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Middle School Pedagogical Order: Lecture or Lab?

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Keywords

Laboratory Exercise, Lecture, Hands On Activities



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Barry R. Thompson and Thomas E. Deering

Abstract

A study was recently conducted in a suburban middle school regarding two teaching strategies. Ninety-three eighth grade students were administered a pretest regarding plate tectonics. Forty-one of the students conducted an inquiry lab; they participated in a class discussion regarding the material. Forty-two of the students first participated in a class discussion regarding plate tectonics; afterwards they completed the laboratory exercise. A posttest was administered at the conclusion of the unit. Ten students were not in attendance for both the pretest and the posttest. Statistical analysis of the 83 remaining students through the use of t-tests indicates no statistically significant performance difference on the scores of the posttest.

Keywords: inquiry, laboratory, taxonomy

Introduction

Many readers would agree that they have a preference when it comes to how they best learn material. How one learns best is a universal question which many have devoted their research lives to solving. There seems to be an almost endless list of learning theories and how and when to use each. Without trying to give a complete list of these theories it is helpful to mention Inquiry. Inquiry is a popular teaching strategy that often includes the use of scenarios designed to assist students create their own questions and protocols to solve their questions (Schwab, 1960). The use of inquiry in the classroom increased due to the launch of Sputnik, which was designed by the U.S.S.R., and was the first satellite to be launched into orbit. This caused a great deal of concern in the United States because it was thought to be proof that the U.S. was losing the Cold War with the Soviet Union. Many new inquiry based curricula, using hands-on laboratory experiences as a means to facilitate learning, were being designed by textbook publishers to increase student's understanding of and attitude towards science.

Unfortunately, for many years those using inquiry didn't see the expected increase in standardized test scores when measuring their student's learning. It was not until the 1980's that a meta-analysis was used to compare test scores of children taught by those who were properly trained to implement this new curricula. The results indicated significant improvements (Shymansky, Kyle, & Alport, 1982; Shymansky, 1984). The achievement test scores of those students using inquiry increased and attitudes became more positive. Several of these programs (Science Curriculum Improvement Study, Science a Process Approach, Biological Science Curriculum Study) were successful in using the process approach in order to increase learning for a variety of age groups.

In addition to theories, content is often taught with the idea that students have various learning styles such as auditory, visual, etc. (Dunn, et.al., 1995). It is hoped that through using instructional variety in the classroom, many different learning styles will be incorporated. This will help to address the various ways students learn such as the use of hands-on activities balanced with class discussions in order to best address the respective learning styles of their students in conjunction with preparing the students for evaluation. Learning is now measured through the use of standardized tests. These have become the evaluation procedure of choice with the advent of national and state standards; therefore, teachers have the obligation to instruct in a manner that best results in increased learning by students as measured by standardized tests.

Researchers in the past have shown that hands-on activities can be beneficial in conjunction with lectures regarding learning material on the standardized test. Saunders (1987) found that hands-on learning was more effective for student learning than was traditional lecture. It was also found that supplementary inquiry activities had a significant positive effect on the achievement of females, indicating an interaction between the genders and teaching strategy (Marshall & Dorward, 2000).

Further research results have indicated conflicting outcomes regarding pedagogical techniques. With regard to hands-on activities, Odubunmi, Olagunqu and Balogun (1991) found that when comparing the lecture versus laboratory teaching method, the cognitive achievement scores of low ability students were significantly higher for pupils instructed using the laboratory activities.

An Australian study conducted by Jones, Holland, and Oldmeadow (2008) indicated positive results when applying both inquiry and lecture. The study was designed to determine whether inquiry or lecture is better for college students (Jones, Holland, & Oldmeadow, 2008). The participants included 49 college students. The same students were exposed to both the inquiry and the lecture method and the results indicated a significant improvement with the inquiry approach at the .001 level. They also found however, they could cover more content using the lecture method.

When dealing with laboratory activities, one would assume that attending the lab would be beneficial to learning the content for the course. Attendance and grades were correlated and they were found to significantly correlate, indicating grades increase as the students attend their labs (Moore, 2008). This was a longitudinal study lasting for years and involving 1697 students. The researcher found that the students' respective grades declined progressively as the students missed one or more labs. Studies done with collegiate level students seem to indicate benefits of hands-on experiences and inquiry learning.

Saunders (1987) conducted research in fourth and sixth grade science classes. Findings indicated hands-on learning was better for student learning than traditional lecture type learning. Additionally, Chang (1999) whose participants included 600 junior high school students, found that students in the inquiry-group instruction classes had significantly higher achievement scores than the students in the traditional group instructional classes.

These researchers exposed different respective groups of students to different teaching approaches, lecture vs. lab, and lecture vs. inquiry. This creates the need for a study where the same students, as opposed to different classes of students, are taught the same material using different methods. This eliminates the potential confounding variable, different groups of students. Each classroom of pupils may react differently to various learning methods. The aforementioned researchers also used achievement and gender as variables. A study now needs

to be conducted whereby a common variable, such as socio-economic status can be compared to achievement.

Educators are beginning to acknowledge the importance of honoring the principles of authentic assessment. These principles require teachers to focus on approximating authentic real-world tasks in the subjects under study and on higher-order thinking skills, all while using assessment as a means for continual student improvement. This gives the student a better learning experience, and increases the chances that what they have learned will be of use beyond their current classroom experience. According to research, traditional assessment tools are often not helpful in assisting students to improve, to understand, or synthesize learned information (Wilson, 1994).

Findings from teacher questionnaires indicates that teachers feel that students achieve high scores in science knowledge and maintain or develop positive attitudes towards science when students are provided with opportunities that apply real-world scenarios to make connections between what is learned in science class and what students do in life (Brunkhorst, 1992).

Methodology

The implications of the research data analyzed indicate a need for more research. Many different variables, such as socio-economic status, must be explored in order to determine what teaching procedure is preferable for any respective group of students. The population in this research was eighth grade students in a suburban, middle class environment. Previously, students had been randomly assigned to specific science classes, and the teaching strategy was randomly chosen for each class.

There were four classes randomly assigned to each respective condition, lecture first versus laboratory first. The third and fourth period classes conducted the laboratory first, and the fifth and sixth period classes listened to a lecture first. All four classes were taught in the same science classroom by the same teacher and included standard furniture for a lecture/lab setting. There were 26 standard-sized desks for middle school students evenly spaced throughout the room. In addition, there were lab stations for groups of four students. The materials for the laboratory exercise were spread evenly around the lab. There was a teacher's work station at the front of the room which included a sink and a gas jet. The station was designed in order for the instructor to do a demonstration that the whole class can see. The station was therefore raised at a higher level than the student lab tables and was designed so the instructor would stand while doing a demonstration. Each teaching condition was designed to eliminate confounding variables such as a room change or change in instructor.

The teacher had previously taught several years and was working to complete a Master's degree. The teacher decided to incorporate both hands-on and lecture instructional procedures into the unit. The teacher assessed content knowledge at two intervals during the experiment and compared the results. Students were administered a pretest, and a posttest. Pretests were administered one week before the beginning of the study. The posttests were administered on the day following completion of the study. Both the pretest and the posttest were worth 100 points.

Results

A t-test was run on the data in order to compare the lab first versus the lecture first teaching strategy. There were no statistically significant differences concerning the pretest scores which indicated that all of the students began the instruction at the same knowledge level. There were also no significant differences in the posttest scores. These results indicate that when

comparing a lecture format to a laboratory format, the middle school students in a suburban setting will gain approximately the same amount of knowledge.

Conclusion

The implications of the results can lead to many future research questions. This study involved suburban students at the middle class socio-economic level. This study indicated that the order of class instruction, when dealing with lecture versus laboratory centered format, made no significant difference in learning. Further studies should be conducted with a different population of students.

These results also indicate the learning of specific information regarding physical science. This study involved plate tectonics. Future research should be done involving the learning of a different subject or group of subjects such as life sciences. These results also indicate no statistically significant differences in learning when dealing with a middle school population. Future research should be done which includes children older or younger than middle school age.

Several confounding variables could also be present. Further research must be conducted in order to determine if there was an interaction between the respective classes and the teaching strategy. Another potential confounding variable was time of day. The two classes that had the lecture first were later in the day than the two classes that conducted the lab first. Further research must be conducted in order to determine whether there was an interaction between the time of day and the teaching procedure.

Teaching procedures are sometimes dependent upon the content being covered. Clearly, the students can learn content that might be addressed on a standardized test by doing an inquiry experiment or listening to a lecture. An action research project conducted by a Master's degree candidate indicates that instructional order when utilizing lecture and laboratory teaching strategies makes no difference in the content learned when teaching plate tectonics to middle class, suburban students. Some students perhaps preferred one teaching strategy over another, so the best practices should include variety in instructional strategies.

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