.). Boston, MA: Allyn and Bacon.

VanderStoep, S.W., Pintrich, P.R., & Fagerlin, A. (1996). Disciplinary differences in self-regulated learning in college students. *Contemporary Educational Psychology, 21*, 345-362.

Wolters, C. A., & Pintrich, P. R. (1998). Contextual differences in student motivation and self-regulated learning in mathematics, English, and social studies classrooms. *Instructional Science, 26*, 27-47.

Yumusak, N., Sungur, S. & Cakiroglu, J. (2007). Turkish high school students’ biology achievement in relation to academic self-regulation. *Educational Research and Evaluation, 13*(1), 53 – 69.

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology, 81*, 329 – 339.

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist, 25*, 3-17

Zimmerman, B. J. (2000). Attaining self-regulation. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13 – 39). San Diego, CA: Academic Press.

Zimmerman, B. J., & Martinez-Pons, M. (1986). Development of a structured interview for assessing student use of self-regulated learning strategies. *American Educational Research Journal, 23*, 614 – 628.

Zimmerman, B. J., & Martinez-Pons, M. (1990). Student differences in self-regulated learning: Relating grade, sex and giftedness to self-efficacy and strategy use. *Journal of Educational Psychology, 82*(1), 51-59.