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Procedia - Social and Behavioral Sciences 46 (2012) 1445 – 1449

Procedia
Social and Behavioral Sciences

WCES 2012

The examination of metacognitive skill levels and usage of learning strategies of preservice chemistry teachers

Senar Temel[a]*, Sinem Dincol Ozgur[b], Senol Sen[c], Ayhan Yilmaz[d]

[a, b,c,d] *Faculty of Education, Hacettepe University, Ankara, 06800, Turkey*

Abstract

This study aims to determine metacognitive skill levels and usage of learning strategies of preservice chemistry teachers and to examine the effect of different metacognitive skill levels on their usage of learning strategies. 46 preservice chemistry teachers of Hacettepe University Faculty of Education, Department of Chemistry Education participated in the study. The preservice chemistry teachers were applied Metacognitive Activities Inventory (MCA-I) which was developed by Cooper and Sandi-Urena (2009) and adapted into Turkish by Temel, Dinçol and Yılmaz (2011) to determine their metacognitive skill levels. Also Motivated Strategies for Learning Questionnaire (MSLQ) which was developed by Pintrich, Smith, Garcia and McKeachie (1991) and adapted into Turkish by Büyüköztürk, Akgün, Özkahveci and Demirel (2004) was applied to determine their usage of learning strategies. It was concluded that preservice chemistry teachers' level in the usage of cognitive and metacognitive learning strategies is well but any significant difference was not found between the usage of both cognitive and metacognitive learning strategies of the preservice chemistry teachers, who were divided into groups depending on different metacognitive skill levels.

Keywords: Self-regulated learning, learning strategies, metacognitive self-regulation strategies, cognitive strategies, metacognition

1. Introduction

Scientific developments has caused that educational programs have been reviewed in our era in which technology and information systems are advancing and changing rapidly (Üredi and Üredi, 2007). Continuous change and increase in information has forced students to know the ways for accessing to information, to use this information and have learning skills (Karakış and Çelenk, 2007). Educators have begun to deal with how learning occurs and the best way for learning (Sağırlı, Çiltaş, Azapağası and Zehir, 2010). They have agreed on the view that a proper education consists of teaching a student how to learn, to remember, to motivate himself, to control and direct his learning (Weinstein and Mayer, 1986). The concept of self-regulated learning has emerged based on the fact that individuals provide themselves with learning and regulating their requirements whenever they feel a need for learning (Altun and Erden, 2006). Self-regulated learning is an active and constitutive process in which students set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and the contextual features in the environment (Pintrich, 2000). According to Perry and Drummond (2002), it is the fact that a student is aware of the factors effecting his learning and motivation

* Senar Temel. Tel.: +90-312-2976787
E-mail address: senar@hacettepe.edu.tr.

1877-0428 doi:10.1016/j.sbspro.2012.05.318

for taking responsibility. According to Rizemberg and Zimmerman (1992), it is to specify targets, to develop strategies for accomplishing these targets and to check the advantages provided by these strategies.

Self-regulated learning includes learning strategies of which a student may take advantage in carrying out an effective learning (Özer, 2002). A learning strategy is a cognitive plan, which has been developed for fulfilling a task (Weinstein and Mayer, 1986). What effects a student's learning is the behavioral and thinking processes used by the student (Aredns, 1997). These strategies have been classified by different researchers in different ways. Three essential learning strategies, which are cognitive, metacognitive and affective, take place in the classification of Weinstein and Mayer (1986) and Dansereau, McDonald, Collins, Garland, Holley, and Diekhoff and Evans (1979), (as cited in İlhan, 2011). Pintrich, Smith, Garcia and McKeachie (1991) have placed learning strategies under two main groups like cognitive, metacognitive strategies and the strategies on resource management. Cognitive strategies help individuals to achieve their targets while metacognitive strategies includes understanding and evaluating whether the targets have been achieved or not (Gagne and Medsker, 1996). Also, metacognitive strategies require having a metacognitive skill.

Metacognition means an individual's information on his cognitive processes and his usage of this information to control the cognitive processes (Flavell, 1985). According to various researchers (Brown, 1987; Schraw and Moshman, 1995), metacognition is composed of two elements like the information on cognition and monitoring the cognition. The information on cognition covers an individual's information on his thinking and learning processes and understanding as well as the information on learning strategies to use them in certain learning states while cognition monitoring is the individual's ability to select a learning strategy suitable for features of the state to be learnt, to use and to monitor it and to make regulations according to the evaluation results (Senemoğlu, 2011).

In brief, an individual, who has the metacognitive information and is able to use his metacognitive skills, can decide on which learning strategy should be employed according to a certain learning state (Senemoğlu, 2011) and thus, they can accomplish effective learning (Weinstein and Mayer, 1986). Based on the aforementioned, main problem of the study has become whether or not usage of learning strategies of preservice chemistry teachers differs from each other according to their metacognitive skill levels.

1.1. Aim of the study

This study aims to determine metacognitive skill levels and usage of learning strategies of preservice chemistry teachers and to examine the effect of different metacognitive skill levels on their usage of learning strategies. In this aspect, we are guided by the following subproblems: 1. What is the degree of preservice chemistry teachers' metacognitive skill levels? 2. What is the degree of usage of cognitive and metacognitive learning strategies of preservice chemistry teachers? 3. Is there a significant difference between usage of cognitive and metacognitive learning strategies of preservice chemistry teachers according to different metacognitive skill levels?

1.2. Study Group

46 preservice chemistry teachers from Hacettepe University Faculty of Education, Department of Chemistry Education in the spring term of the 2011-2012 academic years participated in the study.

2. Method

2.1. Data Collection Tool

Metacognitive Activities Inventory (MCA-I): This inventory was originally developed by Cooper and Sandi-Urena (2009) and adapted into Turkish by Temel, Dinçol and Yılmaz (2011). As a result of conducted factor analysis, it was determined that this inventory is consisted of 4 factors and its' Cronbach alpha coefficient was found 0.89. The inventory is composed of 23 items with 5 point Likert scale.

Motivated Strategies for Learning Questionnaire (MSLQ): The questionaire was originally developed by Pintrich, Smith, Garcia and McKeachie (1991) and adapted into Turkish by Büyüköztürk, Akgün, Özkahveci and

Demirel (2004). The MSLQ is 7 point Likert scale and consisted of a 6-factor motivation subscale and a 9-factor learning strategies subscale. The motivation subscale is consisted of 31 items and the learning strategies subscale is consisted of 50 items. In this study we used learning strategies subscale. The learning strategies subscale is consisted of three sections: cognitive, metacognitive self-regulation and resource management. The Cronbach alpha coefficients were calculated between 0.41 and 0.75 for reliability of subfactors of learning strategies subscale.

3. Findings

Firstly, the data obtained by MCA-I which is used to determine metacognitive skill levels of preservice chemistry teachers were analyzed. The grouping method which is developed by Cooper, Sandi-Urena and Stevens (2008) was used in the analysis. Preservice chemistry teachers were divided into 3 groups according to means of their metacognitive skill scores and standard deviation values. Metacognitive skill groups of preservice chemistry teachers and related descriptive statistics are shown in Table 1.

Table 1. Distribution of preservice chemistry teachers by metacognitive skill groups

Probable metacognitive skill groups		N	%	$\overline{X}$	S	min	max
High Group (H-Grup)	Those preservice teachers with scores above 4.00	14	30.4	4.27	.23	4.00	4.78
Intermediate Group (I-Grup)	Those preservice teachers with scores between 2.74 and 4.00	17	37.0	3.72	.13	3.48	3.96
Low Group (L-Grup)	Those preservice teachers with scores below 2.74	15	32.6	2.29	.32	1.61	2.74

Secondly, the data obtained by cognitive and metacognitive self-regulation sections of learning strategies subscale of MSLQ which is used to determine usage of cognitive and metacognitive self-regulation strategies of preservice chemistry teachers were analyzed. Descriptive statistics related to usage of cognitive and metacognitive self-regulation strategies of preservice chemistry teachers are shown in Table 2.

Table 2. Findings related to usage of cognitive and metacognitive self-regulation strategies of preservice chemistry teachers

Learning Strategies		$\overline{X}$	S	min	max
Cognitive Strategies	Rehearsal strategies (RS)	5.32	.94	2.25	6.75
	Elaboration strategies (ES)	5.66	.73	4.17	7
	Organization strategies (OS)	5.75	.81	2.75	7
	Critical Thinking strategies (CTS)	5.25	.93	3.20	7
Metacognitive Self – Regulation strategies	Planning-monitoring-regulation strategies(PMRS)	5.10	.78	3	6.45

Thirdly, one way ANOVA analyses were conducted to determine whether there is a significant difference between usage of cognitive and metacognitive self-regulation strategies of preservice chemistry teachers grouped according to different metacognitive skill groups. Obtained findings are given in Table 3.

Table 3. ANOVA findings related to usage of cognitive and metacognitive self-regulation strategies of preservice chemistry teachers grouped according to different metacognitive skill levels

Learning Strategies	Sum of	sd	Mean	F	p

		squares		square		
Rehearsal strategies	Between groups	3.12	2	1.56	1.83	.17
	Within groups	36.73	43	.85		
	Total	39.85	45			
Elaboration strategies	Between groups	.51	2	.25	.46	.62
	Within groups	23.51	43	.54		
	Total	24.02	45			
Organization strategies	Between groups	2.34	2	1.17	1.81	.17
	Within groups	27.78	43	.64		
	Total	30.17	45			
Critical Thinking strategies	Between groups	.48	2	.24	.27	.76
	Within groups	38.66	43	.89		
	Total	39.15	45			
Planning-monitoring-regulation strategies	Between groups	.82	2	.41	.65	.52
	Within groups	27.18	43	.63		
	Total	28.00	45			

4. Conclusion and Discussion

Relating to the first subproblem of the study, the data obtained by the MCA-I were analyzed according to the grouping method developed by Cooper, Sandi-Urena and Stevens (2008). As seen in Table 1, preservice chemistry teachers were divided into 3 different metacognitive skill groups. 14 preservice chemistry teachers took place in high-level metacognitive skill group (H-group) while the number of preservice teachers taking place in the intermediate metacognitive skill group (I-Group) is 17 and the number of preservice teachers taking place in the low metacognitive skill group (L-Group) is 15.

Relating to the second subproblem of the study, the data obtained by the MSLQ were analyzed. As seen in Table 2, the mean scores of "rehearsal strategies", which are among subitems of cognitive learning strategies, of the preservice teachers is 5.32 while the mean scores of "elaboration strategies" is 5.66, the mean scores of "organization strategies" is 5.75 and the mean scores of "critical thinking strategies" is 5.25. The mean scores of metacognitive strategies (planning-monitoring-regulation strategies) of the preservice teachers were specified as 5.10. According to these mean scores, it was determined that the preservice teachers most frequently use the "organization strategies" from the cognitive learning strategies while they use "metacognitive strategies" least frequently; however, it may generally be said that their level in the usage of cognitive and metacognitive learning strategies is well. According to the relevant literature review, there are no consistent results about the students' usage frequency of learning strategies (Arsal, 2005; Arsal and Özen, 2007; Karakış and Çelenk, 2007; Öztürk, 1995; Sağırlı and Azapağası, 2009; Somuncuoglu, and Yıldırım, 2000).

Relating to the third subproblem of the study, one-way ANOVA analyses were conducted. As seen in Table 3, any significant difference was not found between the usage of both cognitive and metacognitive learning strategies of the preservice chemistry teachers, who were divided into groups depending on different metacognitive skill levels [RS: $F_{(2-53)}$=1.83, p>.05; ES: $F_{(2-53)}$=.46, p>.05; OS: $F_{(2-53)}$=1.81, p>.05; CTS: $F_{(2-53)}$=.27, p>.05; PMRS: $F_{(2-53)}$=.65, p>.05]. In other words, any significant difference was not found between the usage of both cognitive and metacognitive learning strategies of the preservice chemistry teachers, who took place in the H-Group, I-Group and L-Group; whereas, metacognitive skills ensure that an individual decides to use learning strategy suitable for features of the state to be learnt, monitors his learning and, if the learning has not occurred, he changes the strategy and tries a new strategy according to his metacognitive experiences (Senemoğlu, 2011). Thus, the students having high-level metacognitive skills are expected to perform an effective learning and to ensure self-learning while they can use learning strategies better facilitating to achieve this. However, the reason why there is no difference between the usage of the learning strategies of the preservice chemistry teachers may be said that the preservice chemistry

teachers employed in the study do not have high metacognitive skill levels and accordingly, they do not have many metacognitive experiences. Furthermore, the fact that the percentage of the preservice chemistry teachers having high-level metacognitive skills is low (30.4%) is another indicator for this result because students select and practice the relevant strategy according to their metacognitive experiences depending on their metacognitive information. Thus, the more they have had metacognitive experience the more their metacognitive information increases (Flavell, 1979; Senemoğlu, 2011). Any study could not be presented supporting this result because a similar study could not be found in the literature.

As a result, importance should be attached to development of metacognitive skills of preservice teachers for being aware of how they learn and taking the responsibility for their learning. Moreover, preservice teachers should be informed, in development of metacognitive skills, about learning strategies and where they should exactly be used. Therefore, it may be suggested to review the variables in the study after an application including teaching of learning strategies

References

Altun, S., & Erden, M. (2006). Öğrenmede motive edici stratejiler ölçeğinin geçerlik ve güvenirlik çalışması. Yeditepe *Üniversitesi Eğitim Fakültesi Dergisi*, 2(1), 1-16.

Arends, R. I. (1997). *Classroom instruction and management.* NY: McGraw-Hill.

Arsal, Z. (2005). Ögretmen adaylarının ögrenme ve motivasyon stratejileri. XIV. Ulusal Egitim Bilimleri Kongresi, Denizli.

Arsal, Z. & Özen, R. (2007). Sınıf öğretmeni adaylarının öğrenme stratejileri ve öğrenme biçimi tercihlerinin incelenmesi. *Abant izzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*, 7(2), 151-164.

Brown, A. L. (1987). Executive control, self-regulation, and other more mysterious mechanisms. In F. E. Weinert, & R. Kluwe (Eds.), *Metacognition, motivation, and understanding* (pp.65-116). Hillsdale, NJ: Lawrence Erlbaum Associates.

Büyüköztürk, Ş., Akgün, Ö. E., Kahveci, Ö., & Demirel, F. (2004). Güdülenme ve öğrenme stratejileri ölçeği'nin Türkçe formunun geçerlik ve güvenirlik çalışması. *Kuram ve Uygulamada Eğitim Bilimleri*, 4(2), 207–239.

Cooper M.M. and Sandi-Urena, S.,Stevens, R. (2008). Reliable multi method assessment of metacognition use in chemistry problem solving, *Chemistry Education Research and Practice,* 9, 18–24 .

Cooper, M. M., & Sandi-Urena, S. (2009). Design and validation of an instrument to assess metacognitive skillfulness in chemistry problem solving. *Journal of Chemical Education*, 86 (2), 240-245.

Flavell, J. H. (1985). *Cognitive development.* (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Gagne, R. M., & Medsker, K. L. (1996). *The conditions of learning: Training applications*. New York: Harcourt Brace College Publishers.

Karakış, Ö., & Çelenk, S. (2007). Farklı fakültelerde öğrenim gören öğrencilerin genel öğrenme stratejilerinin kullanma düzeyleri "A.İ.B.Ü. örneği". AİBÜ, Eğitim Fakültesi Dergisi, 7 (1), 26-46.

İlhan, T. (2011). Öğrenme stratejileri ve stilleri. B. Oral (Ed.). *Öğrenme öğretme kuram ve yaklaşımları* (s.223-242). Ankara: Pegem Akademi.

Özer, B. (2002). Ilköğretim ve ortaöğretim okullarının eğitim programlarında öğrenme stratejileri. *Eğitim Bilimleri ve Uygulama*, 1(1), 17-32.

Öztürk, B. (1995). Genel öğrenme stratejilerinin öğrenciler tarafından kullanılma durumları. Yayınlanmamı şDoktora Tezi, Gazi Üniversitesi Sosyal Bilimler Enstitüsü.

Perry, N. E., & Drummond, L. (2002). Helping young students become self-regulated researchers and writers. *The Reading Teacher*, 56 (3), 298-310.

Pintrich, P.R., Smith, D.A.F., Garcia, T., & McKeachie, W.J. (1991). A Manual for the use of the motivated strategies for learning. Michigan: School of Education Building, The University of Michigan. (ERIC Document Reproduction Service No.ED338 122.

Pintrich, R. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self- regulation* (pp.451-501). San Diego, CA: Academic Press.

Rizemberg, R., & Zimmerman, B. J. (1992). Self-regulated learning in gifted students. *Roeper Review*, 15 (1), 98-101.

Sağırlı, M.Ö., Çiltaş, A., Azapağası, E., & Zehir, K. (2010). Yüksek öğretimin öğrencilerin öz-düzenleme becerilerine etkisi (Atatürk Üniversitesi Örneği). *Kastamonu Üniversitesi Eğitim Fakültesi Dergisi*, 18 (2), 587-596.

Schraw, G., & Moshman, D. (1995). Metacognitive Theories. *Educational Psychology Review*, 7 (4), 351-371.

Senemoglu, N. (2011). Gelisim ögrenme ve ögretim: Kuramdan uygulamaya (20. Baskı.) Ankara: Gazi Kitabevi.

Somuncuoğlu, Y., & Yıldırım, A. (1999). Relationships between achievement goal orientations and use of learning strategies. *Journal of Educational Research,* 92 (5), 267-278.

Temel, S., Dinçol , S., & Yılmaz, A. (2011). Metakognition und problemlösen. GDCh Wissenschaftsforum Chemie 2011, Bremen.

Üredi, I., & Üredi, L. (2007). Öğrencilerin öz-düzenleme becerilerini geliştiren öğrenme ortamının oluşturulması. *EDU,* 7, 2.

Weinstein, C. E.,& Mayer, R. E. (1986). The teaching of learning strategies. In M.C. Wittrock, (Ed.) , *Handbook of Research on Teaching* (pp.315-327). New York NY: Macmilian Publishing Company.