An Investigation on Science Students’ Understanding and Solving Of Electric Problems

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Summary

Literature stress on complaints about students’ failure in physics lessons, arised from; the teacher and syllabus (Koca, 1999; Koca ve Şimşek; 2001; Tunçer ve Eryılmaz, 2002; Aycan ve Yumuşak, 2003), students’ prejudices and misconceptions (Demirci ve Çirkinoğlu; 2004; Özdemir, 2004; Çıldır ve Şen, 2006; Stein ve diğ., 2008), ways or methods of teaching (Bağcı, 1999; Azar ve Çepni, 1999; Gürel ve diğ., 2002), assessment and evaluation (Morgil ve Bayaran, 1996; Yiğit ve diğ., 1999; Demirci, 2007). Different reasons for students’ failure in physics lessons should be sought other than learning environments and teachers’ failure in helping students love physics lesson. While students’ achievements in physics are determined by multiple choice tests in the university entrance exam, open questions are mainly used in assessment at the universities. Majority of university students state that they were successful in physics lessons before they came to the university, and they explain this situation making a connection with the number of question they solved correctly in the university entrance exam. Demirci (2007) points out that students who got high score in physics from the university entrance exam are not that much successful in solving physics problems at the university level. Moreover, topics being taught in the fundamental physics courses at the university are almost the same topics being taught in secondary level, yet more detailed. In that case, what are the reasons for students’ failure in physics (Akdeniz, Yiğit ve Karal, 2004) eventhough the topics being taught are almost the same? The experiences for years show that students do not have difficulties to learn basic concepts and principles that are subjects of physics, but majority of the students do not transfer or apply their knowledge to solving different problems. There could be many reasons underlying this situation. In this current study, it is thought that strategies that are not taken into consideration such as drawing diagram or pictures to understand the posed problem, using appropriate symbols and sorting different states out in the problem can be one of the reasons. This is because of the fact that in many studies most of the methods support drawing tables, pictures or diagrams (Polya, 1988; Dhillon, 1998; Kavaz ve Eryılmaz, 2002; Özkök, 2005; Kara 2007). If it is accepted that there is a positive relationship between students’ achievements and their visual capacity, their figures or other descriptive drawings need to be investigated during investigating their ways of understanding of physics problems.

The aim of this study is to investigate students’ capacities in reading comprehension of physics problems and their abilities to transfer what they were asked to do in the problem to paper. To accomplish this main aim answers were sought for the questions; a) How students convert the problem text to drawings or how they complete the drawings given in the problem? b) How they explain why they did their drawings or complementary drawings the way they did?

This survey study was carried out with 40 student teachers in a Primary Science Teacher Education Programme at a university. In different times five open questions related to the topic “electricity” were asked to the participating students. Four of the questions require drawings and one requires completions in the drawing given. The questions were asked just before starting new topic to allow students to establish conceptual connections between the

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learned and new topic as well. Students were asked to solve the problems using drawings after presenting the questions, prepared by benefiting from textbooks, in written formats and verbally. For each question, students were asked to solve the problem within ten minutes on a paper, stressing on drawings. The lecturer solved each problem on the board, drawing related diagram or picture, at the end of time allowed for students, and then students were asked to write down the ways they followed during their own drawings and solutions. Their answers on a paper for each question were collected at the end of the process. Drawings were put into categories taking students’ different perceptions into consideration, and using quantification, basically frequency and percentage, students’ views related to each category were determined. As Erhlem (2009) points out, data are more reliable if you obtain students’ point of view at the end of the process in order not to spoil students’ concentrations.

Findings from the study revealed that students have difficulties in complementary knowledge such as balancing forces, electrical charge, balance principles, understanding of three-dimension environments in coordinate system, direction of electrical field, and not being able to display forces in three-dimension space, which arise from E and B.

According to the study, students’ drawings that require their comprehension of what they were asked were based on their efforts to adapt similar questions they had solved earlier. Analysis of students’ explanations about a question which requires diagram completion shows that students focused on forces on a imaginary “+” charge even though the particle is an electron in the problem. Walsh et al. (2007) found out that students do not pay attention to the meaning of the sentences or words in the problem, and they prefer a scanning approach rather than sufficiently thinking about problems. These results also coincide Gök & Silay (2008)’s findings; that is, students have deficiencies in their solutions of problems such as, lack of reasonable visualization of the problem, adapting their solutions to the solutions of previously solved problems and benefiting from examples solved in the classroom or textbooks. These findings also indicate that students are not capable of constructing meaning conceptually, and thus this effects their problem solving process. These findings also coincide Vanlehn (1998), Heyworth (1999), Kim & Pak (2002)’s findings, in which they conclude that students who solve problems well have better conceptual understanding.

Findings indicate that students had not experienced these processes in solving problems in physics lessons, or, it is related to the preparation process of university entrance exam. Students use their operational knowledge since almost in early years of primary education students start private preparation courses, and thus in those courses they mainly focus on special techniques of solving multiple choice test questions. Kaya Şengören et al. (2006) point out that students’ inappropriate drawings is a result of not attaching required importance to this matter in secondary level.

Students’ memorization of questions formats, their anxiousness about timing during problem solving and their efforts to understand the problem benefiting from solved examples can be thought as reasons for failure in physics lessons. It is possible to overcome this situation by using questions which require reading comprehension in university entrance exam. That most of the physics questions are figure, graph or diagram-supported in current university entrance exam maybe prevent further failure in physics. However, this study revealed that students’ abilities in appropriate visualization of problems are weakened since required drawings of the problems are usually provided for students.

To solve problems successfully students need to not only know subject matter, mathematical equations and principles but also they need to comprehend these in-depth, relate these with concepts in similar topics and know how to use their knowledge in application. For this reason, we need to make room for activities supplying conceptual understanding in physics lessons besides operational knowledge. Research show that school that has a high achievement in verbal area has a high achievement in physics lessons as well (Köse, 1999),
and also PISA results illustrated that the first ten countries have a high level of reading comprehension (Anderson ve diğ., 2007). These tell us that students’ comprehension skills need to be developed in order to increase achievement in physics.