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EFFECTS OF VEE-DIAGRAM FOR UNDERSTANDING OF NEWTONIAN LAWS OF MOTION AND ATTITUDE TOWARDS PHYSICS LABORATORY

ABSTRACT

V-diagrams which one of the learning and alternative assessment strategies in science education.In this study, has been investigated effect of v-diagram on understanding of Newtonian laws of motion and attitude towards physics laboratory in preservice physics teachers. The participants are 73 physics students enrolling to the art-science faculty physics program of Suleyman Demirel University in Turkey. The participants of the study took Mechanics Laboratory-II course in 2008-2009 fall semester. In the study which was done with a pre-test post-test quasi-experimental-control group design, experimental group courses were done laboratory reports with v-diagram, the control group's courses were done laboratory reports classical methods. It has been used Attitude Scale towards Physics Laboratory (ASPL) and Newton Conceptual Understanding Test (NCUT) for determining data. After the fourteen weeks of application, the results of study emerged, v-diagram has caused to more increase understanding of Newtonian law of motion than classical laboratory reports, but not difference at attitude towards physics laboratory.

Keywords: Vee diagram, Attitude, Newtonian Laws of Motion, Physics Education,Physics Laboratory

V-DİYAGRAMININ NEWTON HAREKET KANUNLARININ ANLAŞILMASINA VE FİZİK LABORATUVARINA KARŞI TUTUMA ETKİSİ

ÖZET

V diyagramları fen eğitiminde öğrenme ve alternatif değerlendirme stratejilerinden biridir. Bu çalışmada, v-diyagramlarının fizik öğretmen adaylarının Newton Hareket Kanunlarını anlamasına ve fizik laboratuarına karşı geliştirdikleri tutuma etkisi araştırılmıştır. 2008-2009 güz döneminde Süleyman Demirel Üniversitesi Fizik Bölümü'nde Mekanik II laboratuarı dersini gören 73 öğrenci katılımcı olarak alınmıştır. Ön-test son-test kontrol gruplu yarı deneysel desenin kullanıldığı çalışmada, deney grubu deney raporlarını v-diyagramını yaparken, kontrol grubu klasik yöntemle yapmışlardır. Veri toplama aracı olarak, Fizik Laboratuvarı Tutum Ölçeği (FLTÖ) ve Newton Kavramsal Anlama Testi (NKAT) kullanılmıştır. 14 haftalık uygulama sonucunda deney grubundaki öğrencilerin Newton Kanunlarını anlamalarındaki artış kontrol grubundaki öğrencilere göre daha fazla olurken, fizik laboratuarına yönelik tutumlarda farklılık olmamıştır.

Anahtar Kelimeler: V-diyagramı, Tutum, Newton Hareket Kanunları, Fizik Eğitimi, Fizik Laboratuvarı

1. INTRODUCTION (GİRİŞ)

Experiments and laboratory activities have a significiant importance at science and physics education (Tamir, 1977; Hoffstein and Lunetta, 1982; Ayas et al., 1994; Karamustafaoğlu, 2000). Laboratory activities take a great part in science education in view of devoloping several skills such as logical thinking, critical thinking and scientific process skills. If these activities are only for repeatition, it is hard to establish a relation between the theoratical and practical knowledge. Using vee diagram which many studies have been done, makes easier to merge these knowledge and enable permanent learning (Karamustafaoğlu, 2000; Tsai, 1999; Trumper, 2003; Hesapçıoğlu, 1988; İlhan et al., 2009; Tortop et al., 2007 Alvarez and Risko, 2007). The vee diagram to provide students to understand the structure of knowledge and to understand the process of knowledge construction. The theoretical framework of the Vee heuristic is Ausubel-Novak theory of meaningful learning, which describes meaningful learning as the process in which the student chooses to relate new information to existing knowledge (Ausubel, 1968, Novak, 1985). Underpinning the epistemological vee diagrams Gowin (1981) are the principles of Gowin's educating theory to guide the thinking and reflections involved in making connections between the conceptual structure of a discipline (left side of the vee) on one hand, and its methods of inquiry (right side of the vee) on the other, as required for the investigation and/or analysis of objects or events to generate new knowledge claims as answers to some focus question(s) (top middle of the vee).

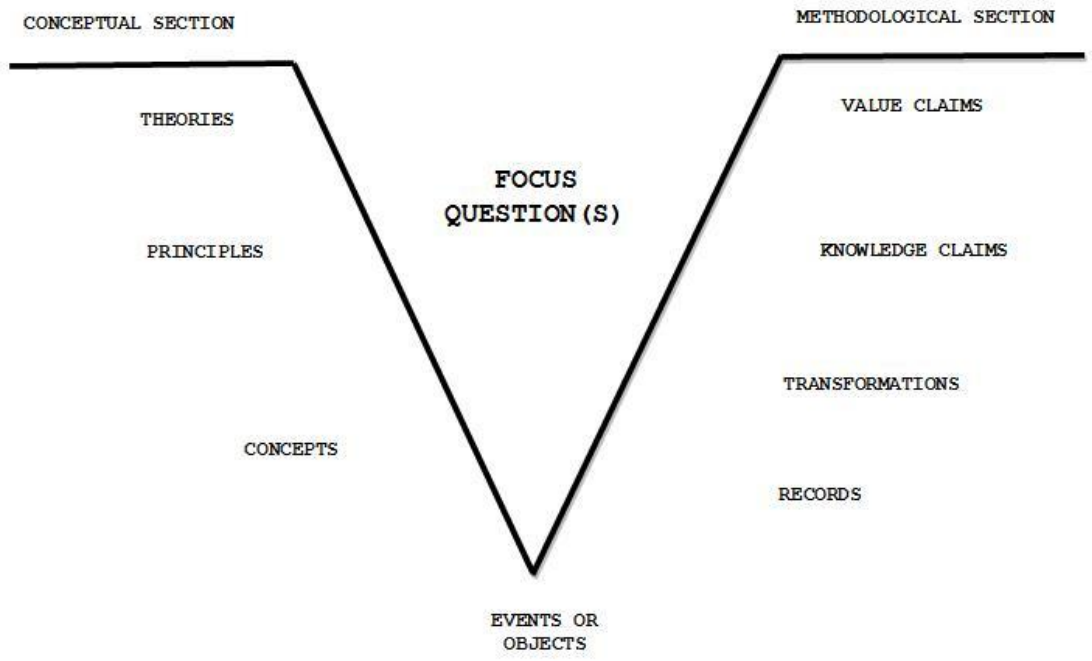

Figure 1. V diagram sample
(Şekil 1. V-diyagramı örneği)

The Vee diagram provides students in this linking process by acting as a metacognitive tool that requires students to make explicit connections between previously learned and newly acquired information. The Vee diagram, to enhance conceptual learning has been stressed by Novak (1990). Vee diagram has been used to guide students in their laboratory experience, to facilitate reflective thinking and learning,

as they plan and conduct their own investigations (Novak and Gowin, 1984; Nakhleh,1994). Luft, Tollefson and Roehrig stated (2001) that vee diagrams increase the communication skills of the students giving them opportunity of studying together since laboratory courses require preparation, it drives the students to research and it also provides a standard as an experiment report (Nakiboğlu and Meriç, 2000). A review of literature revealed that while learning physics subjects, in cooperative learning environments, use of vee diagrams caused students to participate in effective group work and increased attitude towards physics laboratory (Roth and Roychoudhury, 1993; Tortop et al.,2007).

Force concept which is one of the important concepts of physics, plenty of studies determining many misconceptions from primary to university students has been specified (Champagne et al.,1980; Eryılmaz and Tatlı, 2000, Gilbert et al., 1982, Jimoyiannis and Komis, 2003, Goldring and Osborne, 1994 , Trumper and Gorsky, 1996). Force concept is mainly handled in mechanic laboratory courses. Therefore, this situation will increase the importance of preparing experiment reports with vee diagrams.

The purpose of this research was to investigate the effects of vee diagraming on physics students at course Mechanic Laboratory. The research questions were: What was the influence of vee diagramming on students' understanding of Newtonian laws of motion and attitude towards physics laboratory course?

2. RESEARCH SIGNIFICANCE (ÇALIŞMANIN ÖNEMİ)

In the views of literature reviews, it is understood that vee diagrams as a teaching strategy is widely used in science education, especially chemistry and biology courses (Atılboz and Yakışan, 2003; Lebowitz, 1998; Nakiboğlu and Meriç, 2000; Nakleh, 1994; Sarıkaya et al., 2004), while this tool is not used often in physics courses (Ramahlape, 2004; Roth and Roychoudhury, 1993. For this reason, this study has been contributed to the literature.

3. METHODOLOGY (YÖNTEM)

This study was conducted pretest-postest quasi-experimental design (Büyüköztürk et al., 2011).

3.1. Sample (Örneklem)

Data of the study were obtained from 73 sophomore physics students enrolling to the art-science faculty physics program of Suleyman Demirel University in Turkey. The participants of the study took Mechanics Laboratory-II course in 2008–2009 fall semester.

3.2. Instruments (Veri Toplama Araçları)

Attitude Scale towards Physics Laboratory (ASPL): To determine pre-service teachers' attitude towards the physics laboratory course an 36 item developed by Nuhoğlu and Yalçın (2004) is used. The reability of the scale is calculated as Cronbach alpha (α) 0, 97. ASPL includes 19 positive and 17 negative the total of 36 Likert type questions. For statements representing positive attitudes toward the Vee diagram, 5 points were assigned to "strongly agree", 4 to "agree", 3 to "undecided", 2 to "disagree", 1 to "strongly disagree". As for the statements representing a negative attitude, the score was reversed. For the interpretation of the data "strongly agree" and "agree" responses and "strongly disagree" and "disagree" responses were combined together.

Newton Conceptual Understanding Test (NCUT): To determine pre-service teachers' understanding of Newtonian Laws of Motion was developed by Atasoy and Akdeniz (2007)is used. NCUT is consited of 20

multiple choose. To determine students' conceptual understanding level is possible with conceptual based question. For this reason related test is not required numerical process, contrarily it will be emerge from scientific problem solving and interpereting skills questions was selected. The reability of this test is calculated as Cronbach alpha (α) 0,85.

- **Sample question:** It was shown three position which complete oscillation of pendulum bob as follow. Pendulum bob positions has been shown Figure 1 on the button left, Figure 2 on the button middle, Figure 3 on the button rigth. Each of three positions if there was a net force upon pendulum bob, which options correctly explain the net force as following?

Figure 1

Figure 2

Figure 3

Figure 2. Sample question of NCUT
(Adapted from, Atasoy and Akdeniz, 2007)
(Şekil 2. NKAT örnek soru)

A. a F force on the left side Gravitation force to down a F force on the right side
B. Gravitation force to down Gravitation force to down Gravitation force to down
C. a F force on the left side Net force is zero a F force on the right side
D. a F force on the right side Net force is zero a F force on the left side E. a F force on the right side Line tension to upward a F force on the left side
Explanation:

3.3. Procedure (İşlemler)

The quasi-experimental model was used in this study. This study was done by 73 sophomore physics students which had been taking Mechanic Laboratory-II course at Fall semester of 2008-2009 academic year at the deparment of physics. The students obtained the datas and prepared experiment reports with groups. These experiments are done parallel with Mechanic Course-II. Example of experiments are the determination of the coefficient of friction, uniform circular motion, projectile motion, newton's second law and definition of mass, collosions etc. al. Thirty eight of these students formed the experiment group who had prepared Mechanic Laboratory course report with v-diagram and the rest thirty five students formed the control group who had prepared Mechanic Laboratory-II course report traditional method which include parts as experiment name, aims, results. Pre-test and post-test control group pattern was used while forming sampling.

4. FINDINGS AND DISCUSSION (BULGULAR VE TARTIŞMA)

Table 1. NCUT pretest and posttest points of t-test results
(Tablo 1. NKAT öntest ve sontest puanlarının t-test sonuçları)

		N	M	SD	F	t	df	p
Pre-test	Experimental group	38	7.07	2.24	.092	-.58	71	.56
	Control group	35	7.37	2.03				
Post-test	Experimental group	37	9.75	2.52	1.24	2.91	70	.005*
	Control group	35	8.22	1.84				

* p<.05

As shown in Table 1, the pre-test results done to identify the level of understanding of Newtonian laws of motion the experimental and control group. Results of t-test showed that meaningful difference between the groups was not identified (t(71)=,58; p>05). According to this result, the level of understanding of Newtonian law of motion of the students for both groups in the beginning of the process is equal. This data shows that the study is suitable to be carried out with equal groups. It can be stated that the groups' level of understanding of Newton's law of motion in mechanic laboratory course has a homogeneous structure. At the end of process, the post-test done to identify the level of understanding of Newton's law of motion of the experimental and control group. Results of the t-test showed that there was a meaningful difference between the groups (t(70) = 2,91; p<.05). While the post-test score means of the experimental group students was (X =9,75), this value was realized as (x =8,22) in the control group. The difference between them is statistically meaningful. For this, it can be said that the scores of the level of understanding of Newtonian law of motion experimental group which prepared v-diagram. Vee diagram showed meaningful increase according to the control group which took traditional teaching method. This condition can be interpreted as mechanic laboratory courses done with computer assisted v-diagram have more contribution to the students' understanding of Newtonian law of motion level than the traditional teaching method.

Table 2. ASPL pretest and posttest points of t-test results
(Tablo 2. PLTÖ öntest ve sontest puanlarının t-test sonuçları)

		N	M	SD	F	t	df	p
Pre-test	Experimental group	38	135.73	17.06	.007	.55	71	.58
	Control group	35	133.57	16.27				
Post-test	Experimental group	37	138.94	16.06	.92	1.02	70	.30
	Control group	35	135.31	13.69				

* p>.05

As shown in Table 2, the pre-test results done to identify the level of attitude of physics laboratory experimental and control group. Results of the t-test showed that meaningful difference between the groups was not identified (t(71)=,55; p>05). According to this result, the level of attitude of physics laboratory of the students for both groups beginning of the process is equal. This data shows that the study is suitable to be carried out with equal groups. It can be stated that the groups' attitude of physics laboratory has a homogeneous structure. At the end of process, the post-test results done to identify the level of attitude of physics laboratory experimental and control group. Results of the test showed that there was not a meaningful difference between the groups (t(70)=1,02;

p>.05). For this, it can be said that the v-diagram has any effect for increasing of level of attitude of physics laboratory.

5. CONCLUSION AND FURTHER RESEARCH (SONUÇLAR VE İLERİKİ ÇALIŞMALAR)

In this study investigated the effect of v-diagram on prospective physics teachers' understanding level of Newtonian laws of motion and attitude towards physics laboratory course. This findings of the present study V-diagram enhanced laboratory applications had any effects on the students' attitudes towards mechanic laboratory course and however more contribution had on students' understanding of Newton's law of motion.

Physics teachers encounter difficulties while teaching physics. However, it is stated that they even continue to use traditional methods instead of contemporary teaching approaches in which students question their knowledge (Trumper, 2003; Halim and Meerah, 2002). The studies at literature reveal that not only students and pre-service teachers but also even teachers have misconceptions about Newton's law of motion and force concept (Trumper and Gorsky, 1996; Yip et al., 1998; Briscoe and Prayaga, 2004; Kikas, 2004).

Teachers is key factor at constructivistic approach, select appropriate teaching strategy and learning tools to class, and alternates wanted time. By means of using learning tools appropriate for the constructivist approach, teachers provide opportunities in which students are able to solve their problems and have their own discoveries. Teachers, which facilitators, should use learning tools such as vee diagrams and concept maps (Capel et al., 1998; Brooks and Brooks, 1999; Watts and Pope, 1989; Chen, 2002; Yanpar, 2001; Koç, 2007). In the course of teaching Physics, labarotory works and reporting have utmost importance. There has been findings about traditional reporting, most of students state thatit is bored and forced to memorization. In addition to data entries and writing results, use of vee diagrams, which connects theoretical and obtained knowledge, make learning permanent (Dilger, 1992; Nakiboglu ve Meriç,2000; Lebowitz, 1998). Students enjoy participating in lab activities. Not only does it give them a chance to get out of their seats, but they also have the opportunity to learn from their own experiences. The majority of the students like using the vee diagram as a lab report (Gowin and Alvarez, 2005; Tortop et al., 2007). In this study it has been found out that using vee diagrams are effective on understanding of level of Newtonian laws of motion however they are not effective on attitudes towards the course. But there are very studies vee diagrams positively effects on students attitudes towards course or students develope positive attitudes towards use of vee diagrams (Keles and Özsoy, 2009)

V-diagrams are important for science education because they can be used as a learning strategy and an alternative laboratory experiment report format. Hence, its can be suggested to be used as an alternative report format and evaluation tool in higher education with laboratories. For future studies may be adapt to use vee diagram on ICT, so facilitate to construction and ubiquitous learning.

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