

The constructivist approach of teaching and portfolio assessment on science teaching

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Abstract.

This study investigated the impact of the constructivist approach of teaching and portfolio assessment in elementary science learning. A constructivist approach which encourages students to predict, explain, debate, defend their ideas, and uses student-centered interaction, and a conventional teacher-centered approach were designed to compare the student learning. This was a quasi-experimental design, and involved four regular classes, 186 fourth graders, and two science teachers in the same elementary school in Taiwan. Each teacher randomly chose one class as the experimental group and one class as the control group and taught two different approaches. The four classes are regular, and might have different understanding about some science concepts. Therefore, each student took a pretest before the instruction. The science contents for this study are "Thermal Expansion" and "Air Flow". Data collected included quantitative and qualitative information of students' performance. The results of student learning in these two approaches were assessed through a two-tiered type of questions. The results of the pre-test showed that the students in the control group were significant better than those in the experimental group. After the instruction, the results of the post-test indicated that there was no significant difference between these two groups. The statistical results showed that the effect of the teacher was more important than the teaching strategy.

Subject/problem.

How people acquire knowledge has been frequently discussed in the field of education. Constructivism and behaviorism are the two different positions in this continuing debate. For constructivists, learning is not knowledge transplanted to the learner's mind but is constructed actively by learners. The constructivist view of learning has been recognized as a viable alternative by researchers in the field of science education (Pfundt & Duit, 1991). However, the constructivist approach has not been widely adopted by the public schools in Taiwan. Most current teaching promotes passive ways of learning. This study attempted to apply some instructional design variables suggested by the constructivists (O'Loughlin, 1991; Fosnot, 1989; Good & Lavoie, 1986) and to evaluate the effectiveness of these variables in current science teaching contexts in Taiwan.

Theoretical Perspective.

The concept about the process of the acquisition of knowledge has changed from behaviorism to that of constructivism in the past decades. This change influenced dramatically the field of teaching and learning in science. The objectivism claims that

the outcome of learning can be observed by the changes of learners' behavior. This notion has been challenged by some educators (Posner, Strike, Hewson & Gertzog, 1982; Bodner, 1986, Duffy & Janassen, 1991; Perkins, 1991). The perspective of constructivism was greatly influenced by Piaget (1980) and Ausubell (1968).

The constructivist claims that knowledge is not an entity that is waiting to be discovered, it is an ongoing process of criticism and creation. Thus, all knowledge we have at this moment is temporarily, it could be changed by the individual's knowledge schema and the interaction with the environment (Pfundt & Duit, 1991). Fosnot (1989) proposed four major principles for the constructivist approach, and indicated that the importance to understand students' preconception before teaching. In addition, classroom teaching has to provide students with opportunities to make hypothesis, to predict, to explain, to investigate, and to find their own answers (Saunders, 1992). The conventional teacher-centered approach de-emphasizes the discourse between teacher and students, teachers have the absolute authority in the classroom, especially in Taiwan. Driver, Asoko, Leach, Mortimer and Scott (1994) indicated the intrinsic nature of science knowledge constructed through the social communication. Therefore, learning occurs within a social context. Therefore, the interaction of teacher and students or students and students play an important role in learning.

Design/Procedure.

This was a quasi-experimental design, and involved four regular classes, 186 fourth graders, and two science teachers in the same elementary school in Taiwan. This school has five classes of fourth-graders in total, one is an art-talent class, the others are regular classes. We randomly chose two out of four classes as the experimental groups, the rest were the control groups. Each teacher randomly chose one each from the experimental groups and the control groups and taught two different approaches. One was the conventional teacher-centered approach, the other one was the constructivist approach which was carefully designed by the researcher and the two teachers. The major difference in these two approaches was the constructivist approach encouraged students to use prediction, explanation, debating and defending their ideas through student-centered interaction. Data collection in this study included the information of students' preconceptions, the pre- and post-test scores, the portfolio of students' progress, and the information of classroom discourse. The results of student learning in these two approaches were assessed by a two-tiered type of questions. As the four classes might differ to some extent, all students took a pre-test before the instruction. After the instruction, all students took a post-test and four weeks later, the students also had a retention test.

Data analysis and findings.

Student's performance was assessed by means of a post-test. The post-test was designed as a two-tiered type of questions. The two-tiered type of questions asked students to explain the reason after choosing a multiple-choice answer. Portfolio items in classroom observations included student participation in learning activities and discussion, student concentration, student attitude, etc. Some qualitative

information regarding students' alternative conceptions was also investigated (Erickson, 1979). The analysis of the covariance of the post-test indicates that in the first study unit (thermal expansion) there was no major effect in teacher and teaching strategy. However, there was an interaction between teacher and teaching strategy. The results of the retention test in the first study unit showed that the constructivist approach had a beneficial major effect. The analysis of the covariance of the post-test in the second study unit indicated that the teacher had a major effect on student's ability in explanation. Overall the statistical results showed that the effect of the teacher was more important than the teaching strategy.

General interest.

The results of this study provide an insight into the extent to which the constructivist approach can be incorporated into current science teaching. The value of this study is to remind the educators that the teacher might be the key factor when implementing a new teaching strategy, especially in Taiwan.

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