A Study of the Preparation of Preservice Middle School Science Teachers: Exploring Attitudes and Anxieties

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The authors contend that a greater amount of science preparation courses by preservice teachers will produce more favorable attitudes and lower anxiety levels toward science.

In improving science instruction in our schools, research suggests that well developed teacher education programs can greatly influence success. It was not until the mid-1980's that researchers began to indicate that "the history of education reform is one that has left teaching essentially unchanged" (Scales, 1993, p.3). Since this time, many studies have been initiated to examine preservice teacher education. Although research has begun to examine teacher preparation, the area of middle grades science preparation has not received the same attention as elementary or secondary teacher training. The middle school is an integral point for the development of scientific information, process skills and attitudes (Blosser, 1986).

In the area of science education, how the teacher feels about science directly affects the way they teach and how their students learn (Westerback, 1982). If it can be assumed that attitudes are not inborn,
but learned, we might also assume that positive attitudes toward
science can be taught (Shrigley, 1974). A study by Kennedy (1973)
suggested that changes in the curriculum and methods of preservice
teacher education courses in science positively affect the future teachers' attitudes toward both science and the teaching thereof. In an
investigation undertaken by Westerback (1982), evidence indicated that
the single greatest influence on student attitude toward science was the
attitude to the teacher. Another study showed that traditional science
courses required for preservice elementary education programs have
had little influence in developing positive attitudes of future teachers
toward science and the teaching of science (Jaus, 1974). A related and
equally important concept is the anxiety level possessed by teachers
toward science. "...Teachers need to feel that they have adequate
knowledge of science, can teach it without fear..." before they can be
categorized as good science teachers (Fraser-Abder, 1989, p.561).

To examine the changes in and possible solutions to the decline in
achievement and attitudes toward science, one can start with preservice
science teacher education. Institutions of higher learning hold the
initial responsibility for preparing future teachers to teach science. As
a result, it would seem crucial to evaluate levels of scientific under-
standing, the attitudes toward science, and confidence in teaching
science held by preservice teachers (Stepans and McCormack, 1985).

Purpose of the Study

Middle grades teacher preparation programs are extremely varied
in their emphasis on content preparation. Some programs require a
large amount of coursework in one subject area. Others require an area
of emphasis (major concentration) along with a secondary academic
concentration (minor). Still others require an equal number of content
hours in each of two subject areas.

The latest guidelines for the National Science Teachers Association
(NSTA) recommend that middle grades science teacher preparation
programs require at least 24 semester hours in each of two content
areas (e.g. science and mathematics). The NSTA recommendations are
especially important because they are utilized as guidelines by National
Council for Accreditation in Teacher Education (NCATE) for accredit-
tion purposes of teacher education programs; however, the 24
semester hour requirement may not be adequate to best prepare
preservice teachers to teach science in the middle school classroom.

In North Carolina, preservice teachers must complete at least 18 semester hours of science coursework for certification as a middle grades science teacher. Although the exact means of meeting (or exceeding) this requirement varies from one teacher preparation program to another, two patterns seem to emerge. In the first pattern, science content is emphasized by requiring a minimum of 27 semester hours of science coursework. This degree plan may or may not require a concentration in a second discipline. The second pattern for preservice teacher education requires fewer hours in science coursework (approximately 18 to 24), and always requires a second academic concentration area.

The purposes of this study were: (1) to record attitudes and anxieties of preservice teachers working toward certification in science as a primary concentration (27 or more hours of science) and those who have chosen science as an equal or secondary concentration (24 hours or less of science content courses); and, (2) to determine the effect of the amount of required science coursework on the attitude toward and the anxiety about teaching science and the implications thereof.

Research hypotheses related to the science content preparation of middle grades teachers are as follows: (1) Students who have participated in middle grades teacher preparation programs that require 27 or more semester hours of science content will exhibit superior attitudes toward science as compared to students enrolled in middle grades teacher preparation programs that require 24 or fewer semester hours in the content area of science as measured by the Revised Science Attitude Scale (Thompson & Shrigley, 1986); and (2) Students who have participated in middle grades teacher preparation programs that require 27 or more semester hours of science content will exhibit a lower level of anxiety toward science than students who are enrolled in middle grades teacher preparation programs that require 24 or fewer semester hours of science content preparation (as measured by the State-Trait Anxiety Instrument, Spielberger, Gorsuch, & Lushene, 1970).

Sample
Included in this study were 60 preservice middle school
science educators enrolled in the student teaching methods courses at five major universities in North Carolina. Together these five universities produce the vast majority of newly certified middle grades teachers in North Carolina. Of the participants, approximately 38% were enrolled in programs that require 27 or more semester hours in science, and 62% were enrolled in programs that require 24 or fewer semester hours in science. The age range was 19 to 53 years of age for the students involved in this study, with an average age of 24.

Students enrolled in courses at the various universities were asked to volunteer to take part in this study. All of the students volunteered although no incentives were offered for doing so.

Design and Procedures
A causal-comparative research methodology was utilized to gather data for fulfilling the goals set forth for this study. Specifically, the Revised Shrigley Attitude Scale and the State portion of the State - Trait Anxiety Inventory (Spielberger, Gorsuch, and Lushene, 1970) were administered to all of the preservice science educators involved in this study. The Revised Shrigley Attitude Scale was modified in compliance with Thompson and Shrigley (1986). The data for this investigation were gathered during the fall, 1992 and spring, 1993 semesters at the above listed universities.

Instrumentation
The Revised Science Attitude Scale (RSAS) (Thompson & Shrigley, 1986), utilized in this study, was specifically developed to quantify the attitudes of preservice science teachers. The RSAS consists of 22 items (10 negative and 12 positive statements), and possesses a reliability coefficient of 0.92 (Thompson & Shrigley, 1986; Hall, 1990).

The State - Trait Anxiety Inventory (STAI) (Spielberger, Gorsuch, & Lushene, 1970) was chosen because Westerback (1982) found "the STAI an easy to administer, reliable instrument, useful in science education for the measurement of anxiety about teaching science..." (p. 3). This test has been used in numerous psychological studies. The test consists of 40 Likert-type scale items. The first 20 items measure the state anxiety, in this case "How Do You Feel About Teaching Science?" (The publisher granted permission for the change in title on
Both the Revised Science Anxiety Inventory and the State-Trait Anxiety Inventory were utilized to compare groups in terms of attitude and anxiety and to the previously stated hypotheses. Again, the two major groups compared were those that were in middle grades preparation programs which required 27 or more semester hours of science content (students for whom science was their primary content choice) and those which were in programs that required 24 or fewer hours of science content preparation.

**Findings**

The results of this study are presented in relation to the two research hypotheses. Several tables of data are also included for further explanation. The first research hypothesis for this study dealt with a comparison of the two major groups in terms of attitude. As shown in Table 1, the mean score for the 23 pre-service middle school teachers was 8.73, and the mean for the 31 participants with 24 semester hours or less of science was 8.73. When subjected to a one-tailed t-test, a significant difference was indicated between the two groups (t=1.71, p<.05). Thus, the first research hypothesis was supported by the findings. Those students for whom science was the primary academic content choice (27 semester hours or more of science) exhibited a better attitude on the RSAS when compared with their counterparts for whom science was an equal or secondary choice (24 or fewer semester hours of science).
Table 1
Means, Standard Deviations, and t-tests (Attitude Measure)

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>t</th>
<th>P&lt;</th>
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</thead>
<tbody>
<tr>
<td>27 Semester hours or more science content</td>
<td>23</td>
<td>93.30</td>
<td>10.14</td>
<td>1.71</td>
<td>0.05</td>
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<tr>
<td>24 Semester hours or less science content</td>
<td>37</td>
<td>88.73</td>
<td>9.73</td>
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</tr>
</tbody>
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Table 2
Means, Standard Deviations, and t-tests (Anxiety Measure)

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>t</th>
<th>P&lt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>27 Semester hours or more science content</td>
<td>23</td>
<td>29.87</td>
<td>9.75</td>
<td>-3.07</td>
<td>0.005</td>
</tr>
<tr>
<td>24 Semester hours or less science content</td>
<td>37</td>
<td>38.7</td>
<td>11.17</td>
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The second hypothesis for the study dealt with a comparison of the two major groups in terms of anxiety levels, indicated by the state portion of the STAI (How Do You Feel About Teaching Science?). As shown in Table 2, the mean score for the 23 preservice middle school teachers with 27 or more semester hours in science content classes was 29.87, and the mean for the 37 participants with 24 semester hours or less of science was 38.70. When subjected to a one-tailed t-test, a highly significant difference was indicated between the two groups (t = -3.07, p<.005). The second directional hypothesis was supported by the findings. The results of the STAI indicated that Group 1 (27 semester hours or more of science) exhibited a lower level of anxiety than Group 2 (24 or less semester hours of science).

Conclusions and Implications

The results of this study indicate that both directional hypotheses were correct: Students who took part in middle grades teacher preparation programs that require 27 or more semester hours of science
content did exhibit more favorable attitude and anxiety levels toward teaching science than students in middle grades teacher preparation programs which require 24 or fewer semester hours in the content areas of science. In attitudinal studies, it has been repeatedly reported that the teacher's attitudes toward science affects their students' attitudes and directly affects the time and the manner in which science is taught (Koballa and Crawley, 1985). Perkes (1975) reports that teachers' attitudes towards science are shaped prior to their entrance into teaching. Prior attitude toward science research has shown that elementary teachers possess negative attitudes toward the teaching of science (Shrigley, 1976; Atwater, 1991). The results of this study indicate that this was not the case with this sample of middle school preservice teachers.

A closely related and equally important area of study is the anxiety level associated with the teaching of science. Cox and Carpenter (1989) reported that a negative self perception of their ability to teach science has caused high anxiety levels in preservice elementary teachers. As in the case of attitude, the preservice middle grades teachers included in this study exhibited more favorable levels of anxiety than their elementary counterparts. Westerback (1982) stated, "...that students with positive attitudes toward teaching science tended to have less anxiety about teaching science (p.44). This statement held true in that Group 1 had better attitude scores and lower anxiety levels when compared with Group 2.

The results of this study strongly imply the importance of strong content area preparation for preservice middle grades science teachers, and yet the trend in both teacher preparation and certification programs seems to be toward less subject area content and more pedagogical training. This is particularly evidenced in the practice of dual certification (e.g., science and another field, equally). One of the purposes of dual certification is that middle grades students will have fewer teachers in a given year, thereby easing the transition from elementary to secondary school. Other possible benefits of dual certification are increased interdisciplinary instruction and more efficient interdisciplinary teaming. Although these factors may be advantageous, dual certification and the resulting lack of preparation in each subject area may also potentially have a detrimental effect on middle grades students.

Past research on attitudes and anxiety levels indicates a dire
correlation between the teacher's attitudes and anxieties and the students' attitudes and achievement in science (Koballa and Crawley, 1985; Shrigley, 1990; Westerback, 1982). Even if science is not the preferred teaching field for the students involved in this study, many of these students will end up teaching science because of the high demand for science teachers. Koballa and Crawley (1985) state that the time a teacher spends in the teaching of science is directly reflective of the teacher's attitude. It is hoped that the attitude of these students toward science teaching will improve with experience. Otherwise, it is possible that this factor will contribute to what is already recognized as a decline in student attitude toward science in the middle years (Blosser, 1986).
References


