A Case Study of Creativity Development through Scientific Boat Construction

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Abstract: Fostering students' creativity helps enhance their problem-solving abilities and hands-on skills. The purpose of this study was to cultivate middle-school students' creativity and problem-solving abilities through collaboratively constructing a scientific boat. In addition to boat artifacts, this study also collected interview and classroom observation data. The results indicate that the students were able to exert their imagination to create various types of boats with different materials. It was also found that the students' development of creativity appears to be associated with their preference for free-style thinking and boat construction concepts. Those who were more successful tended to appreciate the free style of imagination for constructing the artifact, and were also more self-motivated. On the contrary, those who were less successful in completing the task expected clearer instructions from the teacher. To more effectively help students develop their creativity, differing amounts of instruction provided to students of various backgrounds is important.

Keywords: Scientific boat construction, creativity development, collaborative learning

1. Introduction

Creativity in education has been a topic of concern since the 1950s [1] as it is seen as an important component for developing students' problem-solving and other cognitive abilities [2]. It is also a core element in advancing science [3]. The purpose of this study is to foster students' creative thinking through constructing an imaginary amphibious boat.

2. Literature Review

Most theories addressing creative thought are grounded on one of the following two assumptions: (1) viewing it as an unconscious, undirected incident, or (2) seeing it as a conscious, controlled occurrence that depends upon some mechanisms, such as analogical reasoning [4]. However, some researchers have found that creative effort involves cycles of conscious and unconscious processing occurring at various stages [5]. Once conscious processing has been triggered, the cycles of information processing and the associated strategies are activated to integrate the existing knowledge structures with new understandings of ideas, which are later translated into action [6].

Rowlands [7] argued that creativity is intrinsically subject to the teaching of the academic disciplines, in addition to novel ideas. Classrooms are generally not seen as creativity-cultivating places due to the lack of appropriate curricula [8] or to the preoccupations of the traditional classroom setting [9]. Amabile [10] emphasized that intrinsic motivation, such as self-achievement, is a prerequisite condition for creativity, and argued that a good learning environment helps cultivate such motivation.

The purpose of this study is to explore what and how students gain from being involved in a creative context and instructional activities aimed at helping them develop their creative thinking skills. Two research questions are addressed in this study:

1. How have the students benefited from engaging in constructing an imaginary boat?
2. What challenges have they encountered in the construction process?

3. Methodology

3.1 Research Context and Research Design

A teacher and 24 7th-grade students in a middle school in Taiwan were involved in the study. In 2011, one of the science projects the teacher asked the students to engage in was constructing an amphibious boat. The students were scheduled to meet every Wednesday for one hour in a designated classroom. The knowledge domain of the project was sciences and life technologies. To allow the students more room for creativity, only basic materials were provided to them, including 1 flat motor, 2 axles, 2 AA batteries, and 1 battery holder. In other words, the students had to design and decide on the remaining materials required to produce a boat, including the material for the hull and wheels, the size, and shape, etc.

3.2 Data Collection and Data Analysis

Three sources of data were collected, consisting of:

- Performance-based artifacts: to examine the students' learning outcomes. A course was built for the boat contest held at the end of the project to assess the students' creativity.
- Class observations: to gather the students' dynamic interactions during their participation in the project.
- Group interviews with the students: to obtain information about the students' learning experiences.

The interview data were transcribed verbatim and were analyzed. The analysis was triangulated with the classroom observation data and the contest results.

4. Preliminary Results

The classroom observation data revealed that the teacher adopted various instructional strategies to help the students fulfill the objectives, including mind mapping activities, six-hat thinking activities, lecturing on associated concepts, and requiring students to submit an end-of-project reflection report. The students, in general, were rather active in participating in the project activities.

Based on the presented artifacts, the students seemed to be able to exert their imagination to create various styles of amphibious boats using different materials, including styrofoam, plastic bottles, pearl board, and cardboard. In the contest, four groups (Groups 1, 3, 4, and 6) out of the eight made it right through the course and took 7, 5, 3, and 9 seconds, respectively. The boats in first and second place are displayed in Figures 3 and 4.

The interview data revealed that the students who succeeded in getting their boat through the course tended to appreciate the free style of imagination for designing and creating their boats; most were also more self-motivated. On the contrary, more than half of the students whose boats failed to successfully complete the course said that they had expected clearer instruction from the teacher, such as the shape of the boat, the size of the

wheels, the place for putting the motor, and the area for locating the axles. They also showed less desire to excel, and were found to have devoted less effort to producing their boats.

Figure 3. The 1st-place boat

Figure 4. The 2nd-place boat

5. Conclusion

Constructing a scientific boat allows students to engage in both imagination and problem-solving skills. In this study, the students' development of creativity appears to be associated with their preference for free-style thinking and boat construction concepts. As Rowlands [7] contended, in addition to innovative ideas, creativity is constitutionally subject to the teaching of academic knowledge. Creating a moving boat does indeed require some academic disciplines of floating, force, and balancing concepts. Those who anticipated more instruction from the teacher might have reflected that they were less proficient in the associated knowledge, and thus were less devoted to the project. In contrast, those who were able to integrate the attained concepts were also able to translate them into action, in accordance with Martindale's [6] assertion. The study discloses that it is important to provide an adequate amount of instruction to students of various backgrounds. For more advanced, self-motivated students, minimal instruction with maximal room to engage in free thinking is suggested, whereas for less advanced, less confident students, more detailed guidance is necessary.

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