ABSTRACT

This classroom research project explores the use of guided inquiry and inquiry-based lab activities with college-preparatory chemistry students. The effects of such instruction on student achievement and content comprehension is explored. Also, the effect of cognitive development on student achievement is examined, as well as how students may be aided in their development from concrete toward formal thought. Results showed that concrete thinkers require specific methods of instruction both for science content and in order to aid their cognitive development.

INTRODUCTION

Success in learning science rests in large part on a student’s ability to think formally, or abstractly. In my study I attempt to discover the extent to which my work with students helps them to develop their formal reasoning skills. I am interested in this topic as a result of my teaching practice.

RESEARCH QUESTIONS

How does my work with students, including an implementation of the POGIL teaching method and inquiry-based lab activities, contribute to their growth in developing from concrete thinkers toward formal reasoners?

1. How does the use of POGIL and inquiry-based lab activities affect students’ development of reasoning skills?
2. How does a student’s initial measured level of reasoning skills affect comprehension of science content?
3. How does the use of POGIL affect students’ own evaluation of their success in chemistry?
4. How does my reflection on my practices with respect to the aim of developing students’ formal reasoning affect my approach to teaching?

METHODS

As a central part of my teaching I ask students to work together in small groups to construct their own understanding of the material in the unit. The groups are heterogeneous and teacher-selected. Students had defined roles such as Manager or Reader and they were given the task of working through the carefully designed materials.

RESULTS

Results of the LCTSR test showed that 87% of students were either concrete or early transitional reasoners. The better the existing reasoning skills of the student, the better the student performed on assessments, even though not tested directly on reasoning ability.

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Fig. 1 Sample page from a POGIL activity

Questions which follow this model require students to examine the it carefully. The patterns and relationships shown in the model are discovered by the students, who are guided to form appropriate conclusions.

Fig. 2 Classroom Test of Scientific Reasoning Results

The use of POGIL, inquiry-based laboratory activities, and a learning cycle approach to teaching new material did not lead to much gain in terms of reasoning ability. In fact, when the LCTSR was given again after several months of instruction it was found that most students remained in the same reasoning category. Still, it is valuable to note how important reasoning skills are with respect to learning new material in science.

Fig. 3 LCTSR categories compared with quarter 1 comprehensive test scores

The LCTSR places students into one of four categories: Concrete, Early Transitional, Late Transitional, and Formal. These terms were first introduced by Jean Piaget.