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EVALUATING THE EFFECT OF TEACHING STRATEGIES AND LEARNING STYLES TO STUDENTS' SUCCESS

ABSTRACT

Universities provide the foremost research and advanced training in every society that are generally divided into a number of academic departments, schools, or faculties. Modern educational technology plays an important role in efficient teaching because; the Internet Generation is now being registered to university programs. These digital natives are known with their high dependency on technology and lower attention span, opposed to previous generations who read books and other printed material. Therefore, new teaching strategies should be utilized for these students in higher education institutions. This study aims to evaluate the effect of different teaching strategies and students' learning styles based on questionnaires to the success of students. "Goldratt's Game" is used to help participants understand the impact and interaction of production fluctuations and dependent events on the stylized process flow. Finally, statistical analyses are made to identify whether the strategies have significant effect on students' success or not.

Keywords: Learning Styles, Teaching Styles, Teaching With Games, Teaching Strategies

ÖĞRETİM STRATEJİLERİ VE ÖĞRENME BİÇİMLERİNİN ÖĞRENCİLERİN BAŞARISI ÜZERİNDEKİ ETKİSİNİN DEĞERLENDİRİLMESİ

ÖZET

Üniversiteler fakülte, bölüm ve yüksek okul gibi akademik birimlere ayrılarak toplumlarda önde gelen araştırma ve eğitimi sağlamaktadırlar. İnternet kuşağı üniversitelere kayıt olmaya başladığından modern eğitim teknolojisi öğretimde önemli rol oynamaktadır. Doğuştan dijital bir dünyada olan bu kuşak, basılı materyalleri kullanan önceki nesillerin aksine, teknolojiye bağımlı ve daha kısa dikkat toplayabilen bir kuşak olarak bilinmektedirler. Bu nedenle bu öğrencilerin yüksek öğretiminde yeni öğretim stratejilerinden faydalanılmalıdır. Bu çalışmada anketler kullanılarak öğretim stratejileri ve öğrenme biçimlerinin öğrencilerin başarısındaki etkilerinin değerlendirilmesi amaçlanmıştır. Katılımcıların üretimdeki dalgalanmaların etki ve etkileşimleri ile bir süreç akışında bağlı olayları anlamalarını kolaylaştırmak için "Goldratt's Game" kullanılmıştır. Çalışmanın son bölümünde ise öğretim stratejilerinin öğrencilerin başarısı üzerindeki etkilerinin anlamlı olup olmadığını görmek için istatistiki analizler yapılmıştır.

Anahtar Kelimeler: Öğrenme Biçimleri, Öğretme Biçimleri, Oyunlarla Öğretim, Öğretim Stratejileri

1. INTRODUCTION (GİRİŞ)

Teaching is not just telling and learning is not just listening. Students, either in preschool or in higher education, have a range of learning styles. Each person prefers different learning styles and techniques. Learning styles group the ways people learn. Although some people may have a dominant one, usually everyone has a mix of learning styles. Some learning styles may emerge in different circumstances. Therefore, there is no right combination and the people's learning styles are not fixed. People can develop ability in less dominant styles or the ones that are already being used. This issue is important since it may affect the academic success. Innovative strategies to facilitate learning are being used by educators in nursing, medicine, and the health sciences (Berkebrede et al., 2011).

Teaching methods can best be defined as the types of principles and methods used for instruction. There are many types of teaching methods, depending on what information or skill the teacher is trying to convey. Class participation, demonstration, recitation, and memorization are some of the teaching methods being used. Student success in the classroom may be largely based on effective teaching methods. A recent study by Scherrer (2011) compares and contrasts the three delivery methods (i.e., traditional, hybrid, and online delivery methods) for an introductory level undergraduate statistics course to determine what differences exist in student completion, performance, effort, and satisfaction. It is concluded that the traditional section performance was better when compared to the other methods.

The studies related with Industrial Engineering (IE) education involve subjects such as operations research (OR), supply chain, distribution, and other related areas. A number of faculty members have developed classroom exercises for the teaching of production and operations management courses. Rump (2005) focuses on the application of queuing theory to urban planning that would be suitable for either an undergraduate or graduate. Teich et al. (2005) describe a Bread/Flour/Grain trading game that imparts design, bidding experience, and principles of closed economy for groups sized from six to sixty. DePuy and Taylor (2007) provide examples of the use of games as pedagogical tools in teaching OR. Drake and Mawhinney (2007) have created the Inventory Control at Spiegel Grove classroom exercise, for a single product in a serial supply chain. Gan and et al. (2007) use a strawberry jam-making supply chain model to illustrate how various areas of operations research interact in an actual manufacturing scenario. Hans and Neilberg (2007) present the "Operating Room Manager Game" to illustrate the difficulties of applying Operations Research/Management Science (OR/MS) techniques in healthcare for the IE&MS master's program. Villalobos (2007) introduces undergraduate engineering students to the application of optimization techniques for stock portfolio selection. Strickland (2008) discusses teaching a branch-and-bound procedure motivated by the maximum clique problem and used this approach in small, senior-level optimization courses. Alpers and Trotter (2009) describe a new course on computational discrete optimization to senior-level undergraduate students and toward advanced graduate students. Wright and Ammar (2009) feature eight different learning exercises involving Lego blocks, representations of products, and computer simulations intended to give students some tangible experiences with production problems and quantitative decisions. Salman and Koksalan (2010) discuss their experience in using a case study of location and distribution decisions in undergraduate and MBA level Operations Research/Management Science (OR/MS) courses. Koksalan et al. (2010) present a case study where the students are required to build a multiple linear regression model that

explains the monthly beer demand predictions. Behera and Davis (2010) identify specific action learning projects to incorporate active learning as part of a service operations management (SOM) course at both the undergraduate and graduate levels. Robb et al. (2010) describe a competition engaging students in concepts, including demand estimation, demand uncertainty, and costs of inventory and shortages. Gary (2011) performs a hands-on manufacture of a paper product along a fabrication line set up in a classroom.

Based on this literature review, it can be claimed that the importance and consequently the number of studies related with IE education is increasing. Therefore, this study aims to assess learning styles of students and try to compare different teaching styles. Since the net generation might prefer active, collaborative, and technology-rich learning, an educational game is considered with an application and visually supported example.

The paper is structured as follows: second and third sections provide brief summaries of teaching and learning styles consecutively. An application and the results are discussed in the fourth section. The overall assessment and directions for future studies are presented in the last section.

2. RESEARCH SIGNIFICANCE (ÇALIŞMANIN ÖNEMİ)
This study focuses on learning and teaching styles in undegraduate IE education that mainly rely on practical applications, interactions, and team work. Since there a number of studies in the literature, the study aims to experimentally consider both teaching and learning sides of the education process and evaluate the outcomes through statistical analysis.

3. TEACHING STYLES (ÖĞRETİM BİÇİMLERİ)
Teaching a particular subject is usually a hard work. There are many factors that may affect the success of teaching process, such as, the attention of audience to the subject being taught, experience of the instructor, and teaching environment. Traditional teaching styles such as conference, chalk and chalk-board are still popular. However, depending on the course type and improving technology, new teaching styles are inevitable. For example, the courses such as information technology and computer programming require a computer laboratory and practice lessons.

Felder and Henriques (1995) assess learning and teaching styles in foreign and second language education where Langlois and Thach (2001) in the Clinical Setting. Yaliz et al. (2008) evaluate learning styles of students in the departments of physical and sports education and sports teacher. Blakely et al. (2009) provide a review on educational gaming for health sciences and summarizes the advantages and disadvantages of educational games. Advantages of utilizing educational games are identified as the reduction of stress and anxiety, stimulating interaction, reducing monotonous lessons, promoting teamwork, creating a conductive environment for increased learning and retention of knowledge, enhancing motivation, promoting a relaxed in the learning environment, and adding entertainment. On the other hand, there are some disadvantages of educational games, for it may create stress and embarrassment when incorrect answers given, can hinder evaluative learning, competition can be seen as threatening, cost, increase difficulty in assessing individual competencies when teams are involved, require special preparation which can be time consuming, and may require instruction and background reading outside of the game to provide a successful technique.

4. LEARNING STYLES (ÖĞRENME BİÇİMLERİ)

Learning styles are defined as the various approaches or ways of learning. It is known that teachers should assess the learning styles of their students and adapt their classroom methods to best fit each student's learning style. The David A. Kolb styles model is based on the Experiential Learning Theory and the model outlines two related approaches toward grasping experience: Concrete Experience and Abstract Conceptualization. The most common learning modalities are summarized as visual, auditory, and kinesthetic (Barbe etal., 1979). Fleming's VARK model claimed that visual learners have a preference for seeing (think in pictures; visual aids such as overhead slides, diagrams, handouts, etc.). Auditory learners best learn through listening (lectures, discussions, tapes, etc.). Tactile/kinesthetic learners prefer to learn via experience moving, touching, and doing (active exploration of the world; science projects; experiments, etc.). Coffield, et al. (2004) identify 71 different theories of learning style. However, it is stated that none of the most popular learning style theories had been adequately validated through independent research. Therefore, the idea of a learning cycle, the consistency of visual, auditory, and kinesthetic preferences and the value of matching teaching and learning styles are still "highly questionable".

5. APPLICATION (UYGULAMA)

In this study, "Goldratt's Game" that has been developed based on the matchstick game, played during the Boy Scout hike in Goldratt (1992), is used. The basic purpose of these exercises is to help participants understand the impact and interaction of statistical fluctuations and dependent events on the stylized process flow. Johnson and Drougas (2002) describe the use of "Goldratt's Game" to provide an Excel-based introduction to the topic of simulation within the normal flow of the introductory operations management course. Lange and Ziegenbein (2005) report on the experiences gained playing the game with postgraduate and executive MBA students. Umble and Umble (2005) illustrate how spreadsheet simulation be used to demonstrate the dice game for undergraduate and graduate operations management class.

The game is studied with the undergraduate students enrolled in Introduction to Industrial Engineering course. The students are suggested to read the book "Goal" by Goldratt at the beginning of the semester,. A week before the application, the details of the game is uploaded to the course's web site. The students are randomly grouped into two before the teaching strategies are held in different classrooms. The main concepts of the game are illustrated by use of a power point presentation. Then, students in the first group executed the game. The second group watched an animation about the game and listened to instructor's explanations about the main concepts. Just after each course hour, a quiz with 17 True-False questions (each 5 points) and one classical written question (15 points) was completed. After a short brake, the questionnaire that aims to determine the learning styles of the students was handled.

5.1. Evaluating Students' Success Based on the Teaching Styles Used (Kullanılan Öğretim Biçimi Temelinde Öğrenci Başarılarının Değerlendirilmesi)

Various teaching styles can be utilized for higher education students. Zimmers et al. (2004) study on teaching different sections of an MS course describes an e-learning-type course built on three different delivery modes: classroom, web-based, and experiential. The

applications in this study are held in a classroom environment. Based on Benjamin Franklin's famous quotation "*Tell me and I forget. Teach me and I remember. Involve me and I learn.*", the authors had encouraged students to practice the game to learn the concepts. The first group included 45 students and this teaching style is refereed as 1st Teaching strategy throughout this study. In the 2nd Teaching strategy, the game was illustrated by a video simulation to a group that included 35 students, keeping in mind that they are keen on using technology.

A t-test or z-test is most commonly applied when the test statistic would follow a normal distribution. However, when the data were tested for normality, although their sample sizes were greater than 30, it was determined that the quiz score data for second group did not have a normal distribution. A natural logarithm transformation was tried to obtain normalized data. However, the data again did not fit to normal distribution. Therefore, one of the non parametric tests, Mann-Whitney test, was utilized to assess if there is a statistically significant difference between the average quiz scores. The hypothesis in this study was defined as H_0: "there is no significant difference between the average quiz scores for 1st and 2nd Teaching strategies", and H_1: "there is a significant difference between the average quiz scores for 1st and 2nd Teaching strategies ".

In statistical significance testing, the p-value is the probability of obtaining a test statistics at least as extreme as the one that was actually observed, assuming that the null hypothesis is true. When the p-value is less than the significance level α that is often 0.05 or 0.01 the null hypothesis is rejected and the result is said to be statistically significant. For a %95 confidence interval (CI), the test was performed and the results are stated as follows:

Mann-Whitney Test and CI: C1; C2

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      N  Median
C1   45  55.000
C2   35  75.000


Point estimate for ETA1-ETA2 is -15.000
95.1 Percent CI for ETA1-ETA2 is (-20.001;-9.998)
W = 1370.0
Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at 0.0000
The test is significant at 0.0000 (adjusted for ties)
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Since p-value = 0 and p<0.05, it was determined that the differences between the averages scores of two teaching strategies is statistically significant.

5.2. Determining Learning Styles of Students
(Öğrencilerin Öğrenme Biçimlerine Karar Verme)
Learning styles of students were determined by use of a questionnaire with 70 questions that can be accessed from www.memletics.com. Each student's rate for seven different learning styles was assessed. People that have a visual learning style prefer using pictures, images, and spatial understanding where aural like to use sound and music. Verbal favor using words, both in speech and writing, on the contrary, physical generally use the body, hands and sense of touch. Logical prefer reasoning and systems. Although social favor to learn in groups or with other people, solitary choose to work alone and use self-study. The numbers of students for each individual group are stated in Figure 1.
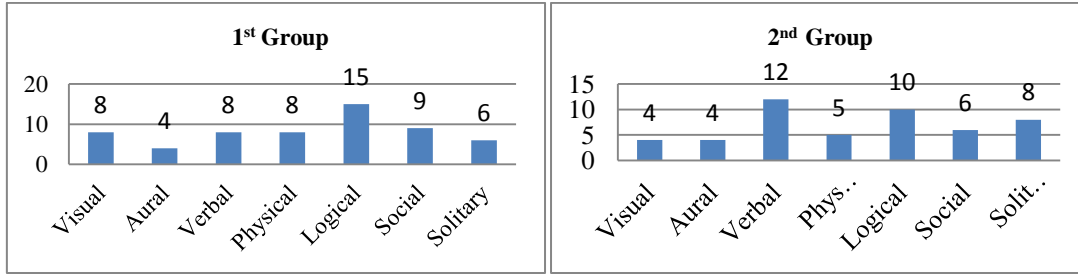
Figure 1. The number of students and their learning styles in each group
(Şekil 1. Her bir gruptaki öğrenci sayıları ve öğrenme biçimleri)

It is not surprising that the logical learning style in each group is a notable number since these are engineering students. 20% of the students in the first group have a social learning style that supports the 1st teaching strategy that plays the game. The students having physical, verbal, and visual learning style were expected to be more successful in the quiz. The questionnaire results state that most of the students in the second group have a verbal style followed by a logical style. Considering Table 1, it is observed that 2nd teaching strategy exhibits more successful results. For the case considered in this study, the new generation students in 2nd group understood the subject better by watching the simulation of the event that is also supported by explanations verbally.

Table 1. Test statistics for the quiz results in each group
(Tablo 1. Her bir grubun küçük sınav sonuçları için test istatistikleri)

Statistics	1st Group	2nd Group
Sample Size	45	35
Mean	57.86	71.43
Standard Deviation	14.00	12.04

6. CONCLUSION AND RECOMMENDATIONS
(SONUÇLAR VE ÖNERİLER)

This study assesses two teaching styles and tries to identify a relationship between students' learning styles and their success. First teaching style was defined as an educational game because the use of games reinforces the knowledge and skills learnt by students. It is observed that students have both positive and negative attitudes to the use of games, suggesting that games may support the learning styles of some students, but not others. Also, it is concluded that any educational game in the classroom should be well organized to benefit from the learning environment and small groups should be defined. Educators should not assume that all students might find games enjoyable because either depending on student's learning style or character, some of the students were observed to get bored during the educational game. Future research is needed to establish the utility of classroom games for engineering students. The real-world experience is invaluable for students because participants not only play an educational game and complete an actual project but also got to strengthen their oral and written communication skills and manage interpersonal conflicts.

The second teaching style was designed as to use the technology and a simulation video was used to teach the concepts. It was observed that students had enjoyed the class and able to understand the concepts better by visual and audio support. It can be claimed that a

well prepared video simulation can be helpful to teach any concept in IE education although it might be time consuming and costly.

Learning styles of students in each class might be considered to stimulate the attention of students during teaching. Depending on the class size, the difficulty, and students'familiarity to the subject being taught, different teaching style can be used. Since there are a scarce number of studies for engineering, particulary IE, education, this study aims to take attention of researchers to this area. Following studies might utilize 3D environments and several outcomes can be assessed. Further, the members of the same group whose learning styles are previously determined may be studied for different teaching styles.

NOTICE (NOT)
In this study, 22-24 September 2011 in Elazig between the "(ICITS-2011) 5 International Computer and Instructional Technologies Symposium" presented as an oral presentation in.

REFERENCES (KAYNAKLAR)
1. Alpers, A.L. and Trotter, E., (2009). Teaching computational discrete optimization at the undergraduate level. INFORMS Trans. Ed. 9(2) pp:63-69.
2. Barbe, W.B., Swassing, R.H., and Milone, M.N., (1979). Teaching through modality strengths: Concepts and practices, Columbus, OH: Zaner-Bloser.
3. Behara R.S. and Davis M.M., (2010). Active Learning Projects in Service Operations Management. INFORMS Trans. Ed , 11(1), 20-28.
4. Bennett S., Maton K., Kervin L., (2008). The 'digital natives' debate: A critical review of the evidence, British Journal of Educational Technology, 39(5), pp:775-786.
5. Berkebrede, G., Warmelink, H.J.G., and Mayer, I.S., (2011). Reviewing the need for gaming in education to accommodate the net generation, Computers and Education, 57, 1521-1529.
6. Blakely, G., Skirton, H.G., Cooper, S., Allum, P., and Nelmes, P., (2009). Educational gaming in the health sciences: systematic review, Journal of Advanced Nursing, 65(2), pp:259-269.
7. Coffield, F., Moseley, D., Hall, E., and Ecclestone, K., (2004). Learning styles and pedagogy in post-16 learning. A systematic and critical review. London: Learning and Skills Research Centre.
8. DePuy, G.W. and Taylor, G.D., (2007). Using Board Puzzles to Teach Operations Research. INFORMS Trans. Ed. 7(2) 160-171.
9. Drake, M.J. and Mawhinney, J.R., (2007). Inventory Control at Spiegel Grove. INFORMS Trans. Ed. 8(1) pp:19-24.
10. Felder, R.M. and Henriques, E.R., (1995). Learning and Teaching Styles In Foreign and Second Language Education, Foreign Language Annals, 28, 1, pp:21-31.
11. Gan, H., Khammuang, K., and Wirth, A., (2007). Getting out of a (Strawberry) Jam: An Introduction to Supply Chain Analysis. INFORMS Trans. Ed. 6(3) pp:20-27.
12. Gray, I., (2011). Learning from a Classroom Manufacturing Exercise, INFORMS Transactions on Education, 11, 2, pp:77-89.
13. Goldratt, E. and Cox, J., (1992), The Goal: A Process of Ongoing Improvement, 2nd Revised Edition, Great Barrington, Massachusetts: North River Press.
14. Hans, E.W. and Nieberg, T., (2007). Operating Room Manager Game. Revisited. INFORMS Trans. Ed. 8(1) pp:25-36.

15. Johnson, A.C. and Drougas, A.M., (2002). Using Goldratt's Game to Introduce Simulation in the Introductory Operations Management Course. INFORMS Trans. Ed. 3(1) pp:20-33.
16. Köksalan, M., Özpeynirci, S. ve Süral, H., (2010). Case Article—Forecasting beer demand at Anadolu Efes. INFORMS Trans. Ed. 10(3) pp:140-155.
17. Lange, I. and Ziegenbein, A., (2005). The constraints game-learning, studying and teaching, in the Prooceedings of 9th International Workshop on Experimental Interactive Learning in Industrial Management: New approaches on learning, studying and teaching, Espoo, Finland, June 5-7 2005, 11 pages.
18. Langlois, J. and Thach, S., (2001), Teaching and Learning Styles in the Clinical Setting, Family Medicine, Vol. 33, No. 5, 344-346.
19. Robb, D.J., Johnson, M.E., and Silver, E.A., (2010). An in-class competition introducing inventory management concepts. INFORMS Trans. Ed. 10(3) pp:122-125.
20. Rump, C.M., (2002). COPS: Whatcha Gonna Do?. INFORMS Trans. Ed. 2(2) pp:47-55.
21. Salman, F.S. and Koksalan, M., (2003). Beer in the Classroom: A Case Study of Location and Distribution Decisions. INFORMS Trans. Ed. 4(1) pp:65-77.
22. Strickland, D.M., (2008). Teaching Note—Using the maximum clique problem branch-and-bound. INFORMS Trans. Ed. 8(2) pp:96-99.
23. Teich, J.E., The Bread/Flour/Grain Trading Game: Bidding in and Designing Auction. INFORMS Trans. Ed. 5(3) pp:42-54.
24. Umble E.J. and Umble M., (2005). The production dice game: an active learning classroom exercise and spreadsheet simulation, Operations Management Education Review, 1, pp:105-122.
25. Villalobos, J.R., (2007). The Stock Portfolio Game. INFORMS Trans. Ed. 8(1) pp:41-48.
26. Wright, R.S. Ammar. (2009). Accessed June 16, 2011, http://web.lemoyne.edu /~wright/ learn.htm.
27. Yaliz, D., Sonmez, A.G., and Eristi, B., (2009). Learning styles of students in the department of physical education and sports education and sports teacher at Anadolu University, IJAS Germany Conference, Gottenheim, Germany, 01-04 December 2008.
28. Zimmers, E.W., Tonkay, G.L., Baskin, N.L., Butler, L.R., and Sohail Ahmed, M., (2004). Operations management education utilizing e-learning techniques with industry-university collaboration. Proc. 2nd World Conf. POM/15th Annual POM Conf.,Cancun, Mexico, April 30–May 3. Accessed June 16, 2011, www.pomsmeetings.org/ ConfProceedings/ 002/POMS_CD/…/002-0030.pdf.