Extended Summary

Is it Possible to Eliminate Alternative Conceptions and to improve Scientific Process Skills with Different Conceptual Change Methods? ‘An Example of Electrochemical Cells’

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Introduction

The content of science consists of scientific concepts and Scientific Process Skills (SPS). Which one is more important: Giving the scientific content to the students or SPS in science education? Both scientific content and SPS have the same importance in science education. When the literature is investigated, it is observed that there has been a positive relationship between students’ conceptual development and SPS (e.g. Beaumont Walters & Soyibo, 2001).

In order to succeed conceptual teaching effectively and gain SPS, the students first need to get rid of alternative conceptions and to teach them how to reach information. However, when the studies conducted both in Turkey and in the other countries around the world are investigated, it was determined that the students have some alternative conceptions before or after they come to the class environment and the students’s SPS levels are low. Term ‘alternative conceptions’ means that students hold various conceptions which differ from the scientific one accepted by scientific community (e.g. Bodner, 1990). In fact, because alternative conceptions are not necessarily spontaneous ideas, they may result from instruction, or teachers, or the textbooks or the discrepancy between daily language and scientific language or students’ social environments (Nieswandt, 2001). This means that teachers are potentially one of resources producing alternative conceptions. Phrased differently, if teachers or student teachers do not fully hold sophisticated subject matter

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knowledge and think their existing conceptions are correct, they may engender students’ alternative conceptions (Karslı & Çalık, 2012). For this reason, remedying student teachers’ alternative conceptions would be worthwhile to prevent teacher-based alternative conceptions.

Chemistry course has been described as a difficult subject by students of different ages in different countries it has a lot of abstract concepts (Orgill & Bodner, 2004; Ayas & Demirbaş, 1997). As well as, it was determined that “electrochemical cells” was the one of the difficult topics to teach and understand for teachers, student teachers and students because of being its both complex and contain qualitative and quantitative variables (Ogude & Bradly, 1994).

There are studies conducted to determine alternative conceptions about electrochemical cells concepts in the literature. Further, their sample range is varied: high school and graduate students (Schmidt et., 2007; Ogude & Bradley, 1994; Sanger & Greenbowe, 1997), and even the chemistry textbooks (Sanger and Greenbowe, 1999). Since identifying and/or categorizing students’ alternative conceptions are not enough to overcome them. Conceptual change studies have generally concentrated on one conceptual change method and/or technique on electrochemical cells concepts. They have also often employed one conceptual change method and/or technique to facilitate students' conceptions. All of them point out that their used conceptual change methods and/or techniques are effective in remedying students' alternative conceptions. But they also report that their used techniques fail to completely overcome the students’ alternative concepts on the electrochemical cells. Unfortunately, this may stem from structure of conceptual change method and/or technique. That is, using just one teaching method to accomplish conceptual change may in fact result in some disadvantages (Karslı and Çalık, 2012). For example, it is generally not possible to find a course book or curriculum document that incorporates conceptual change text for all topics of study at school. In any case again students soon become bored with continued reading of conceptual change texts (Orgill & Bodner, 2004). A similar situation applies to the repeated use of computer animation or analogy (Huddle, White & Rogers, 2000). To prevent such problems, using two or more conceptual change methods or techniques may help students develop a better conceptual understanding.
because this process gives an opportunity for students and improve their SPS to expose to an enriched learning environment.

**Purpose of the Study**

The aim of this study is to develop a laboratory guided material offering the opportunity on both improving SPS and conceptual change of prospective science teachers about the concepts of “Electrochemical Cells” at the course of laboratory practices in science education and investigate the effectiveness of the material on them.

**Methodology**

The sample of the study consisted of 49 third-year students enrolled in two different classes of Department of Science Teaching Programme in Faculty of Education in Giresun University. A quasi-experimental approach with a pre-test–post-test design was used in this study. Experimental group was instructed with enriched laboratory guide materials embedded different teaching methods and techniques such as worksheet, computer animations, conceptual change text, hands-on activities, and experiment within 5E model. Control group was instructed with traditional methods (theoretical knowledge, question-answer, and experiment). The data were gathered by means of Multiple Form of Science Process Skills Test (MSPST) developed by Karslı and Ayas (2013) and two-tier Electrochemical Cells Concept Tests (ECCT).

**Results**

The statistical analysis of the data obtained from the MSPST and two-tier ECCT indicated that there were significant differences in favor of the experimental group in terms of the prospective science teachers’ achievement both their SPS and conceptual change (p<0.5). The results obtained from qualitative data indicated that laboratory guide materials based on the 5E instructional model and enriched with different teaching methods and techniques helped the prospective science teachers both to improve their SPSs and achieve conceptual change together with removing their alternative conceptions. In order to teach the concepts and improve SPS of students, activities or teaching materials such studies illustrated here should be developed, applied and examined the effectiveness of physics, chemistry, and biology courses.

**References**


