

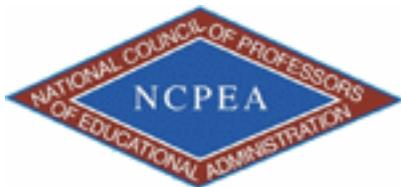
# INSTRUCTIONAL METHODOLOGIES' IMPACT ON CLASSROOM ACHIEVEMENT AND ATTITUDES: SHOULD SCHOOL LEADERS BE CONCERNED?\*

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## Abstract

School administrators are often under pressure to improve test scores and school accountability ratings. The school leaders are in need of data to assist them with decision-making. The purpose of this study was to discover whether students who are taught the same content using diverse methods have similar outcomes in learning, test scores, and attitudes. Two fourth grade classrooms were chosen to participate based on the methods the teachers used throughout the school year. This study was designed to determine whether using the inquiry approach, an approach most commonly found in use with young children, would be as effective as the deductive method with intermediate level students. Results indicate that the teachers' chosen methods did not result in significantly different student state-mandated assessment scores.



NOTE: This module has been peer-reviewed, accepted, and sanctioned by the National Council of Professors of Educational Administration (NCPEA) as a scholarly contribution to the knowledge base in educational administration.

One of the challenges educators face today is finding the best way to teach children while adequately preparing students to excel on state mandated tests. Educators are often curious about the comparability of learning in diverse classrooms, but are reluctant to try something new or different because they are not sure that the learning from those things will be more effective than the method they currently employ. Not only are

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they not convinced that student learning will increase, they are not certain that the learning will be as high quality as with their current methods.

The tendency in schools today is to teach to the high stakes tests in which children, teachers, schools, and districts are held accountable for passing. This type of teaching usually requires deductive instruction. A deductive classroom typically includes a direct-instruction approach. Smith (1994) defined direct instruction as, “an educational philosophy based on the belief that learning takes place most effectively when the learners are told in specific detail what they should learn and are monitored closely to ensure they do so” (pp. 309-310). Deductive instruction emphasizes decoding mechanisms in early reading. This type of teaching often has little or no emphasis on comprehension. The two methods most commonly used in the presentation of science material in deductive classrooms are question-and-answer and lecture (Yager, 1980, 1983; Yager & Stodgill, 1979).

An inquiry approach to teaching is child-centered and helps children develop thinking skills while gaining content knowledge (Blosser & Helgeson, 1990). Inquiry classrooms are moving from dispensing information solely from textbooks to an integration of the major ideas that connect the disciplines (Blosser & Helgeson). An inquiry approach promotes higher order thinking skills and a transfer of information into other disciplines, thus an inquiry curriculum combines a student’s experiences with the learning process (Resenick, 1979; Memory, Yoder, Bolinger, & Warren, 2004).

Characteristics of an inquiry classroom include active engagement, inquiry, problem solving, and collaboration with others. The teacher is a guide, or fellow researcher, who encourages learners to question, challenge, and formulate their own ideas, opinions and conclusions. Correct answers and single explanations are not emphasized (Cannella & Reiff, 1994).

#### Background

Harste (1994) expressed three requirements for a true inquiry curriculum. The first was openness, where students pose a question and are open to searching for their answers. The second requirement was what Harste called, “personalized construction of meaning” (p. 1223) which allows each student to construct his or her own meaning. Harste’s final requirement for an inquiry curriculum is collaboration; students and teachers alike are involved in each child’s inquiry process and meaning development. This type of inquiry curriculum is social, or Vygotskian, constructivism because it emphasizes the individual’s development within a social context.

The rationale of inquiry teaching is that students will acquire an understanding of the nature of science, as well as being actively involved, which will lead to increased interest in science (Schwarz & Gwekwerere, 2007; Blosser & Helgeson, 1990). Lloyd and Contreras (1987) found that a group of students who used a hands-on activity with vocabulary words scored significantly higher on a vocabulary test than students who looked the terms up in the dictionary. Multiple studies have indicated that well planned, field-based strategies promote cognitive learning (Lisowski & Disinger, 1987).

In recent years, research has shown the importance of combining a student’s interests with the curriculum employed by the school. The core of the curriculum is student investigations (Pine & Aschbacher, 2006). The investigations focus on the use and development of science inquiry and process skills (Blosser & Helgeson, 1990). In an inquiry classroom, a teacher who is instructing about the topic of weather will ask students what they know about the subject, then what they want to know. Students pose questions and search for answers to the questions they posed. This structure creates a sense of purpose as well as meaning. Learning the science content is secondary to the acquisition of scientific thinking skills (Blosser & Helgeson, 1990). Schmidt, Gillen, Zollo, and Stone (2002) found that children successfully participated and produced a better concentration and more in-depth conversations while engaged in inquiry lessons. Children with language deficiencies fared also well in inquiry classrooms as they practiced using and developing language while learning scientific concepts (Schmidt et al., 2002). During inquiry lessons, reading, writing, listening and speaking are natural occurrences, providing children practice with critical thinking, questioning, and problem solving skills (Bredderman, 1985).

Studies in American schools have shown that inquiry is not being taught effectively (Barufoldi & Swift, 1980; Welch, Klopfer, Aikenhead, & Robenson, 1981). These studies found that some teachers in the beginning stages of employing inquiry methods experienced classroom management difficulties, student confusion,

and a curriculum too difficult for low and average students (Welch, Klopher, Aikenhead, & Robenson, 1981).

The stated arguments against an inquiry curriculum present difficulties in implementation, but not an obstruction to the process. A teacher must consider several things when changing from a traditional to an inquiry curriculum. Students often lack prior knowledge of non-fiction, or expository text (Sheingold, 1987; Derewianka, 1990), have inadequate questioning skills (Harste, Short, & Burke, 1996), and are inexperienced with the research process (Harvey, 1998). Another decision to be made in the implementation process is whether the topic will foster a whole-class or an individual inquiry process. According to Harste (1994), “An inquiry curriculum is designed to alter the very way students and teachers see knowledge as well as the role that language and other sign systems play in knowing not as lessons, but as direct experiences in conversational living” (p. 1240).

#### Methods

This study evaluated how students’ achievement differed based on teaching methods used in the classroom. Each type of teaching was described in detail based on observations of one specific three-week unit on ecosystems. The observations include how the differing methodologies were delivered and received throughout the year. Comparisons of the students’ achievement were measured by observations, unit tests, and standardized tests. A secondary purpose of this study was to determine students’ attitudes about science, math and reading, and if these attitudes differed based on the classrooms’ instructional methods.

#### Sample

This study was conducted in an elementary school located in a suburb of a metropolitan area in a southwestern state. The school included 720 students and 65 staff members for grades pre-kindergarten through five. Two fourth grade classes were chosen to participate in the study. The deductive class was comprised of 19 students, 8 boys and 11 girls. The student population of this class was 53% Anglo, 37% Hispanic, and 11% African-American. The deductive class included 58% low-income students with 5% in speech, and 11% in content mastery or resource classes. The inquiry class had 22 students including 8 boys and 14 girls. The student population of this class was 73% Anglo, 18% Hispanic, 5% African-American, and 5% American Indian. The inquiry class included 50% low-income students with 9% in speech and 27% in content mastery or resource classes. The teacher of the deductive class was a male who had worked in education for 20 years, 5 of those years teaching grade. The inquiry class teacher was a 31-year-old female who had worked in education for 7 years, 4 of those years in fourth grade.

## 1 Procedures

This quasi-experimental study examined two fourth grade classrooms on the same elementary school campus. Both classes were given a subjective pre-test over the unit of Ecosystems prior to the beginning the unit of study. Each test was coded to ensure objectivity during the grading process. Both classrooms were observed to validate the teachers’ approach and their lesson plans. The students’ scores from state-mandated third and fourth grade assessments were collected and a parametric t-test was used to determine if statistical differences were present. For the three-week instructional science unit, the components of the pre-test were also included as a part of the post-test. Both tests were administered in both classrooms. The pre-test consisted of matching eight vocabulary terms to definitions and eight multiple-choice questions dealing with understanding concepts. The post-test included the pre-test materials in addition to three critical thinking short answer questions and two performance based tasks. Objective data (matching and multiple choice) were collected from both the pre-test and the post-test along with the subjective data (short answer and performance based) tasks from the post-test.

#### Observations of Instructional Approaches

Both teachers in the two different classrooms spent three weeks teaching the unit of Ecosystems using the methods (deductive or inquiry) they consistently employed throughout the year. Each teacher covered the same district prescribed curriculum content. In the deductive classroom, the teacher primarily dispensed information in a lecture or question and answer format, achievement was determined by standardized tests, and the classroom textbooks were the primary, and sometimes only, materials used. In the inquiry class feedback was obtained through students’ questions and research on the unit of study. Achievement was

measured through assessments such as projects, journals, and portfolios. Alternative materials such as trade books, the Internet, newspapers, magazines, and experts in the field of study were used in lieu of, and sometimes in addition to, the classroom textbook.

## 2 Data Collection

Field notes were taken during observations in both classrooms and work samples and lesson plans were collected. At the beginning of the three-week ecosystems unit, the students in both classes took a two-part pretest. Part one entailed matching vocabulary words to definitions and part two included multiple choice questions about ecosystem concepts. At the conclusion of the unit, the students were administered a post-test consisting of 5 parts. The first two parts were identical to the pretest. Part three asked critical thinking questions in a short answer format and required students to apply the things they learned to different situations. The last two parts were performance tasks in which the students were required to use knowledge about ecosystems in order to create a specific project. The test was coded to ensure objectivity in the grading process.

Each fourth grader in the school was given an Estes Attitude Scale in reading, science, and math. The scale included a series of questions in each subject area. Students were asked to respond whether they agreed or disagreed with provided statements. Scores were calculated and attitude scores in the areas of reading, science, and math, were assigned to each student.

## 3 Data Analysis

To determine the comparability of the two groups examined in this study, the students' learning index scores on the previous year's end-of-year state mandated tests in reading and math were used and compared by an independent samples t-test. To establish growth on the state mandated tests in reading and math, the difference between each child's third and fourth grade learning index score was calculated. A learning index score indicates how far above or below a student is from the passing standard and is used to show annual progress. To compare the content knowledge of the two groups, a composite score for each student was derived for both the pretest and the posttest and a two-way repeated measures ANOVA was conducted to examine differences of the scores across the two groups.

The Estes Attitude Scale (Estes, Estes, Richards, & Roettger, 1981) scores for each child were summed to obtain a single attitude score for each child. The scores were compared using an independent samples t-test. To provide an accurate and consistent confirmation of the characteristics in each classroom, the learning process, and progress of the students, classroom observations, field notes, videotapes, and interactions were compiled to identify similarities and differences in the methods.

### Findings

The purpose of this study was to examine the classrooms of two educators who have the freedom to teach to their strengths. This study looked at the children in these classrooms to determine the areas where both classes score equally as well, along with areas in which the

students' achievement differed. The study also evaluated the students' attitudes about school to determine if differences existed.

The means on the pretest and posttest for the inquiry class are  $M=5.94$ ,  $SD=2.304$ ,  $n=17$ , and  $M=11.94$ ,  $SD=1.249$ ,  $n=17$ , respectively. The means on the pretest and posttest for the deductive class are  $M=3.765$ ,  $SD=2.047$ ,  $n=17$ , and  $M=5.118$ ,  $SD=3.498$ ,  $n=17$ , respectively. The pretest for the inquiry class, the pretest for the deductive class, and the posttest for the deductive class was normally distributed  $W(17)=.940$ ,  $p=.316$ ,  $W(17)=.906$ ,  $p=.085$ ,  $W(17)=.947$ ,  $p=.412$ , respectively. However, the posttest for the inquiry class was not normally distributed,  $W(17)=.816$ ,  $p=.003$ . A data transformation was necessary to change the distribution of the scores. A reflection and a square root transformation was applied and using the skewness test for normality, the scores were normal, where  $z=1.12$ . The new mean for this variable was 1.3769, and the standard deviation was .41620. Mauchly's test of Sphericity was used to assess equality of variances, and the greenhouse-Geisser statistic with  $\epsilon=1$  was used. Variances are homogenous.

Using the Wilkes' Lambda, the interaction between the class groups and the tests was significant,  $F(1,16)=48.956$ ,  $p<.001$ ,  $*=.05$ . Simple main effects were assessed using a paired samples t-test. A Bonferroni adjustment was applied to adjust the type I error,  $*=.025$ . There were significant differences found between both the pretests and the posttests,  $t(16)=2.749$ ,  $p=.014$ ,  $*=.025$ , and  $t(16)=-4.458$ ,  $p<.001$ ,  $*=.025$ , respectively.

As a follow-up to differences in the pretest scores, a new test was run looking at only the growth from the pretest to the posttest between the two classes. The growth score was calculated by subtracting the pretest scores from the posttest scores. This was done for both the inquiry class and the deductive class. An independent samples t-test was then conducted to determine if there were differences in the growth scores. The independent samples t-test has two model assumptions, normality and equal variances. The growth scores were normally distributed,  $W(34)=.974$ ,  $p=.586$ ,  $*=.01$ , and variances were equal,  $F_{Levene's}(1,32)=.013$ ,  $p=.909$ ,  $*=.01$ . A large practical significance was calculated,  $d=1.72$ , which indicated that within sample differences were significant.

Data were collected on both the third grade TLI scores and fourth grade TLI scores for both classes. To determine if there were differences between the two classes, an independent samples t-test was conducted. The scores were collected as separate scores for reading and math. For the purpose of this study, the reading and math scores were combined to create a total reading and math TLI score. In order to calculate a growth score, the fourth grade total score was subtracted from the third grade total score. The mean for the inquiry class was 6,  $SD=2.693$ ,  $n=17$ , and the mean for the deductive class was 1.35,  $SD=2.737$ ,  $n=17$ .

The independent samples t-test has two underlying assumptions that were addressed before analysis began. The growth score was normally distributed,  $W(27)=.964$ ,  $p=.458$ ,  $*=.01$ . Equality of variances was also checked and found to be acceptable,  $F_{Levene's}(1,25)=4.162$ ,  $p=.052$ ,  $*=.01$ . The mean for the inquiry group was 5.933, and the standard deviation was 9.339,  $n=15$ . The mean for the deductive group was 9.333, and the standard deviation was 17.469,  $n=12$ . There was a statistical difference between the inquiry class and the deductive class,  $t(32)=4.990$ ,  $p<.001$ ,  $*=.05$ . A small practical significance was calculated,  $d=.25$ , which indicated that within sample differences were not very significant.

An independent samples t-test was conducted to detect any differences between the two classes. Attitude scores were normally distributed,  $W(36)=.963$ ,  $p=.275$ ,  $*=.01$ . Variances were also checked and found to be acceptable,  $F_{Levene's}(1,34)=2.083$ ,  $p=.158$ ,  $*=.01$ . The mean for the inquiry group was 59 and the standard deviation was 10.302,  $n=17$ . The mean for the deductive group was 61.68 and the standard deviation was 12.966,  $n=19$ . There was no statistical difference between the inquiry class and the deductive class,  $t(34)=-.682$ ,  $p=.500$ ,  $*=.05$ . A small practical significance was calculated,  $d=.23$ , which indicated that within sample differences were not very significant.

#### Findings and Conclusions

The purpose of this study was to examine the classrooms of two educators who have the freedom to teach to their strengths. This study looked at the children in these classrooms to determine the areas where both classes score equally as well, along with areas in which the students' achievement differed. The study also evaluated the students' attitudes about school to determine if differences existed.

The teaching method used in the classroom was found not to effect how the students performed on state-mandated tests. The teaching method used in the classroom did not affect students' attitudes toward the three academic areas of math, reading, and science. In an era of especially intense accountability, this information has application for school administrators. School leaders are often in a quandary about which methods to endorse and encourage in their buildings. This study indicates that the method, whether inquiry or deductive, is not the issue. The method that worked best for the individual teacher did not affect students' state assessment scores.

#### References

- Barufaldi, J. P., & Swift, J. W. (1980). The influence of the BSCS-elementary school sciences program instruction on first-grade students' listening skills. *Journal of Research in Science Teaching*, 1 (5), 485-490.
- Blosser, P. E., & Helgeson, S. L. Selected procedures for improving the science curriculum. Columbus, OH, 1990. (ERIC Document Reproduction Service No. ED 325 303.)
- Bredderman, T. (1985). Laboratory programs for elementary science: A meta-analysis of effects on

learning. *Science Education*, 69, 577-591.

Cannella, G. S., & Reiff, J. C. (1994). Individual constructivist teacher education: Teachers as empowered learners. *Teacher Education Quarterly*, 21(3), 27-38.

Derewianka, B. (1990). *Exploring how texts work*. New South Wales: Primary English Teaching Association.

Estes, T. H., Estes, J. J., Richards, H. C., & Roettger, D. (1981). *Estes attitude scales: Measures of attitudes toward school subjects*. Austin, TX: Pro-Ed.

Harste, J. C. (1994). Literacy as curricular conversations about knowledge inquiry, and morality. In R. B. Ruddell, M. R. Ruddell, & H. Singer (Eds.), *The critical models and processes of reading* (4th ed.) (pp. 1220-1242). Newark, DE: International Reading Association.

Harste, J. C., Short, K. G., & Burke, C. (1996). *Creating classrooms for authors and inquirers*. Portsmouth, NH: Heinemann.

Harvey, S. (1998). *Nonfiction matters: Reading, writing, and research in grades 3-8*. Markham, Ontario: Penbroke Publishers.

Lisowski, M., & Disinger, J. F. (1987). *Cognitive learning in the environment: Secondary students*. Columbus, OH: (ERIC Document Reproduction Service No. ED 286 756).

Lloyd, C., & Contreras, N. (1987). Science inside-out. *Science and Children*, 25, 30-31.

Memory, D. M., Yoder, C. Y., Bolinger, K. B., & Warren, W. J. (2004). Creating thinking and inquiry tasks that reflect the concerns and interests of adolescents. *Social Studies*, 95(4), 147-154.

Pine, J., & Aschbacher, P. (2006). Students' learning of inquiry in 'inquiry' curricula. *Phi Delta Kappan*, 88(4), 308-313.

Resenick, L. B. (1979). Theories and prescriptions for early reading instruction. In L.B. Resenick & P.A. Weaver (Eds.), *Theory and practice of early reading* (Vol. 2), (pp. 321-338). Hillsdale, NJ: Lawrence Erlbaum.

Schmidt, P. R., Gillen, S., Zollo, T. C., & Stone, R. (2002). Literacy learning and scientific inquiry: Children respond. *The Reading Teacher*, 55, 534-549.

Schwarz, C. V., & Gwekwerere, Y. N. (2007). Using a guided inquiry and modeling instructional framework (EIMA) to support preservice K-8 science teaching. *Science Education*, 91(1), 158-186.

Sheingold, K. (1987). Keeping children's knowledge alive. *School Library Media Quarterly*, 15, 80-85.

Smith, F. (1994). *Understanding reading* (5th ed.). Hillsdale, NJ: Lawrence Erlbaum.

Welch, W. W., Klopfer, L. E., Aikenhead, G. S., & Robinson, J. T. (1981). The role of inquiry in science education: Analysis and recommendations. *Science Education*, 65(1), 33-50.

Yager, R. E. (1980). *Analysis of current accomplishments and needs in science education*. Columbus, OH: Ohio State University (ERIC Document Reproduction Service No. ED209106).

Yager, R. E. (1983). The importance of terminology in teaching K-12 science. *Journal of Research in Science Teaching*, 20(6), 577-588.

Yager, R. E., & Stodgill, R. (1979). School science in an age of science. *Educational Leadership*, 35(6), 439-445.