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The development of science reasoning ability in individuals has been shown to be correlated with a multitude of variables, some related directly or indirectly to Piaget's cognitive theory of development (Inhelder and Piaget, 1958). Prior knowledge (Resnick and Gelman, 1985), processing capacity (Finegold and Mass, 1985), cognitive styles (Stuessy, 1989), age (Helgeson, 1992), sex (Hernandez, Marek, and Renner, 1984), IQ (Lawson, 1982), culture (Cherian, Kibria, Kariuki, and Mwamwenda, 1988), SES (Acuna, 1983), majority/minority status (Lawson and Bealer, 1984), as well as a number of individual aptitude (Owen, 1987), achievement, and personality factors (Cloutier and Goldschmid, 1976) have all been found to influence the development of science reasoning. Many of these variables are pre-existing attributes students bring with them to the college campus. However, limited efforts have been made to discover what influences the development of science reasoning ability once the student enrolls in a course of study at a two-year institution.

This Digest presents a 1991 study of science reasoning development in students at Riverside City College. The results of the study point to the importance of science in the curriculum and of academic involvement in the sciences for the development of students' science reasoning ability.

DEFINING AND ASSESSING SCIENCE REASONING

Steussy (1984) presents a definition of science reasoning which stems from the concepts inherent in Piaget's formal operations stage. For Steussy, "Scientific reasoning is used to denote consistent, logical thought patterns which are employed during the process of scientific inquiry that enable individuals to propose relationships between observed phenomena; to design experiments which test hypotheses concerning the proposed relationships; to determine all possible alternatives and outcomes; to consider probabilities of occurrences; to predict logical consequences; to weight evidence, or proof; and to use a number of instances to justify a particular conclusion" (p. 2).

This definition of science reasoning ability also parallels the approach taken by American College Testing (ACT) in the development of the Science Reasoning Test, the instrument used in this study. The test is one element of a battery of tests called the Collegiate Assessment of Academic Proficiency (CAAP), which measures selected general education skills typically obtained by students in the first two-years of college (ACT, 1991). The Science Reasoning Test was determined appropriate for this study specifically because many of the components found in Stuessy's (1984) definition of science reasoning mirror the content of the test. In addition, the test is designed to evaluate the development of science reasoning ability among students who matriculate through both science and non-science courses.

COLLEGE AND SAMPLE

This study was conducted at Riverside City College (RCC), located in southern California. RCC offers comprehensive lower division, transfer-oriented curricula in the liberal arts and sciences along with a wide range of certified occupational programs and courses in continuing and developmental education.
This study reports the findings from two samples of RCC students. One sample, the college-wide sample, consisted of student volunteer subjects (N=843) from across the campus who were enrolled in one of 55 courses. The second sample, the science-oriented group, was a sub-set of the college-wide sample and made up of students who took at least one science course (N=494) at RCC.

RESEARCH DESIGN

Students participating in the study were asked to complete the CAAP Science Reasoning Test twice. The pre-test was administered at the beginning of the 1991 fall semester. The post-test was administered at the conclusion of the 1991 fall semester. Regression analyses were conducted to determine the factors that influence the development of science reasoning from pre-test to post-test.

RESULTS FROM THE COLLEGE-WIDE SAMPLE

Analyses of the college-wide responses from pre- to post-test administration of the CAAP Science Reasoning Test offer the following results:
1. The science curriculum at the college serves as a positive influence for the development of students' science reasoning ability.

2. The positive effect of taking science courses on a student's science reasoning ability increases with the number of science units taken.

3. Calculus-based physics courses strongly influence the development of science reasoning ability.

4. Training in undergraduate psychology contributes positively to students' science reasoning development, while training in history appears to have the opposite effect. While reasons for this are not exactly clear, evidence indicates that the course contents and methods in psychology are more congruent with science offerings, in particular life sciences.

RESULTS FROM THE SCIENCE-ORIENTED SAMPLE

The results for the science-oriented sample are similar to those for the college-wide sample. New and additional findings to highlight are:
1. A background in college humanities courses favorably influences science reasoning ability.

2. Physics courses contribute most to the development of science-reasoning.

3. The introductory chemistry course had a negative impact on science reasoning.

CONCLUSION

The present research was an exploratory study into the nature of science reasoning ability of community college students. It provides us with an understanding of the positive and negative influences on the development of science reasoning in community college students. It also provides a vivid demonstration of the applicability of the theory of student involvement and the importance of science in the curriculum.
During the past decade a number of researchers have placed high priority on increasing student involvement in learning as a means to academic achievement (Chickering & Gamson, 1987; Astin, 1987; The Study Group on the Conditions of Excellence in American Higher Education, 1984). According to Astin's theory of student involvement, "Students learn by becoming involved" (1987, p. 133-134). Quite simply put, the greater the amount of physical and psychological energy a student devotes to an academic experience the greater will be the dividends paid by that experience in terms of the talent development of the student. Applied to the development of science reasoning ability, student involvement implies that a student highly involved in the sciences will tend to develop energy to devote to studying and other experiences related to the sciences. The outcome of this involvement is an increase in science reasoning ability. This study discovered that this is indeed the case. Another conclusion drawn from this study is that science is a component of the curriculum that plays an important role in community college students' progress in developing reasoning ability--a very encouraging premise upon which to develop future curricula.

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This digest is drawn from "Impact of Differential College Environments on the Science Reasoning Ability of Community College Students: A Matriculation Study," a dissertation by John Harry Georgakakos, University of California, Riverside, 1995. Detailed information on this study including the research design and statistical analyses can be obtained from this source.

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