Reporting Laboratory Applications in Argument-Based Science Inquiry Report Format Effects on Conceptual Understanding and Using Modal Representation

Safiye ASLAN*, Nurcan TEKİN**

Extended Summary

In the last half century, the research seeking an answer to the question “How do people learn?” resulted in a paradigm shift in learning (Köseoğlu & Tümay, 2013). A new paradigm called constructivism causing educational policies to change and instructional programs to be renewed entails active participation of students in their own learning processes, provision of experiences for students to stimulate their thoughts and promotion of students to rearrange their convictions and beliefs (Köseoğlu & Tümay, 2013; Schunk, 2011). In this context, the meaning loaded on learning by constructivism is “discovery and construction of meaning by the individual” (Köseoğlu & Tümay, 2013). For the process of discovery and construction of meaning, an inevitable tool is “language”. Therefore, speaking and writing activities that are the utilization areas of language are of great importance for learning process. In this regard, the present study focused on writing activities.

Purpose

The study aims to investigate the using different reporting formats while writing the reports of laboratory practices on the students’ levels of acquiring concepts related to reaction rate and equilibrium and using modal representation. For this purpose, answers to the following questions were sought:

1. According to the results of the evaluation made based on letter writing activity, is there a significant difference between the levels of concept learning related to reaction rate and equilibrium of the students preparing laboratory reports in line with argumentation-based science inquiry (ABSI) report format and the students preparing laboratory reports in compliance with the traditional report format?
2. Is there a significant difference between the modal representation descriptions used in the letter writing activity by the students preparing laboratory reports according to ABSI report format and those used by the students preparing laboratory reports?
reports according to the traditional report format in terms of genre of the descriptions and suitability of the descriptions?

**Method**

In the study, one of the qualitative research methods, case study method was used. In this case study, the data were collected in the form of a written document (letter) and were evaluated through content analysis (Creswell, 2013, p. 104). The letters written by the students and dealing with the subjects reaction rate and equilibrium were evaluated by using the rubrics designed after seeking the opinions of an expert on the issue of rubric. These letters were separately evaluated by two researchers by using the evaluation rubrics, assessment consistence identified, inter-rater reliability was found to be high and agreements were reached on evaluations not showing compliance with each other and the evaluation results related to the data were analyzed.

The study was conducted with 11 male and 27 female first-year students, totally 38 students, from the department of science teaching of a Turkish state university in 2013-2014 academic year within the context of general chemistry laboratory II course. Within the present study, totally five experiments, three of which were about the topic of reaction rate (the effect of concentration, heat and catalyst on the reaction rate) and two of which were about the topic of chemical equilibrium (Le Chatelier Principle, the effect of heat on chemical equilibrium) were conducted. Of 38 students participating in the study, 17 took the laboratory course in Class A and 21 took the course in Class B. While the students of Class A reported the laboratory applications according to traditional report format, the students of Class B did it according to ABSI report format. The classes were randomly selected by the researchers. The groups’ achievements in relation to the chemistry laboratory courses were determined by comparing their grades taken from the general chemistry laboratory I class taught last year and no statistically significant difference was found.

**Result and Discussion**

At the result of the study, it was concluded that using different ways of reporting did not lead to a statistically significant difference between the students’ levels of concept learning related to reaction rate and equilibrium. This result is not consistent with some other research exploring the use of ABSI report format (Demirbağ & Günel, 2014; Kabataş Memiş, 2014; Kıngr, 2011; Kıngr, Geban & Günel, 2011; Yeşildağ-Hasançebi & Günel, 2013). In mentioned studies teaching-learning process was conducted in line with ABSI approach and ABSI report format was used both as a part of the process and as a means of evaluation of it. However it was used as a complement to the laboratory applications and a learning tool in this study. ABSI approach was not use in the laboratory, that’s why the efficiency of ABSI report format may have been reduced. Moreover, it was determined that in the
previous term, the students used the traditional report format in all of their laboratory courses. In addition to this, use of only five experiments may not have been enough to elicit the differences to be brought about by the use of two different report formats during the laboratory applications between the students’ levels of the concept learning related to the topic of reaction rate and equilibrium. Besides, the students may have been inadequate in displaying their conception and understanding of the topic through writing. Finally, as the students were first-year undergraduate students and before their university education, they mostly dealt with multiple-choice questions to be successful in the university entrance exam, they might have lacked the experience required to organize the information they learned in a written format. This may have also affected the results of the study.

As a result of the analysis of the data collected in the study, it was found that both groups of students made use of textual, mathematical and graphical representations; yet, few students in the control group also used pictures in addition to these types of representations, the level of using modal representation in their letters is low for both groups; on the other hand, they constructed high majority of their representations in a manner that can be considered scientifically correct and the representations in which the highest mistakes were found graphical representation. Modal representations can be considered an indication of the deep understanding. In this regard, when the findings of the study were evaluated, it was observed that the both groups of students did not develop deep understanding of the subjects of reaction rate and equilibrium, or even if they had developed a deep understanding, they could not have demonstrated how to organize this in a writing activity in which they could use modal representations.

The findings of the study show that the ABSI report format, one of the non-traditional writing activities, is not enough to acquire a deep understanding of science concepts without being accompanied by a learning process based on ABSI. Moreover, it can be argued that students need guidance during the use of ABSI report format for the proper utilization of modal representations. In this regard, the stages of ABSI report format can be revised and stages that can clearly support the use of modal representations might be added. In this way, students can be helped to use non-traditional writing activities and modal representations during learning processes.

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