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The effect of learning styles on students' misconceptions and self-efficacy for learning and performance

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Abstract

The purpose of this study is to investigate the effect of learning styles on students' misconceptions related to the subject of melting and dissolving. Moreover, the present study also analyzes the effect of students' learning styles on their self-efficacy for learning and performance. The population of this study was comprised of first- and second-grade students attending the Faculty of Education at Hacettepe University. As data collection tools, Learning Style Inventory was used in order to determine students' learning styles, the Motivated Strategies for Learning Questionnaire (MSLQ) was administered to determine students' self-efficacy for learning and performance and the Melting and Dissolving Concept Test (MDCT) was used to assess students' misconceptions regarding melting and dissolving. For the evaluation of the data, statistical analysis was applied.

Keywords: Misconceptions, learning styles, self-efficacy for learning and performance, melting and dissolving

1. Introduction

Learning-teaching approaches that students prefer, reactions they give to instructional applications vary according to personal properties they have. Many factors, which can be counted depending on individual differences such as intelligence level, motivational differences, perceptive preferences and psychological factors, affect learning processes of people (Kuzgun & Deryakulu, 2004). Students structuring concepts in a meaningful manner without forming of misconceptions rests on these individual differences in learning-teaching environments. One of these individual differences is learning styles, which are known as individual preferences of students regarding perceiving and processing information. Many definitions are come across in the literature for learning styles defined as individual characteristics and preferences, which are crucial in their perception of learning environment, interaction with this environment and reactions they give. According to Grasha (1996), learning style is individual properties, which impact individual's ability to perceive information, their relationships with peers and teachers and their participation in learning experiences (as cited in Alşan, 2009). According to Kolb, learning style is the method individually preferred in extracting and processing information (Kolb, 1984). According to Dunn and Dunn (1993), learning style is the path that every learner follows in the course of extraction and processing of information beginning with their concentration upon new and difficult information (as cited in Veznedaroğlu & Özgür, 2005). According to Keefe (1990), learning style is a combination of cognitive, affective and psychomotor behavioral properties, it is an indicator, which determines how a student perceives, learn learning environment, how he/she

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interacts with learning environment (as cited in Veznedaroğlu & Özgür, 2005). Felder (1996) defined learning style as distinctions in individual approach in the process of extracting and processing information. According to these definitions, learning style is attributes that demonstrate individual's inclinations or preferences towards learning.

Kolb (1984) generated Learning Style Model out of Experiential Learning Theory. Kolb stated learning styles of individuals as a cycle and defined four learning styles within this cycle and learning paths, which symbolizes this every learning style (Aşkar & Akkoyunlu, 1993). Learning paths representing every learning style are different from each other. Students, who possess learning style of concrete experience, learn by sensing; the ones, who possess learning style of reflective observation, learn by following; the ones, who have learning style of abstract conceptualization, learn by thinking and students, who have learning style of active experimentation, learn by doing. Learning style of every individual consists of the combination of these four fundamental learning styles. These are learning styles of accommodator, which is based on active experimentation and concrete experience; assimilator, which is based on reflective observation and abstract conceptualization; diverger, which hinges on reflective observation and concrete experiences and converger, which hinges upon abstract conceptualization and active experience (Aşkar & Akkoyunlu, 1993; Kolb & Kolb, 2005).

1.1. The Significance and Objective of Study

Learning styles can be an important consideration both in coming into being of misconceptions and allaying of these misconceptions. In this study, putting forward to what extent misconceptions of students having distinct learning styles on the subject of melting and dissolving is the main study objective. This research aims specifically at answering the following questions:

1. What is the learning style distribution of students?
2. Do melting and dissolving concept test and self-efficacy for learning and performance scores of students differ according to their learning styles?

2. Method

2.1. Study Group

A total of 118 students, who have been receiving the course of Basic Chemistry in the Department of Secondary Science and Mathematics Education in the Faculty of Education of Hacettepe University, participated in this study.

2.2. Data Collection Instruments

2.2.1. Melting and Dissolving Concept Test (MDCT)

Melting and Dissolving Concept Test employed in the study was prepared to reveal misconceptions of students (Şen, 2011). A score between 0-16 is received from the test. Comparison of scores received from the test indicates that students getting high scores have fewer misconceptions than the ones getting low scores regarding melting and dissolving. MDCT is of two tiers, consists of 16 multiple choice questions each with four choices. A score between 0-16 is received from the test. As a result of analysis conducted for reliability of the test, α internal consistency coefficient was found as 0.854.

2.2.2. Motivated Strategies for Learning Questionnaire (MSLQ)

MSLQ was developed by Pintrich, Smith, Garcia and McKeachie (1991) to evaluate university students' motivational adaptations and uses of different learning strategies for their university courses. MSLQ has two main sections, which are motivation and learning strategies. The motivation part consists of 31 items and sub-dimensions of intrinsic goal orientation (IGO), extrinsic goal orientation (EGO), task value (TV), control of learning beliefs (CLB), self-efficacy for learning and performance (SELP) and test anxiety (TA). Pintrich et al. (1991) expressed that researchers can use MSLQ according to their needs and sub-sections of motivation and learning strategies solely

or together. In this study, the items 5, 6, 12, 15, 20, 21, 29, 31, which are located in sub-dimension of self-efficacy for learning and performance (SELP), were used. Results of confirmatory factor analysis performed for determining university students' motivations towards chemistry are χ^2/df = 3,04, GFI= 0.87, AGFI= 0.77 and RMSEA= 0.07' and reliability coefficients pertaining to their sub-dimensions are 0,74 for IGO; 0,575 for EGO; 0,89 for TV; 0,72 for CLB; 0,91 for SELP and 0,56 for TA (Şen, 2011).

2.2.3. The Kolb Learning Style Inventory

The Kolb Learning Style Inventory, which was developed by Kolb (1985) to determine learning styles of students and adapted to Turkish by Aşkar and Akkoyunlu (1993), was employed. The Inventory consists of 12 items with four choices, which asks from individuals for sorting four learning forms best describe their own learning styles. Each of these 4 choices situating in these 12 items represents one learning form. The first of these choices is expressions related to the ability of concrete experience, the second one the ability of reflective observation, the third one the ability of abstract conceptualization and the fourth one the ability of active experimentation. A score between 12 and 48 can be received from the test for each choice. Alpha reliability coefficient of the inventory was discovered as α =,73 (Aşkar & Akkoyunlu, 1993).

2.3. Data Analysis

Frequency (f) and percentage (%) distributions and MANOVA analysis were used in the data analysis.

3. Findings

Results of the research were investigated in line with sub-problems of the research.
1) What is the learning style distribution of students?

Table 1. Learning styles of students

Learning style	f	%	$\overline{X}$ (MDCT)	$\overline{X}$ (SELP)
Assimilator	55	46,6	13,09	40,72
Converger	43	36,4	10,88	38,21
Diverger	11	9,3	11,54	30,54
Accommodator	9	7,6	7,88	37,00
Total	118	100,0	11,74	39,13

When Table 1 examined, 46.6% of students have assimilator learning style, 36.4% have converger learning style, 9.3% have diverger learning style and 7.6% have accommodator learning style. According to the table, majority of students of the Faculty of Education, approximately 83%, have either assimilator or converger learning style. It was also detected in studies carried out in the literature that learning style preferences of students of the Faculty of Education again are in an assimilator or converger fashion (Ateş & Altun, 2008; Demirbaş & Demirkan, 2007; Kazu, 2010; Özyalçın Oskay, Erdem, Akkoyunlu & Yılmaz, 2010).
Due to the fact that learning style of 83% of students is assimilator and converger and students with learning style of diverger and accommodator are few in the study, as from this stage, the study was performed with students possessing assimilator and converger learning styles.

2) Do melting and dissolving concept test and self-efficacy for learning and performance scores of students differ according to their learning styles?
The effect of learning styles of students on MDCT and SELP scores was tested by using one way MANOVA. Results indicated that there is a statistically significant effect of learning styles (assimilator and converger) on MDCT and SELP scores (Wilks' Lambda (λ)=0,689, $F_{(2, 95)}$= 21,45 p<0,01). According to the conducted univariate ANOVA results, while MDCT scores ($F_{(1, 96)}$ = 21,065, p<0,05) exhibit a significant difference with

respect to learning style preference, SELF scores $(F(1, 96) = 2,31, p<0,05)$ do not show significant difference with respect to learning style.

4. Conclusions and Discussion

Students possessing assimilator learning style got significantly higher scores in MDCT than students possessing converger learning style. This outcome revealed that students with assimilator learning style had fewer misconceptions than students with converger learning style regarding melting and dissolving. If learning-teaching environments are set up according to different learning styles, a decrease in misconceptions of students and an increase in their performances might occur. Because, learning styles is a factor effective on student performance (Collison, 2000; Demirbaş & Demirkan, 2007; Kvan & Yunyan, 2005; Matthews, 1996). Here, the important thing is preparation of learning-teaching environments suitable with learning style of student. Another reason behind the difference among misconceptions possessed by students with assimilator and converger learning styles on the subject of melting and dissolving is that the subject melting and dissolving is a chemistry topic. Because, it was determined in a study carried out by Uzuntiryaki, Bilgin and Geban (2003) that learning styles of students have impact on students' successes in chemistry course and their attitudes towards it.

As a result of analyses conducted, majority of students having assimilator learning style and students with assimilator learning style having fewer misconceptions can stem from the understanding of education being performed in our country. Because, teaching courses with traditional instructional method in our education system leads to failure of students with learning styles other than assimilator learning style. Students having assimilator learning style regard teacher as the most important source of information, prefer lectures performed with audible and visual presentations. Owing to the fact that they tend to learn by listening and watching, assimilating students become more successful in traditional learning environments (Hein & Bundy, 1999).

There was no statistically significant effect of learning style (assimilator and converger) on SELP. According to this result, there isn't any difference with respect to students with different learning styles putting forward a certain behavior at desired level or their beliefs towards their own learning capacity. If learning-teaching environments appropriate with different learning styles are set up, learning styles of students cease to be an individual property, which will directly impact their accomplishments; they will positively affect students' beliefs related to self-efficacy for learning and performance.

Self-efficacy belief is also one of the factors affective on motivation, learning and success (Pintrich & De Groot, 1990; Tseng, Tuan, & Chin, 2010; Wolters & Rosenthal, 2000; Zimmerman, Bandura, & Martinez-Pons, 1992; Zimmerman & Martinez-Pons, 1990). Students with high self-efficacy belief become successful by studying more, using learning strategies more effectively (Zimmerman & Martinez-Pons, 1990). Self-efficacy belief impacts both individuals' forms of thinking and emotional reactions. When coming up against a difficult problem, individuals possessing high self-efficacy are able to perform productive studies aimed at solution of the problem. However, when facing difficult problems, individuals with low self-efficacy belief experience a drop in performance. Individuals having low self-efficacy experience more anxiety and stress (Pajares, 2002). Not having a significant difference among their self-efficacy beliefs albeit students possess distinct learning styles points to that both students with assimilator and converger learning styles will be successful in appropriate learning-teaching environments.

5. Recommendations

Misconceptions of students with converger learning style being more do not mean they are unsuccessful students. Because, instructional applications applied affect student performances. From this point, pedagogues should act being aware of that students have distinct learning styles. Pedagogues should arrange their syllabuses according to different learning styles. Students should be ensured to structure new concepts taking into account the distinction of methods, which students with different learning styles prefer in learning, using, keeping and organizing new concepts. It was determined at the end of this study that misconceptions of university students concerning melting

and dissolving differ according to learning styles and students with assimilator learning style have less misconceptions. The impact of learning styles on misconceptions can be examined by changing both the study group and subject in studies to be carried out after this study. By investigating what sort of performance students with different learning styles will display in the process of allaying of misconceptions, reactions they will give to different methods of conceptual change can be determined by studies to be performed.

References

Alşan, E. U. (2009). Temel kimya laboratuarı dersinde öğretmen adaylarının başarılarına öğrenme stili tercihlerinin etkisi. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi (EFMED)*, 3(1), 117-133.

Aşkar, P., & Akkoyunlu, B. (1993). Kolb öğrenme stili envanteri. *Eğitim ve Bilim*, 87, 37 – 47.

Ateş, A., & Altun, E. (2008). Learning styles and preferences for students of computer education and instructional technologies. *Eğitim Araştırmaları-Eurasian Journal of Educational Research*, 8(30), 1–16.

Collison, E. (2000). A survey of elementary students learning style preferences and academic success. *Contemporary Education*, 71, 42-49.

Demirbaş, O. O., & Demirkan, H. (2007). Learning styles of design students and the relationship of academic performance and gender in design education. *Learning and Instruction*, 17, 345-359.

Felder, R. M. (1996). Matters of Style. ASEE Prism, 6(4),8–23. [Online] Retrieved on 17.09.2011, at URL: http://www4.ncsu.edu/unity/lockers/users/f/felder/public/Papers/LS-Prism.htm.

Hein, T.L., & D.D. Bundy (1999). Teaching to students' learning styles: Approaches that work. 29th ASEE/IEEE Frontiers in Education Conference, November 10 - 13, 1999, San Juan, Puerto Rico.

Kazu, İ. Y. (2010). Learning styles of teacher candidates: A sample of Fırat University. *African Journal of Business Management*, 4(15), 3265-3276.

Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of Management Learning and Education*, 4, 193-212.

Kolb, D. A. (1985). Learning Style Inventory: Self Scoring Inventory and Interpretation Booklet. Boston: McBer and Company.

Kolb, D.A. (1984). Experiential learning: experience as the source of learning and development. Englewood Cliffs, N.J: Prentice-Hall.

Kuzgun, Y., & Deryakulu, D. (2004). Bireysel farklılıklar ve eğitime yansımaları. Y. Kuzgun (Ed.) ve D. Deryakulu (Ed.), *Eğitimde bireysel farklılıklar* (s.95–136). Ankara: Nobel Yayın Dağıtım.

Kvan, T., & Yunyan, J. (2005). Students' learning styles and their correlation with performance in architectural design studio. *Design Studies*, 26,19-34

Matthews, D. B. (1996). An investigation of learning styles and perceived academic achievement for high school students. *Clearing House*, 69 (4), 249-255.

Özyalçın Oskay, Ö., Erdem, E., Akkoyunlu, B., & Yılmaz, A. (2009). Prospective chemistry teachers' learning styles and learning preferences. *Procedia Social and Behavioral Sciences,* 2(2010), 1362–1367.

Pajares, F. (2002). Overview of social cognitive theory and self-efficacy. [Online] Retrieved on 11.09.2011, at URL: http://www.emory.edu/EDUCATION/mfp/eff.html.

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

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 Center for Research to Improve Postsecondary Teaching and Learning, The University of Michigan.

Şen, Ş. (2011). *Kavramsal değişim metinleri ve ikili yerleşik öğrenme modelinin erime ve çözünme konusunda öğrenci başarısı ve motivasyona etkisi*. Yüksek Lisans Tezi, Hacettepe Üniversitesi, Ankara, Türkiye.

Tseng,C.H., Tuan, H.L., & Chin, C.C. (2010). Investigating the influence of motivational factors on conceptual change in a digital learning context using the dual-situated learning model. *International Journal of Science Education*, 32(14), 1853–1875.

Uzuntiryaki, E., Bilgin, İ., & Geban, Ö. (2003). The effect of learning styles on high school students' achievement and attitudes in chemistry. Paper presented at the Annual Meeting of the National Association for Research in Science Teaching, Philadelphia, PA, (ERIC Document Reproduction Service No. ED 475 483).

Veznedaroğlu, R.L., & Özgür, O. (2005). Öğrenme stilleri: Tanımlamalar, modeller ve işlevleri. *İlköğretim-Online*,4(2), 1–16.

Wolters, C. A., & Rosenthal, H. (2000). The relations between students' motivational beliefs and their use of motivational strategies. *International Journal of Educational Research*, 33, 801-820.

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.

Zimmerman, B. J., Bandura, A., & Martinez-Pons, M. (1992). Self-motivation for academic attainment: The role of self-efficacy beliefs and personal goal setting. *American Educational Research Journal*, 29(3), 663-676.