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ABSTRACT

Abstracts and abstractors' critiques of ten articles dealing with various aspects of teacher education are presented in this journal issue. Studies reviewed focused on: (1) preservice secondary science teachers' understanding of the nature of science; (2) laboratory teaching skills; (3) science backgrounds of elementary teachers; (4) use of microcomputers in science teacher training; (5) effect of methods classes and practice teaching on attitudes toward science; (6) effect of different inservice formats on teacher attitudes; (7) teachers' views on mainstreamed students; (8) teacher beliefs and their role of personal convictions; (9) elementary teacher preparation in earth science; and (10) Israeli teachers' concerns related to a high school biology project. Included for each study are purpose, research design and procedure, and findings and interpretations. A critique follows each review. (ML)

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NOTES FROM THE EDITOR:

All of the published reports critiqued in this issue deal with some aspect of teacher education. Some involve preservice teachers and their courses while others are focused on in-service teachers. Andersen et al. explored preservice teachers' understanding of the nature of science. James and Crawley examined laboratory skills needed for effective science instruction whether these are acquired in science courses or science methods experiences. Zeitler looked at the science backgrounds of elementary teachers as well as other factors that might influence how they teach science to elementary school pupils. Lehman looked at the use of microcomputers in science teacher training programs. Lawrenz and Cohen looked at teacher attitudes toward science and science process skill and the effect of science methods courses on these variables. In another article, Lawrenz evaluated and compared different inservice formats on teacher attitudes. Atwood and Oldham investigated teachers' views on mainstreamed students in science classes. Munby studied teacher beliefs and their role in his/her behaviors. Crow and Barufaldi reported on a program designed to prepare elementary teachers to become earth science teachers. Dreyfus et al. studied Israeli teachers' concerns related to a high school biology project.

While the focus of the research varies from study to study, all can be said to relate to the improvement of science teaching in both elementary and secondary classrooms although the impact is more direct in some reports than in those of the preservice studies.

Patricia E. Blosser
Editor

Stanley L. Helgeson
Associate Editor

Teacher
Education

Andersen, H. O., H. Harty and K. V. Samuel. "Nature of Science, 1969 and 1984: Perspectives of Preservice Secondary Science Teachers." School Science and Mathematics, 86 (1): 43-50, January 1986.

Descriptors--*Comparative Analysis; *Comprehension; Higher Education; *Preservice Teacher Education; *Science Education; *Science Teachers; Secondary School Teachers; Teacher Attitudes

Expanded abstract and analysis prepared especially for I.S.E. by Lynn Dierking, Howard County, Chamber of Commerce, Columbia, MO.

Purpose

The purpose of this article was to describe a comparative study exploring preservice teachers' understanding of the nature of science. Results of an earlier study conducted in 1969, in which 24 preservice teachers were administered an instrument called the Nature of Science Scale (NOSS) were compared to the results of 21 preservice teachers who were administered the same instrument in 1984. The 1969 study was based on a study by Kimball (1967) in which he determined a "Model Response" for the NOSS (which he developed) by administering it to 712 science majors, science teachers, and philosophy majors. Since 1969, the science teaching certifiction requirements had changed and there had been a real effort to integrate the "understanding of the nature of science" into the preservice curriculum. Researchers wanted to determine whether any changes in the "understanding of the nature of science" had occurred in light of these changing certification requirements. The primary question was, how do the 1969 and 1984 preservice teachers compare with respect to their understanding of the nature of science? A secondary question was, to what extent did the 1984 group of preservice teachers agree with the Kimball (1967) "Model Response?

Rationale

This research study was based on the premise that science teachers need to understand the nature of science because it is their responsibility to convey this understanding to their students. It was felt that because of the importance of this goal, teacher educators need to determine occasionally the conceptualization that students who graduate from their programs with certification possess for the nature of science. The authors felt this to be most important after certification requirements change and particularly when the changes include a reduction in the number of required science hours as was the case in this situation.

Research Design and Procedure

In the present study, as in the 1969 study, the NOSS was administered on the first day of class to students enrolled in the "Methods of Teaching High School Science" course. An alpha internal consistency reliability coefficient was calculated. Face, content, and construct validities were established, both qualitatively and quantitatively by way of extensive field testing and later published studies. The average scores on each item of the instrument for the group taking the test in 1984 ($N = 21$) was compared with the average scores on each item for the group taking the test in 1969 ($N = 24$). The 1984 item responses were also compared with the Kimball Model Response Scores. T-Tests and the Mann-Whitney U-Test were utilized for these comparisons. The NOSS was not administered to students after the Methods course in which the understanding of the nature of science concepts were integrated.

Findings

Results of the analysis indicated that the 1984 preservice group was significantly higher than the 1969 group. The students' average score was still lower than one might hope of students soon to be practicing teachers, however. The 1984 student group was significantly more in agreement with Kimball's Model Response Score on 24 of the 29 items than was their 1969 counterpart.

Interpretations

The researchers made two major inferences to explain these results: 1) Secondary preservice programs may be attracting more mature students with a better understanding of the nature of science, and 2) Science instructors may be providing students with instruction that provides the student a better sense of the nature of science. The authors suggest that more than science courses may be required to provide this understanding of the nature of science and propose that Kimball's (1967) recommendation to include philosophy of science courses in the curriculum be implemented.

ABSTRACTOR'S ANALYSIS

It is critical that science teachers understand the nature of science. In fact, in this abstractor's opinion, that understanding should be a requirement necessary to receive professional certification. This understanding can not be superficial, but should be so much a part of the teacher's repertoire that it is discussed and modeled for students by the instructor's own utilization of the processes of science. Because of its importance, it is essential that science education research include the investigation of the understanding of the nature of science on the part of students and teachers.

This research study was an attempt to explore this topic, particularly in light of current trends to reduce the science requirements of preservice teachers, a trend still occurring in colleges of education across the country despite all the "crisis in science education" rhetoric. The authors chose to compare the results of a 1984 preservice group with those of a 1969 preservice group on an instrument that has been well documented for validity and reliability, the Nature of Science Scale (NOSS).

The results obtained in this study indicated that the 1984 preservice group performed significantly better on the instrument than did the 1969 preservice group, despite the fact that the science requirements for certification had been reduced. The authors seemed surprised by this finding and suggested that perhaps students attracted to preservice programs are more mature and have a better understanding of science prior to entering programs, or that science instruction has improved and is providing students a better understanding of the nature of science.

Actually, these explanations seem very plausible and, in fact, led the abstractor to question the validity of the results of this study because it did not seem that the assumption of equal groups at the beginning of the study was a correct one. The average age of students in the 1984 group was two years higher than the 1969 group and more than half had already earned a bachelor's degree. This group also contained a larger proportion of graduate students than did the 1969 group. These reasons alone seem to suggest that the groups may have been very different, but if one also thinks about the pre-college science education that a student in college in 1984 potentially had, compared to the offerings for a student in college in 1969, it seems unlikely that the groups were equal. It is much more likely that the 1984 preservice group had encountered an inquiry-based science course in their pre-college career than had the 1969 group, which probably was a few years too old to reap the benefits of the National Science Foundation-funded inquiry-based curriculum projects. Therefore, it seems difficult to generalize in this particular study about the relationship between the reduction in preservice science requirements for certification and the students' understanding of the nature of science.

Another approach to this study would have been to also administer the instrument after completion of the methods course so that a pre-test, post-test design could have been utilized. This would have enabled researchers to also assess the effectiveness of integrating nature of science concepts into the methods course. This design could be used to determine three results: 1) the two groups' understanding of the nature of science could be compared at the beginning to determine how equal they were; 2) the difference between students' understanding of the nature of science at the beginning of the methods course could be compared to their understanding at the end of the course; and, 3) if the groups were equal, their posttest scores and gain scores could be compared.

The abstractor would agree with the researchers' suggestion to include a philosophy of science component in the curriculum, considering Kimball's (1967) finding that philosophy majors' responses were significantly more like the literature-generated model responses than were those of scientists or teachers. Many of the required survey lecture courses and even laboratories, if they are too cookbook, may not give the students the opportunities to actively engage in the processes of science. A philosophy course requiring inquiry and analytical thinking may be able to provide such experiences.

It is important to remember also that testing preservice teachers' understanding of the nature of science is only one aspect of this important area of research. Some fascinating research being conducted by Lederman and Druger (1985) and Lederman (1986) is testing the untested assumption, certainly held in this study, of a positive relationship between teachers' conceptions and changes in students' conceptions of science. Secondly, and more importantly, this research is attempting to identify classroom variables that are related to changes in students' conceptions of science.

Interestingly enough, this research seems to indicate that correlations between teachers' and students' understanding of science scores, as measured by the Nature of Scientific Knowledge instrument (Rubba, 1976), are low, and therefore, the research does not support the contention that changes in students' conceptions of science are related to their teachers' conception of the nature of science. These findings do support the importance of modeling the nature of science to students. It seems that it is not enough for a teacher to have an adequate concept of the nature of science, as measured by a paper and pencil test, he or she must be able to communicate that understanding to students.

Findings did suggest that certain teacher behaviors and classroom climates correlate with students' understanding of the nature of science. These correlations were found with teachers that had frequent inquiry-oriented sessions with little emphasis on rote memory/recall and seat work. Lederman (1986) suggests that this creates quite a dilemma for the teacher, often evaluated on the basis of students' scores on achievement tests predominately measuring lower level knowledge. In this study, these lower level understandings were determined to have little correlation with students' conception of science, while stress on higher level understandings and inquiry were strongly associated with changes in students' conceptions of science.

It is clear from this study and others, that investigating the understanding of the nature of science is a complex issue. Researchers have only begun to explore the complexities which may very well require some changes in our present concepts of science education.

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Descriptors--Methods Courses; Science Education; Science Teachers; Secondary Education

Expanded abstract and analysis prepared especially for I.S.E. by Richard A. Duschl, Department of Curriculum and Instruction, University of Houston.

Purpose

The identification of laboratory teaching skills which enable science teachers to be more effective in the teaching of laboratory science is the principal focus of the article. The authors ask, "What is needed? Where is it to be acquired?" A secondary purpose is to refute claims concerning the assumption that teachers gain preparation for laboratory teaching from college level science courses which require laboratory experiences.

Rationale

Knowledge of subject matter and of how science relates to the personal and societal needs of students is not, in and of itself, a sufficient knowledge base for secondary level science teaching. Given the existence of such knowledge, it does not follow that a person will be able to design and implement meaningful investigations.

Several factors functioning in institutes of higher education have had the net effect of reducing both the quality and quantity of laboratory experiences in college science courses which are applicable to teaching secondary level science. Specifically, increased costs have forced the elimination of lab sections either for all students or for non-majors. Next, advances in scientific technology introduce college students to equipment and instrumentation typically not found in secondary school science programs. Finally, management of large laboratory teaching programs has resulted in the hiring of lab assistants and staff technicians to perform basic operations, thereby denying science student teachers the opportunity to practice such basic skills.

Research Design and Procedure

Efforts at the University of Texas at Austin and at Kansas State University have been taken to understand the basic skills science teachers need to teach lab science effectively. Beginning in 1973, James and others have carried out a research program which sought to identify such skills through the employment of survey techniques (James and Stallings; James and Voltmer, 1982; James and Schaff, 1975). Similarly, Bartholomew and Crawley (1980) have examined carefully commercial and inhouse laboratory manuals, workbooks, demonstration texts, and textbooks to generate detailed descriptions on how to perform 150 laboratory skills.

Findings

There is a paucity of literature on laboratory teaching skills and on laboratory techniques. From the studies cited above, two implications emerge:

1) teachers recognize the importance of the laboratory in science teaching; and
2) science teacher educators should address laboratory teaching skills in instruction directed at both preservice and inservice teachers.

A description of what would be considered adequate preparation in laboratory teaching skills and techniques includes eight basic areas. They are as follows:

A. Safety - minimizing the risk of injury and the training of students in safety education (i.e., handling, recycling, and disposing of hazardous substances).

B. Techniques - manipulating equipment and materials to best achieve their functions (i.e., locating images in mirrors and lenses).

C. Science process skills - operations by which facts, concepts, and principles are generated in the laboratory (i.e., making inferences and recognizing assumptions when inferring).

D. Delivery - teaching methods and strategies used to begin, carry out, and conclude laboratory investigation (i.e., leading discussions-verbal interaction, level of questions, domain of questions).

E. Management - organization of students, equipment, and materials to foster learning in lab (i.e., directing class, group, and individual investigations).

F. Development - design investigations, write printed materials, and procure laboratory equipment (i.e., preparing self-paced learning packets).

G. Support - design and carry out activities of an advanced or a remedial nature (i.e., designing take home experiments).

H. Evaluation - assess and judge the effectiveness of materials, methods, strategies, and performance of students (i.e., assessing the outcomes of laboratory investigations using observational checklists, anecdotal records, skills tests, attitude measures, and cognitive tests).

Interpretations

National Science Teachers Association (NSTA) materials are recommended by the authors as resources to be used with Area A. Safety, and Area B, Technical Skills; "The NSTA's 'How to' series provides considerable assistance here" (p. 17). Area C, Process Skills, is perhaps the most difficult area to teach. The experience of the authors indicates that college science courses and professional education courses devote little attention to the development of such skills. Available resources for teaching such skills have been developed for the preparation of elementary, middle level, and junior high teachers, but, the authors stress, "it is imperative that all teachers receive training in the use of science process skills." (p. 17, italics by authors).

Delivery skills (Area D) and many of the skills in Areas E through H are traditionally covered in science methods courses. But, science methods course instructors should make the effort to assist both preservice and inservice teachers in the transfer of their knowledge and skill from the university classroom to the secondary school laboratory setting. Yet, foundations in the nature of science and the nature of the learner are to be recognized as essential areas of training also.

To address the various and sundry levels of technical skills characteristic of preservice and inservice science, training may need to be individualized, self-paced, and prescriptive in nature. Clearly, a well stocked lab facility must be available for such training. Science teachers should use the laboratory and with improved laboratory teaching skills would be in a better position to do so.

ABSTRACTOR'S ANALYSIS

A dominant focus of science education since the formation of the National Science Foundation (in 1951) has been to emphasize the role of the "learner as scientist" in science classes. Through the design of curricula and the implementation of teacher training programs addressing such curricula, one major goal of the NSF curriculum projects was to engage students in a set of instructional tasks which would enable them to think like a physicist, chemist, biologist, or geologist (Crane, 1975; Duschl, 1985a). Two fundamental aspects of the NSF philosophy of science education were the important role of the laboratory/laboratory teaching and the teaching of science through inquiry.

One can make a very strong argument that the most dominant theme in science education over the past three decades has been learning science through inquiry (Schwab, 1962; Welch, Klopfer, Aikenhead and Robinson, 1981; Connelley and Finegold, 1977). For many science teacher educators and science teachers, teaching science as inquiry is synonymous with teaching laboratory science. Such a marriage has both positive and negative implications for the teaching of science in secondary schools. The positive aspect is that students are doing and learning science (Shymansky, Kyle and Alport, 1983); the negative aspect is that students and teachers can misrepresent science as an activity which is exclusively the domain of experimental scientists (Brush, 1976) and the justification of knowledge.

The delineation of specific laboratory skills by James and Crawley is to be applauded. Within the eight areas they have provided a comprehensive description of laboratory skills secondary science teachers will need to teach laboratory science. In the sections to follow, I will focus my comments on (1) an assumption which seems to be inherent in the list of skills-that secondary science teachers need to have a mastery of lab skills across disciplines; and (2) the critical goal of having prospective teachers of science appreciate the comprehensive and evolving nature of scientific inquiry.

Given the comprehensive nature of the list - 63 items - it isn't surprising to this reviewer that science courses at universities and colleges do not adequately address such skills. I am inclined to agree with the authors that laboratory skills ought to become a part of science education methods classes if guarantees can't be made that such skills will be a component of preservice teacher's science education. The breadth of skills listed under the category 'Technical Skills,' as an example, would seem to require, however, advanced study in each of three or four areas of science to adequately meet such skills. Advanced study is required because it is in such classes that students develop the investigative or technical skills of the discipline.

Physics, chemistry, geology, and biology skills are all listed by James and Crawley. Typically, future science teachers only pursue advanced hours in one or, at the most, two disciplines and yet the sum total of science credits is still below the requirements for majors. Thus, seeking an alternative for science teacher training programs under such conditions is expected. The question of whether it is desirable, however, is a debate for another time.

A concern of mine is the implicit message from the authors that science teachers should be able to perform laboratory skills across all disciplines. Continuing the established generic role for process skills in science methods classes is counterintuitive to contemporary research results (Osborn and Freyberg, 1984) and learning theory (Resnick, 1983) which suggest that learning in science occurs within specific content domains. Finley (1983) comments that the generic role of science processes in science education programs may serve to misrepresent the nature of science and contribute to a broader confusion on the part of the learner seeking conceptual conformity.

Hence, while I support the authors' position that expertise in laboratory skills needs to be a mastered by science teachers, I do not endorse the across-the-board/discipline approach that they suggest be included in a science methods class. The authors' position that training in technical skills be individualized, self-paced, and prescriptive in nature is a sound one. How it is to be implemented and by whom is critically important.

One alternative to the Kansas State modules approach is to require as part of a science teacher's formal training an internship in a science lab. For preservice teachers it could be an academic year inservice and for inservice teachers it could be a summer inservice. Duschl and Anderson (1983) have posited that science teachers may need to engage in two field experiences, borrowing a model of teacher education from vocational education programs. One experience is the traditional student teaching field experience. The other experience, which occurs prior to placement in student teaching, is a type of apprenticeship in the field you wish to teach. That is, use the internship for actual work experience in the teacher's trade, craft, or skill field.

The preservice business teacher works in an office using hi-tech communication equipment, the future electronics teacher works in an electronics equipment assembly plant, the preservice auto mechanic teacher works in an auto repair facility. Preservice science teachers could be placed in research laboratories or teaching laboratories on or off campus for the same purpose - improving their understanding of the processes and techniques used in science. The vocational model internship enables the teacher to maintain currency in the tools and processes within the field and also adds a dimension of respect for being a skilled technician. Likewise, science teachers could enhance their identity as scientists by working as interns in science programs. Placements outside a college or university might include zoos, government testing centers, medical centers, industrial R&D programs, hospitals, and university field projects. In any case, clearly negotiated expectations would need to be outlined to assure that the student is not merely used to "wash dishes" or "sweep up the shop."

What such an experience provides, beyond what the modules can address, is the presence of an expert who can speak to the tricks of the trade for making technical skills work and for explaining the conceptual context in which the techniques have developed. The emphasis would be to strengthen the technical skill and process skill knowledge of the student teachers in their chosen field of teaching. This recommendation, of course, does not help with the training of teachers in inservice programs unwilling or unable to participate in summer programs, nor does it address individuals who are asked to perform the yeoman's task of preparing two or more separate science classes (although science teachers should not be placed in classes outside of their certified area). But it does contribute to the task of providing secondary school science teachers with technical skill opportunities at both the simple and complex levels; the later often being employed by students engaging in science fairs or in advanced courses.

The second issue I would like to raise concerns the portrayal of the nature of science. More specifically, the issue concerns the degree to which laboratory science as outlined by the eight areas of specific skills can portray the nature of science accurately or adequately. James and Crawley do recognize the importance of this topic when they state, "it is imperative they (teachers) recognize that knowledge of the nature of science and the ways pupils learn are needed for science instruction to be effective and valid" (pg. 18, parenthesis mine). But, unfortunately, specific recommendations are absent.

Missing from the list of laboratory skills are those reasoning skills or strategies scientists frequently employ in the pursuit of an explanation or a decision. I submit that certain skills for the manipulation and interpretation of data need to be taught as skills to teachers. Intu   y, I sense the authors had this in mind but they do not explicate   specifics in the section which identifies constructing hypot , collecting data, organizing data for interpretation, maki   nferences and recognizing assumptions, model constructing as process skills.

The recommendation for specific knowledge in these areas is consistent with the identification of procedural knowledge tasks that educational psychologists and science education researchers (Gunstone, White, and Fensham, 1986; Gagne and White, 1978) have demonstrated scientists and learners employ to solve problems. In addition to the skills outlined by James and Crawley, research on learning and on teaching science which involves conceptual change (Anderson and Smith, 1986) would suggest secondary science teachers be equipped with a much broader and more elaborately conceived array of science skills. Such skills might include:

1) determining significant differences among experimental and control groups - data analysis (Giere, 1984);
2) strategies for distinguishing science from pseudoscience (Radner and Radner, 1982);
3) identifying and applying the guiding conceptions of scientific investigations (Connelley and Finegold, 1977);
4) understanding the role of probability in science investigations (Giere, 1984);
5) constructing and analyzing argument patterns used in the reporting of science (Giere, 1984);
6) developing criteria for distinguishing among scientific theories and between scientific theories and scientific facts (Duschl, 1985b).

These skills are typically excluded from the science classes offered in academic science departments also. They are nonetheless as important as the skills listed by James and Crawley. It is recommended that subsequent attempts to delineate basic laboratory skills for secondary level science teachers take a broader perspective which would include but not be limited to the procedures and definitions used in the present study.

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Descriptors--*Educational Background; *Elementary School Science; Higher Education; *Preservice Teacher Education; Science Education; *Science Instruction; Teacher Attitudes; *Teacher Background; *Teacher Characteristics

Expanded abstract and analysis prepared especially for I.S.E. by Eugene Chiappetta, Unversity of Houston.

Purpose

The aim of this investigation was to determine the science backgrounds of preservice elementary teachers, their conceptions about the purposes of science instruction in the elementary school, and their concerns about teaching science at this level. In particular, this study addressed three questions:

(1) What courses comprise the science background of preservice teachers, both at the secondary school level (grades 9-12) and at the college level?

(2) What purposes do preservice elementary school teachers identify for teaching children science in the elementary school?

(3) What concerns about teaching children science are identified by preservice elementary school teachers?

Research Design and Procedure

A nine-item questionnaire was designed to obtain information from the preservice elementary school teachers regarding science course preparation, concerns, and science instruction in the elementary school. Items 1 through 4 pertained to demographic data. Items 5 and 6 addressed science courses taken at the secondary and college levels. Item 7 requested the respondents to identify purposes for teaching science to children. Item 8 solicited concerns about teaching science. And item 9 was for additional responses. Items 7, 8, and 9 were designed for free responses rather than providing a preconceived structure through a checklist of suggestions.

Validity of the questionnaire was established by a panel of five members consisting of two science educators, one inservice elementary school teacher, and two students in a graduate course in elementary school science instruction. Each panel member rated each item on: appropriateness, wording, and clarity. There was a 90% agreement among panel members that items on the questionnaire met the criteria.

Questionnaires were sent to preservice teachers enrolled in elementary school science methods courses in the different geographic areas of the country. Responses were received from a total of 229 preservice teachers.

Findings

Question #1a: Science courses completed at the secondary school level. The course most frequently taken was biology (93%), followed by chemistry (59%), physical science (42%), earth science (22%), and physics (17%). When you consider all data from the many courses that were listed on the questionnaire for the teachers to check, these preservice teachers took approximately one course in the biological sciences and one in the physical sciences during their secondary school education.

Question #1b: Science courses completed at the college level. The single most popular course selected at the introductory college level was biology (71%), followed by geography (45%), physical science (34%), chemistry (25%), geology (25%), and physics (24%). Approximately 17% of the teachers took one advanced course in the biological sciences (biology, physiology, anatomy, microbiology, etc.), while hardly any of these people took an advanced course in the other areas of science.

Question #2: Purpose for teaching elementary school science. The percentage of elementary teachers reporting a given purpose for teaching science to elementary school children is as follows:

- Teaching science information (58%)
- Developing an awareness of the world (38%)
- Teaching problem solving (23%)

- Teaching science processes (10%)
- Teaching the benefits of science to society (7%)
- As preparation for future science courses (7%)
- Developing student curiosity (5%)
- Miscellaneous (15%)

Question 3: Concerns about teaching science to children. Four categories of concerns emerged. The first and strongest concern was knowledge of science content, then followed (2) teaching science content, (3) knowledge of a variety of teaching methods and resources, and (4) the background of the students.

Interpretations

There are many problems which appear to interfere with elementary school teachers' ability to teach science in the elementary school. High on this list is their lack of knowledge and understanding of science content. At best, these teachers have an adequate background in general biology, but little understanding of this subject since they have taken few or no courses beyond the introductory level in college. Their knowledge of the physical and earth sciences is minimal and rudimentary. No wonder elementary school teachers are concerned about their knowledge of science as it relates to teaching science to children. With an inadequate background in the physical and earth sciences at the introductory level, these teachers cannot enroll in advanced level college courses to gain indepth knowledge and understanding of these fields. In addition to content knowledge concerns, preservice elementary teachers appear to deemphasize teaching science process skills, developing a positive attitude toward science, and developing student curiosity as major outcomes of the science curriculum.

ABSTRACTOR'S ANALYSIS

Although this research report calls attention to a well-known problem regarding elementary school teachers' background preparation to teach science, should content knowledge be addressed as the most important problem for science educators to solve? Is it true that until these teachers feel comfortable with their knowledge of topics such as electricity, light, sound, atoms, acids, bases, genetics, nutrition, ecology, and weather, they may never feel adequate to each science in the elementary school?

Further investigation is necessary to identify programs that prepare elementary school teachers whose level of concern regarding their science content background is less than that reported in this article. We need to determine what it is about these programs that contribute to a lower level of concerns about science content knowledge. This inquiry may determine that preservice elementary teacher training programs should either require more science course experiences or a different emphasis on science teaching. And which of these approaches or combinations lower the concerns level of preservice elementary school teachers?

The fact that preservice elementary teachers focus so much on their lack of science content on one hand, and deemphasize science process skills on the other hand, indicates one of the serious problems in promoting elementary school science. Have we overemphasized the acquisition of science content and deemphasized the importance of developing science process skills? Many science educators believe that a major purpose for teaching science in the elementary school is to stress investigation and to improve basic thinking skills, not to stress the teaching and memorization of science facts and concepts. It appears that all of the science course experiences or lack of these experiences, including content and methods courses, have made elementary teachers feel inadequate and concerned about their knowledge of science content and unconcerned about the processes of science.

What do science educators do about the process/content emphasis in the elementary school science teaching? Do they resolve that content backgrounds will always be a problem and therefore deemphasize it, stressing process science in the elementary school as indicated below.

> Content oriented science programs present many problems for the elementary school teacher. In general, elementary teachers find it very difficult to teach science effectively when the emphasis is on content. The teacher's background in biology, chemistry, earth science, and physics is usually too limited to teach a content curriculum. The prospects for elementary

> teachers receiving adequate training in the major science areas in preservice or inservice programs seem to be very slim. At present, teacher training institutions do not require prospective elementary teachers to take more than one or two science courses. It is difficult for inservice training programs to increase the amount of science information teachers need to know without increasing the already heavy loads which elementary school teachers carry. A more dismal picture is presented when one realizes science information accumulates at such a tremendous rate that it would be almost impossible for most elementary teachers to keep up with the knowledge explosion. (Chiappetta and Collette, pg. 17, 1973).

Perhaps this is an overstatement of the problem. In any event, there are several steps that must be taken by Zeitler and others who desire to resolve the content/process problem in elementary school science teacher preparation. First, determine the emphasis of the elementary science methods courses from which the data are being collected. Characterize these programs as follows:

(1) stresses science content and deemphasizes science process skills,

(2) stresses both science content and science process skills, or

(3) deemphasizes science content and stresses science process skills.

It seems that students in science methods courses that stress content/process to different degrees might react differently to their content backgrounds.

Second, collect data from preservice teachers at several points--at the end of their science methods course, at the end of student teaching, and after a few years of teaching. How do elementary teachers react to their ability to teach elementary science as they get more involved in teaching? And how does the concern level interact with methods course emphasis (content/process)?

Third, survey a large number of experienced elementary school teachers. Ask them to give their science course backgrounds, science methods course emphasis, the extent to which they presently teach science, how comfortable they feel teaching science, how successful they are in teaching science, etc. This may help us to determine if elementary science methods courses that stress process and deemphasize content in fact promote science teaching in the elementary school and reduce elementary teachers concerns about their content deficiencies or vice versa.

Fourth, separate the teachers' data into primary school teachers and upper elementary school teachers. It is possible that the concern level may be related to the grade level. For example, the primary school teachers may feel more comfortable with an inadequate science content background if they believe elementary school science should stress process. Conversely, upper elementary school teachers may feel more uncomfortable with an inadequate content background if they believe that elementary school science should stress content.

In addition to elementary school teachers' deemphasis on process, they appear to place little importance on two other aspects of science teaching: developing a positive attitude toward science and developing curiosity. These results are just as serious as the others cited above, because one of the major outcomes of science in the elementary school is to turn children on to science and to make them realize that science is a worthwhile enterprise. Also, elementary school science educators have always sought to make children curious about the world around them. The present study might have attempted to determine why so few prospective teachers listed these attitudes as important purposes for science in the elementary school.

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Descriptors--*Computer Science Education; Higher Education; *Inservice Teacher Education; *Microcomputers; *Preservice Teacher Education; *Science Education; *Teacher Education Programs

Expanded abstract and analysis prepared especially for I.S.E. by F. Gerald Dillashaw, Bradley University, Peoria.

Purpose

This study was a survey designed to determine (a) if colleges and universities are providing science teachers with training in "content independent and content dependent instructional applications of microcomputers" and (b) the role that science educators have in providing such training.

Rationale

A National Education Association survey indicated that a majority of teachers are not prepared to use computers in any meaningful way. This problem should concern science educators since science and mathematics classrooms are often where schools place the computers. Teachers must be instructed in the various applications of microcomputers including general uses such as word processing, record keeping, and programming. Additionally, teachers need instruction in specific applications of computers to science instruction.

Research Design and Procedures

A questionnaire using ten multiple choice items and one open-ended item was developed and judged to be content valid by expert opinion. The multiple choice questions addressed an institution's science education program and use of computers in the program. The open-ended item asked the respondents to identify science teachers who were successfully using microcomputers in their secondary science classrooms.

In January, 1985, the questionnaire was sent to 400 colleges and universities randomly selected from the education directory of Peterson's Guide to Graduate Study in the Humanities and Social Sciences. Two hundred responses were received (a 50% return rate).

Findings

The findings of the author are summarized as follows (based on the two hundred responses):

a. 67% of the institutions provide microcomputer training in the teacher preparation program.
b. 25% require a microcomputer course.
c. 71% offer the course(s) within the unit responsible for science teacher preparation.
d. 62.5% have microcomputer courses available outside the unit responsible for science teacher preparation.
e. 24.5% offer at least one microcomputer course specifically for science teachers.
f. 12.5% of the institutions with specific courses for science teachers had a science educator teaching the course.
g. 6% require field experience with microcomputers in a science classroom.
h. Emphasis in the courses was on programming, word processing, and materials generation. Less attention was given to laboratory use of microcomputers.

Interpretations

While a majority of the responding institutions provide opportunities for teachers, few offer courses specifically for science teachers. The emphasis in the courses offered is on content-independent applications with relatively little attention given to science specific applications. Unless science teachers are provided with more specific instruction on the use of computers in science classrooms, the computer is likely to have little impact on science teaching.

ABSTRACTOR'S ANALYSIS

This descriptive study was designed to describe the state of microcomputer training for science teachers. While microcomputers are seen by some to be of great value in teaching, the question of how teachers are prepared to use computers in instruction is a valid one. It would appear from this study that, at least as of January, 1984, science content specific instruction in the use of microcomputers is at a low level.

The 50% response rate for a single mailing of a survey is good. However, the author does not provide an explanation of why there was no follow-up of the non-responding institutions. It is generally recommended (Gay, 1986) that follow-ups be conducted in an effort to increase the response rate.

The data collected are succinctly summarized and presented. The results indicating that most of the teacher preparation programs offer some opportunities for microcomputer training, yet little science training, probably does not come as a surprise to most science educators.

These results must be viewed with some caution. The survey data were collected in January, 1984. The growth of microcomputers in schools and colleges has been rather high in the last few years. The picture at this time may be quite different. The author states that some of the respondents indicated that changes in microcomputer training was to take place shortly at their institutions.

While it might be useful to know the status of microcomputer training for science teachers, perhaps more useful would be more specific suggestions and strategies for providing appropriate training. The author stresses that science teachers need more training, but offers little assistance for science educators. Future study in this area should address the issue of how to provide the training rather than simple descriptive studies of the current state of training.

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Descriptors--*Elementary School Science; Elementary School Teachers; Higher Education; *Methods Courses; *Preservice Teacher Education; Process Education; Science Education; *Secondary School Science; Secondary School Teachers; *Student Teaching; *Teacher Attitudes

Expanded abstract and analysis prepared especially for I.S.E. by Thomas R. Koballa, Jr., The University of Texas, Austin.

Purpose

Reported are the results of two sequential studies; one involving secondary science education majors and the other involving elementary education majors. The purpose of these studies was to assess the attitudes toward science and the understanding of science process skills of these two groups of students prior to taking science methods courses, immediately after completion of the courses, and upon completion of their practice teaching. The intent of the studies was to provide information on existing attitudes toward science and process knowledge and demonstrate how these attitudes and this knowledge differ over time and between levels of preparation.

Rationale

The studies were prompted by the notion that students' academic success in science is affected by the attitudes toward science of the teachers presenting the science experiences and the teachers' knowledge of science process skills. Science methods courses and practice teaching are identified as experiences during which attitudes and knowledge of science process skills can be modified. Used to support the idea that the attitudes held by teachers can be passed on to their students were studies by Stollberg (1969), Hone and Carswell (1969) and Washton (1971). A more recent study by Lawrenz (1975) was used to point out that teachers who possess minimal knowledge of science process skills are likely to be ineffective in promoting the acquisition of these skills in their students.

Research Design and Procedure

The subjects used in the studies were from two distinct groups. One sample consisted of 22 secondary education majors at State University College of New York, Buffalo. The other sample consisted of 52 elementary education majors at Arizona State University.

The similarities and differences between the conditions experienced by the two groups were documented. Although the universities are in different areas of the country, both grew out of the teacher college tradition; both are also located in metropolitan areas with residents from varied ethnic and economic backgrounds.

The programs in which the two sets of students were enrolled are different. The secondary science education majors were seeking teacher certification in a science content area. The methods course, which they took as part of their 24 semester hour requirement of education courses, emphasized techniques for teaching science in grades 7-12 and was required before practice teaching. The methods course was designed to assure minimum competencies in four areas: (a) the nature of science, (b) the nature of the learner, (c) the nature of society, and (d) the nature of the profession. The practice teaching experience for these students was divided into two full time eight-week sessions. One eight week session was spent teaching in their science field in a senior high school and the other teaching a seventh or eighth grade class in a junior high school, middle school, or elementary school.

The elementary education majors were seeking teacher certification at the elementary school level. Their backgrounds in science were minimal, with most having taken only two college science courses. The science methods course taken prior to practice teaching by these subjects was directed toward teaching science in the elementary grades and designed to familiarize them with available materials, with techniques to maximize scientific inquiry in the classroom, and with issues confronting science education. The course was identified as part of a 60 semester hour education component and included a 10 hour practicum requirement. The practice teaching experience for these students was full time for one semester. Students remained in one elementary school for the entire experience.

The two instruments employed in the studies were the Science Attitude Inventory (SAI) and the Science Process Inventory (SPI). Designed to measure general intellectual and emotional attitudes, the SAI is a 60 item, four option Likert-type instrument. Scores may range from 60 to 180, with scores above 90 designated as indicating positive attitudes. The reliability of the SAI was determined using a test-retest procedure and reported to be 0.93. The SPI is a 135 item forced choice (agree/disagree) instrument designed to assess knowledge of the processes of science. The reliability of the instrument was reported at 0.90 using the Kuder-Richardson #20 procedure.

The studies were conducted one year apart. In both studies the students completed the two instruments in the same order of presentation. The instruments were administered on three different occasions: (1) in the beginning of the fall semester before their methods course; (2) between the fall and spring semesters, i.e., after their methods course, but before practice teaching; (3) after the spring semester, i.e., after they had completed both the methods course and practice teaching. Paired t-tests were used to analyze the data. The design employed for both studies, using Campbell and Stanley nomenclature, is presented below:

$$O_1 \; X_1 \; O_2 \; X_2 \; O_3$$

Findings

Comparisons between pretest scores obtained at the beginning of the year and posttest scores obtained at the end of the year after taking the methods course and practice teaching showed a statistically significant difference for both the elementary and secondary education students. The elementary education students became more positive in their attitudes while the secondary education students became negative. The second comparison between the pretest scores and the midterm test scores obtained after completing the methods course but before student teaching showed that participation by either elementary or secondary students in a methods course resulted in statistically significant improvement in attitudes toward science. The third comparison between the midterm scores and the posttest scores showed that the secondary students' attitudes toward science were significantly lower after practice teaching and the attitudes of the elementary education students did not change.

The same comparisons were conducted for the SPI. There were no significant differences for any of the comparisons.

Due to attrition among the elementary education majors over the course of the study, the number of data sets used to make comparisons was far less that 52. Eleven complete sets of data were used for the first comparison (pretest-posttest); 21 were used for the second (pretest-midterm); and 6 sets of data were used for the third comparison (midterm-posttest).

Interpretations

Five possibilities based on the differences in the elementary and secondary experiences were suggested to explain the secondary education majors' decrease in attitudes toward science.

1) The decrease was caused by an overall reaction to the realities of teaching. Because of their coursework and actual classroom experience prior to practice teaching, the elementary education majors were more realistic about what to expect in the practice teaching situation and therefore experienced less shock.
2) The decrease was caused by a subject matter saturation effect. Having been involved with science continuously for an entire semester, the secondary education majors were just fed up with it.
3) Having become frustrated in dealing with apathetic high school or junior high school students may have caused the decrease.
4) Having two different practice teaching situations may have adversely affected the secondary education majors.

5) The difference is most likely to be due to some combination of the preceding possibilities.

The similarities of the secondary science and elementary education majors' scores on the SPI give rise to two interesting lines of speculation. The findings could be interpreted as a success story; elementary education majors even with their limited background in science have become sufficiently aware of the processes of science. On the other hand, it may be suspected that the secondary science education majors are not as knowledgeable about the processes of science as they should be. The authors conclude that the former speculation seems most likely given the strong emphasis placed on process oriented science at the elementary level.

ABSTRACTOR'S ANALYSIS

The science methods and practice teaching courses taken by elementary and secondary education majors represent a very complex set of experiences. Social and physical elements of the science methods class, science methods instructor, college supervisor, cooperating teacher(s), and age and maturity level of the students taught are some of the factors that make up this complex set of experiences. Researchers often isolate components of this set of experiences in order to cope with the barrage of interacting stimuli. The decision to focus on specific stimuli separately or in combination, or to study the set of experiences as a whole lies ultimately with the researchers.

In the two studies reported on in the article, Lawrenz and Cohen focus on the set of experiences as a whole in that they assessed the change in attitudes toward science and the learning of process skills of both elementary and secondary education majors prior to taking science methods course, immediately after the completion of the courses, and upon the completion of their practice teaching. The studies represent a growing body of research on the effects of preservice science teacher training on teacher characteristics thought to influence school students' achievement in science (see Welch, 1983).

In general, the written report is more than adequate. Descriptions of the subjects, science methods courses, practice teaching, instruments, procedures, and results are clear and unambiguous. However, an explicit statement in the introduction section indicating that the results of two separate, yet sequential studies are reported would have added greatly to the clarity of the article.

The major weakness in the studies is the design. The samples were quite small and not randomly selected. Control subjects were not identified. The results of the elementary study may be biased because of the attrition that occurred during the second semester. The situations in which the studies were conducted are different. Different instructors taught the methods courses and many different teachers and localities impinged on the practice teaching. To the extent that these limitations could have influenced the conclusions drawn from the studies, the authors consider the studies strictly exploratory.

The nature of the treatment also suggests that the studies be viewed as exploratory. The experiences that composed the science methods and practice teaching courses were many, including those mentioned above and a host of others. Amassed, these experiences compose a treatment that is extremely gross in nature; one cannot even begin to speculate as to which experience or set of experiences could have caused the outcomes reported. For instance, what experiences are responsible for the decrease in the secondary majors' attitudes between the midterm and the posttest? Is it possible that one experience could have had a favorable influence, but its effect may have easily been negated by another experience that was also a part of practice teaching? The same scenario might also be used to explain the failure of the treatment to cause an increase in the students' knowledge of process skills.

The attitudinal findings must be further scrutinized when considering the recent criticism levels against the SAI. Munby (1983) showed that many of the items thought to tap attitudes can be interpreted quite differently. He concluded that we can be less than certain of what is measured by the SAI, and that it needs reworking before it can be used with confidence.

Related to concerns of attitude measurement, the authors admit that changing teachers' attitudes toward science is probably not the most effective way to promote science teaching in schools. Measuring preservice teachers' attitudes toward the behavior of teaching science is currently advocated by many science educators investigating attitudes. Thompson and Shrigley (1986) have recently published a Likert-type scale designed for this purpose. Researchers in the near future will probably consider using models that delineate the relationship between attitude and behavior. A model proposed by Ajzen and Fishbein (1980) seems to be the most fruitful option at the present time.

One of the marks of a maturing discipline is the extent to which research grows out of and contributes to a theoretical matrix. Recent attitude research in science education has been undergirded by the assertions of Festinger, Hovland, Rokeach, and other social psychologists (see Shrigley, 1983). Why were no attempts made to link the findings of the reported studies to theoretical models derived from social psychology? While the authors did an adequate job of relating their work to earlier studies on the effects of preservice science instruction on attitudes per se, they seem to have missed an opportunity to relate their findings to the broader and larger theoretical issues of attitude change.

The real strength of the work and its major contribution to the science education literature resides in the many questions raised in the discussion section. Lawrenz and Cohen should be commended for their efforts in this area. The questions serve as a springboard to further research. Those interested in exploring the intricacies of elementary or secondary science teacher preparation would do well to consider each question raised by the researchers. Hypotheses could be easily generated from some of the questions and well controlled experiments devised.

To conclude, the idea of the studies is commendable as it attempts to place our understanding of attitude change and process skill learning in the whole of its context rather than concentrating on a small artificial fraction of what takes place in the preparation of teachers of science. Unfortunately, the broader context makes the study of attitudes and process skills very complex, necessitating either deeper study of the different facets thought to affect them or limiting the boundaries of investigation. Whether studying the attitude improvement of or acquisition of process skills by elementary or secondary education majors, great care needs to be exercised in the design, data collection, nd interpretation in order to arrive at an appropriate account and analysis.

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Descriptors--*Attitude Change; Elementary Secondary Education; *Inservice Teacher Education; *Program Effectiveness; *Program Length; *Science Education; *Teacher Attitudes

Expanded abstract and analysis prepared especially for I.S.E. by Constance M. Perry, College of Education, University of Maine.

Purpose

The primary purpose of the study was to evaluate and compare the relative effectiveness of two inservice presentation formats in achieving teacher attitude modification.

Rationale

One of the most important aims of energy education is to modify the energy-use behavior of future generations. Because one step toward changing behavior is the development of appropriate attitudes, energy educators are very interested in attitude formation and change. Some evidence suggests that teachers pass their attitudes on to students (Hone and Carswell, 1969; Washton, 1971) and also, if teachers have positive attitudes towards appropriate energy use, they are more inclined to teach energy topics (Weiss, 1978). However, very little is known about the best way to modify teacher attitudes so that they will involve their students in energy education.

Inservice is one method that has been shown to modify teacher attitudes and it can be assumed that it would be effective in the area of energy education. The question of which is the more effective format for inservice still remains. This study looks at two different formats in an effort to discover which is more effective.

Research Design and Procedure

Method. Teacher attitudes were assessed on the first and last day of participation in two different inservice trainings. "Effectiveness was determined by change in three types of teacher attitudes considered most likely to affect implementation of energy education: attitudes toward curricular change, opinions on energy concepts, and beliefs about science education" (p. 498). The research design was termed by the author to be a multivariate, repeated measures design.

Both inservice formats were designed to provide knowledge of energy concepts and to develop positive attitudes toward activity-centered energy education. Both inservice training courses were open to any interested teacher, provided graduate credit, and were tuition free. The main differences were the length of the training and the energy content expected to be learned. Of 33 inservice courses, 11 ran for five weeks for one credit and 22 ran 15 weeks for three credits. A much stronger emphasis on content knowledge was present in the longer course.

Sample. The sample consisted of teachers who chose to enroll in one of the two inservice courses. There were 140 participants in the shorter class and 296 in the longer. Teachers could not be randomly assigned. The author states that this lack of random assignment necessitated a repeated measures design to control for any initial differences. The longer course group had more men (38% vs. 17%) and fewer people with majors in elementary education (52% vs. 65%) than did the shorter course. However, 76% of the participants in both groups taught in grades 1-8. There was no significant difference in the ways the two groups rated their inservice classes; both rated their experience highly.

Instrumentation. Three instruments were used in this study. They were: Curriculum Attitude Survey (CAS); the Energy-Opinionnaire (EO); and the Beliefs about Science and Science Education (BSSE). These instruments were chosen because they measured three relevant attitudinal areas. The CAS measures receptivity to curricular change, the EO measures attitudes toward energy conservation topics, and the BSSE assesses beliefs about how and which science topics should be taught.

All three instruments had five-option Likert response formats. The CAS overall reliability was (Cronbach alpha) 0.85 and the scale reliabilities average, 0.50. The EO Cronbach alpha reliabilities ranged from 0.35 for one scale to 0.74 for the total test and the BSSE Cronbach alpha reliabilities from 0.54 to 0.70.

Data analyses. Because each instrument has more than one scale, MANOVA techniques were used. The data were analyzed in three repeated measures MANOVAs using the SPSS-package (Hull and Nie, 1979). The changes in scores were examined over time using the repeated measures scores as the dependent variable. For each MANOVA, the independent variable was type of inservice training and the dependent variables were the pre- and posttest scale or factor scores for each of the three instruments.

The repeated measures MANOVAs produced three contrasts: one for Group, one for Time, and one for the interaction of Group with Time. If the multivariate tests were significant, the univariate tests were considered. The variance explained (W^2) by any factors showing significance as well as scale mean scores and standard deviations for each instrument were reported.

Findings

CAS. Both the Time contrast and the Group by Time interaction had p values of 0.05 or less. The results of the Group by Time univariate contrasts indicated that attitudes changed differently toward openness and reward. Teachers in the three-credit course became more willing to try new things and saw more value in curricular change. Teachers in the one-credit course became less willing and saw less value in curricular change. The teachers in both groups became more positive toward using a variety of materials.

EO. There was no significant Group by Time effect; therefore, there was no difference in the ways the two inservice trainings affected opinions of energy. There were significant Group and Time effects. Teachers in the three-credit group had more favorable attitudes toward conservation and teachers in both groups became more positive toward conservation issues.

BSSE. There were no significant changes in the teachers in either group over time. Significant differences were found in the Group and Group by Time contrasts. Teachers in the one-credit group decreased their belief in the importance of two factors (Specific Science Concepts and Structured Science Teaching), while three-credit teachers increased theirs. More clearly stated, the one-credit teachers became more positive toward teaching general science skills rather than specific skills and more in favor of a less structured class environment.

To summarize the major findings, attitudes toward the value of curricular change and the willingness to participate in that change became more positive for the three-credit group and less so for the one-credit group. The belief in teaching specific science concepts increased in the three-credit group and decreased in the one-credit group.

Interpretations

The author has interpreted her findings in the following ways. The difference in change in attitudes toward curricular change may be explained by "burn out" for the one-credit group. Each group was required to try out energy activities in the classroom. The three-credit group had the semester to do this while the one-credit group had to squeeze it all into one month.

The difference in change in beliefs toward teaching specific science concepts may be due to the different course formats. The one-credit course was conducted on a nondirective, inductive manner whereas the three-credit course had a more directed format due to the increased subject matter content.

The Time differences coincide with previous research findings that inservice training can affect teaching attitudes. The Group differences show that the participants in the two groups were different. There may be a participant effect operating. It is possible that certain people prefer different course formats. It seems that those with more positive attitudes toward energy may be more likely to enroll in the longer course. Also the activity orientation of the one-credit course may have been more appealing to those with a less structured approach to science teaching. According to the author, Good and Fletcher (1981) suggest that tests of significance are inadequate as the only basis for making decisions on educational significance and that explained variance should also be considered. The variance explained by factors in this study was relatively small; however, in the increase in teachers' attitudes toward energy education 15% of the variance was accounted for.

Two limitations to the study should be noted. First, there was no random assignment to training formats; however, a teacher questionnaire showed no substantial differences between groups and the repeated measures analyses used control for pre-existing differences. The second limitation was that the formats differed not only in length, but in content.

"Based on the significance testing it appears that the longer, three-credit format may be slightly more effective than the shorter one because the participants...learned more energy content, and they became more favorably inclined toward curricular change during the course...the one-credit format appears to influence the participants toward a more favorable belief in teaching for general science skills rather than specific concepts. Therefore, unless a high level of content knowledge is a desired goal, a shorter inservice...is the more efficient method for presenting energy education." (p. 505)

ABSTRACTOR'S ANALYSIS

The purpose of the study - to evaluate and compare the effectiveness of inservice training of two different lengths in achieving teacher attitude change - is an appropriate and important area for study. Findings from such a study can give direction not only to energy education inservice training but perhaps could be expanded to inservice training in general.

This study has been reported clearly with, in most instances, enough information for the reader to understand the process and results. In addition, the author has stated the limitations of the study and made interpretations of the findings keeping those limitations in mind. There are, however, as with any study, several questions that arise.

The design is termed a multivariate, repeated measures design and the author states that the repeated measures design was necessitated in order to control for any initial differences between the groups. It is not clear from the article how the repeated measures design controlled for non-random assignment to groups. More specificity could clarify that point. Covariance is frequently used to control for initial differences and could perhaps provide useful insights to the study.

The fact that the two inservice formats differed in content emphasis as well as the studied variable length necessitates treating the findings with caution. This limitation mentioned by the author cannot be minimized. The author states that even though the subject matter content confounds the duration effect it is possible to compare effectiveness of the two types of training in regard to the basis of teacher attitudes toward activity-centered energy education, since the two types of training had the same goals in that area. However, later the two formats are described as different in approach--the content centered, longer term training being much more direct than the shorter, activity-centered training. The differences in delivery style were suggested to be instrumental in causing differences in attitudes towards teaching specific science concepts. Even though the goals in regard to activity-centered energy education were the same, the fact that the trainings did differ in much more than length raises questions as to whether the two inservice training formats are indeed comparable. Can they be assumed to be the same for purposes of comparing attitudes toward activity-centered energy education?

When describing the sample and later while interpreting the findings, it is stated that the two treatment groups had no substantial differences. Does no substantial difference mean no significant difference, or just what does it mean? Is the fact that there were 38% men in the longer course versus 17% in the shorter course and 52% elementary majors versus 65%, a significant difference or not? It is not clear whether tests for significance were carried out in deciding whether substantial differences existed.

In describing the instrumentation, reliabilities are reported. For the CAS the overall reliability is 0.85 with the scale reliabilities averaging 0.50. The EO reliability was 0.74 with factor reliability ranging from 0.35 to 0.69. The reliability of the BSSE was 0.70 with separate scale reliabilities being 0.55 and 0.54. The reliabilities for the scales and factors appear low, yet conclusions were drawn from the results. "In basic research a good working rule is that the reliability coefficient should be at least .70..." (Mitzel, 1982, pg. 1600). Since several of the stated reliabilities are well below .70, the conclusions drawn from the change in test results over time can be questioned.

The author referred to Good and Fletcher (1981) who suggest that tests of significance are inadequate as the only basis for decision-making. They state that explained variance should also be considered. Using that information, the author allows that the explained variance in the study is small but in the increase in teachers' attitudes toward energy education, 15% of the variance was accounted for. Isn't 15% explained variance small or is it significant? Further clarification would be helpful.

In the final paragraph of the study the author states that the longer format may be slightly more effective than the shorter one because the teachers in the longer course learned more energy content. That may well be true. Throughout the article the longer course was described as having a greater emphasis on content than the shorter course had. One would assume that if a course had more content emphasis, the participants would learn more content but nowhere in the article was there any mention of measuring content learned. How can it be concluded that one format was slightly more effective because more content was learned if content achievement was not measured?

This study is a beginning in evaluating effectiveness of inservice training in energy education. The conclusions would profit from a further look. If an ideal study could be designed, it would control for initial group differences and training format differences and would use instruments with high reliability. As we all realize, perfect studies don't exist but a repeat of this study with some of the above characteristics would be worthwhile.

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Descriptors--*Disabilities; Elementary Education; *Elementary School Science; *Inquiry; *Mainstreaming; *Science Activities; Science Education; Special Education

Expanded abstract and analysis prepared especially for I.S.E. by David P. Butts, University of Georgia, Athens.

Purpose/Rationale

In this study the authors proposed to ascertain if teachers think handicapped students can be effectively integrated into a regular classroom for science instruction. The research references indicated some difference in the beliefs as to whether such integration is being done or, if it is being done, how well it is working. In this study, five variables are embedded in the question:

a. the teacher;
b. the curriculum;
c. the handicap;
d. the mainstreaming and
e. the efficiency.

Research Design and Procedure

A survey strategy was used to secure opinions of 269 second, fourth, and sixth grade teachers in an intact school population where SCIS was being used. The return of the survey was 146 or 54%. The survey instrument was not described. A summary of the results was provided but there was no identified analysis of these results.

Findings/Interpretations

The study began with four main quesitons. The findings relate to these questions as follows:

a. What is the ease with which handicapped students are effectively integrated into the regular science classroom? Teachers said that SCIS works well for both handicapped and non-handicapped students.

b. Are there advantages or disadvantages for SCIS as compared with other subjects? Teachers expressed wide agreement on the advantages and few disadvantages were mentioned.

c. How do students feel about science as a subject? The teachers reported that they all feel positive about science.

d. How do teachers feel about teaching either SCIS or handicapped students? The teachers generally felt positive about both.

The general conclusion was that "SCIS works well for handicapped students."

ABSTRACTOR'S ANALYSIS

The report of this study is written in a clear straightforward way. The study adds another interesting piece to our understanding--but it is not clear as to how or where that piece fits. The literature referenced and the study itself suggests a number of investigations have been done and a number of individually interesting conclusions have been constructed. What would strengthen both this study and the literature to which it relates is a conceptual map that provides the reader with a picture by which one can understand the access and success handicapped learners have in science. It would substantially enhance the readers's understanding if there were an explicit rationale for why we should expect handicapped learners (all varieties of handicapped) to be successfully integrated into the science classroom. Is this integration based on the teacher, the student's handicap, or the nature of the instruction, or other variables? Thus, a clear conceptual map would help the reader to visualize why it is reasonable to expect student success to be a function of teacher opinions.

Munby, Hugh. "A Qualitative Approach to the Study of a Teacher's Beliefs." Journal of Research in Science Teaching, 21 (1): 27-38, 1984.

Descriptors--*Beliefs; Case Studies; *Curriculum Development; Elementary Secondary Education; Instructional Innovation; Middle Schools; Science Curriculum; *Science Education; *Science Instruction; *Science Teachers; *Teacher Characteristics

Expanded abstract and analysis prepared especially for I.S.E. by Robert E. Yager, The University of Iowa, Iowa City.

Purpose

Munby states two distinctive purposes for his research. The first is to show how the beliefs and principles of a teacher can be expected to constitute a significant part of his or her context for making choices about adopting research findings, implementing novel curricula, or in other ways altering professional practice. The second purpose is to describe a qualitative methodology, which is fortified with factor analysis, for learning about a teacher's beliefs and principles. Such methodology illustrates the case study procedure with a focus on the attention to the thinking that is foremost in the mind of one teacher of science.

Rationale

Russell's 1980 essay which argues for the significance of teachers' beliefs and principles provides the basic rationale for the research. His essay emphasizes the importance of personal convictions in making decisions about teaching. Only rarely are teachers viewed as pragmatic skeptics who assess changes in view of the particular context of their personal lives. Roberts' work with the "theory-practice interface" is reviewed. The treatment that novel materials and approaches receive at the hands of teachers are linked with their perceptions. The latter is a function of belief and principles about what it means to be a science teacher, what is important to teach, how teaching should be conducted, and how learning occurs. Olson's 1981 research is cited as further evidence of the importance of teachers' beliefs to the success of curriculum implementation. Teachers' perceptions of role massively intervene in the curriculum implementation process and substantially transform an externally designed curriculum into the curriculum students experience. The research is designed to expand on previous evidence of the importance of teacher beliefs and to substantiate that such beliefs can be identified and described in a valid and reliable manner.

Research Design and Procedure

Roberts' earlier work with qualitative research techniques is used as a base. Attending to the uniqueness of an individual within a particular environment is basic to qualitative efforts; special attention is needed to giving an individual teacher opportunity and assistance with talking about fundamental beliefs and principles in a form that provides integrity.

The Repertory Grid Technique was employed; it involves ratings, on a grid, between an axis of "elements" which are people or situations and an axis of "constructs" (ways a subject thinks about the "elements"). The completed grid is analyzed factorially to determine relationships among constructs. The entire methodology in using such a grid with one teacher is described; the methodology and its use are central to the research. The operative assumption is that phrases used by the teacher to distinguish or characterize the groups of elements are representations of some set of coherent beliefs and principles about his/her teaching and that the primary task is to determine what these are. Presumably, coherence is reflected in the scores of association obtained from the grid. If the distinguishing or characterizing phrases in the "construct" axis are thought of as "variables" and the "elements" as "subjects", the correlations among variables can be factored with reasonable expectation that the "variables" which exhibit some commonality will be placed in the same factor. The grid was subjected to a principal component factor analysis with varimax rotation, using a packaged program. Problems with the analysis are discussed and described. Ultimately results were obtained which included groups of phrases obtained from the factor analysis; they were used in a second interview to probe for what might underlie them. Transcripts of teacher response to the factor analyses are recorded. Generally the teacher was unable to identify the particular source for her thinking.

Findings

Information concerning how one teacher thinks about her teaching is presented. Generalizing is difficult and dangerous; headings are often overlapping and may omit certain characteristics that arise from discussion. The teacher studied was interested in specific student outcomes, including:

1) Student success at curriculum content and their subsequent confidence;
2) Making them think;
3) "Daily life" information;
4) Application and transfer making factual information more real;
5) Successful use of resource material;
6) Group work and social learning.

The teacher was seen to be committed to helping youngsters cope with information; she was also committed to her students "learning" the content in the curriculum. The teacher's dominant concerns were found to be increasing student confidence and increasing their ability to handle information independently. The origin for her principles were pragmatic rather than theoretical.

Interpretations

The point of the research was not to portray the teacher's thinking _per se_, though knowledge of it would be essential to anyone willing to introduce new materials/and/or approaches in a particular classroom. The author, however, advances the study as recognition for the importance of qualitative studies. The utility of the knowledge obtained is recognized in and of itself as very limited because it pertains to one teacher. However, the author stresses that knowledge is not judged solely upon the criterion of its range of applicability as well; he states that the power of knowledge is also important. The power of qualitative research is derived from its ability to provide knowledge that can help with understanding of the particularities of unique professional practice.

ABSTRACTOR'S ANALYSIS

Munby's study provides a fine example of how qualitative research techniques can be used to affect practice and to provide more specific information about impediments to improvements. The relationship to studies and writings of Russell, Roberts, and Olson is helpful in providing a fine rationale for the case study. The study takes the ideas and the maps provided by authors and offers a fine example of what can be done and how the resulting information can be used.

The article provides a rich source of information for researchers interested in qualitative research. The use of the Repertory Grid Technique in qualitative research, the interview techniques and procedures, and factor analysis all provide methodological contributions that are extremely useful to other researchers. In a sense this is the primary contribution--often stressed by the author.

The "study" is actually an example of what case studies can do and what kind of information may be available only from such studies. The importance of a teacher's belief system is underscored for those interested in introducing new curriculum materials and/or teaching approaches. The design is a careful one with helpful references to previous studies, positions, techniques, and assertions. The record of the procedure is a most commendable feature. However, the information presented concerning a single teacher has limited value in and of itself--a fact emphasized by the author.

At times the author provides more information, e.g., direct transcript of teacher response than is needed. At other times, there seems to be a major leap between an observation and/or a response and a general statement. There is also some question concerning the investigator's suggestions for classification and interpretation that were mentioned. Was not there some way to get the information, the picture, the suggestion from the interviewer rather than asking for verification of suggestions from the investigator? Perhaps the technique could be strengthened with the inclusion of more direct statements and/or other evidence that the interpretation came from the respondent.

There is surely power in qualitative research. However, much of the power can come from the use of such procedures at a local level and/or by those interested in specific change in the school program or in teaching behaviors. Space in professional journals is too limited to encourage repeated Case Study approaches. And, getting significant numbers to permit generalizations defeats the purpose and the strength of the design.

Munby's article adds valuable information and specific direction for those desiring to pursue qualitative strategies. Perhaps more would have been served if he had concentrated on the procedures, the pitfalls, the ultimate use of specific information. At times he seems to reflect too much on the study of one teacher and her responses and interpretations. More information concerning the validity of the grid and the factor analysis may be more helpful to other researchers. Was the information used in the school? Was the outcome merely an elaboration of the research design? Was it merely a fine exercise for the teacher involved--and for the researcher? Information concerning use of the specific results would be interesting as a follow-up on the study.

Crow, L. W. and J. P. Barufaldi. "SEARCH: An Exploratory Study of an Innovative Retooling Science Program for Elementary School Teachers." School Science and Mathematics, 85 (6): 486-493, October, 1985.

Descriptors--Educational Research; Elementary Education; *Elementary School Teachers; *Inservice Teacher Education; *Program Descriptions; *Research Reports; *Science Education

Expanded abstract and analysis prepared especially for I.S.E. by Jerry G. Horn, Kansas State University.

Purpose

The purpose of this study was to describe an innovative "retooling science program SEARCH."

Rationale

The current demand for science and mathematics teachers and the projected shortage for the future are well documented (DeRoche and Kuwaja, 1982). Various recruitment methods and the hiring of substitutes with limited preparation and experience have been utilized to fill the void. In addition, the results of recruitment of potential science teachers from the ranks of undergraduate science majors have been unsuccessful. While there may be many reasons for the latter case, low teacher salaries and the perceived low status of the teaching profession are often cited. Some success has been achieved in the recruitment of science teachers from more traditional populations. The "retooling" of elementary school teachers in science may provide some relief for this shortage of science teachers.

Research Design and Procedures

This program attacked the problem of science teacher shortages by attracting elementary school teachers from among the district's ranks to be initially retrained through a process that included two community college earth science courses. The program, designed to ease the shortage of earth science teachers, included a group of 18 participants who were carefully screened on the basis of their past academic achievement, teaching performance, and their performance in an interview session. Initially, it was hoped that 50 participants would be chosen, but only these 18 survived the rigorous screening process. All of the participants were teaching in the district, and most had a bachelor's degree with a specialization in elementary education. While they had some interest in science, their academic preparation in science and mathematics was very limited. Incentives to participate in the program included cost of the course work, a bonus of $1,000 for completion of the courses and, due to a differential pay scale in the Houston schools, an extra bonus of $1,000 when placed in a science teaching position.

The courses offered as a part of this retooling process included the topics of astronomy, oceanography, meterology, physical geology, and histrocial geology. The traditional lecture and laboratory format was modified to include discussion sessions on earth science, teaching strategies, and social issues, field trips, laboratory activities focusing on earth science and taught by practicing science teachers, and readings in college-level texts.

The following three instruments were used for the purpose of describing the participants as they matriculated through the program.

a. Teacher Concerns Statement (TCS) - This instrument, developed by the Personal-Professional Development Systems Division of the Research and Development Center for Teacher Education at the University of Texas as Austin, is based on the conceptual model that supports the contention that teachers progress not only through a sequence of concerns about teaching, but their conc about the new practice or innovation are also identifiable and developmental. A concern may be operationally defined as feelings, attitudes, thoughts, ideas or reactions an individual has related to a new practice. The following three categories of concerns have been identified.

Category I - Self-oriented Concerns
Category II - Self-benefit Concerns
Category III - Pupil-benefit Concerns

b. State-Trait Anxiety Inventory (STAI) - This inventory consists of two scales, state anxiety (A-State), a transitory emotional state which can be influenced by training, and trait anxiety (A-Trait), relatively stable individual differences in anxiety (A-Trait), relatively stable individual differences in anxiety proneness (Spielberger, Gorsuch and Lushene, 1970). A modified form of the STAI (A-State) was used to measure the subjects' anxiety level related to teaching science at a particular point in time.

c. Science Attitude Scale II (SAS) - The Shrigley Science Attitude Scale for Preservice Elementary Teachers III, a 20 item Likert-type test, was used for measuring the subjects' attitudes toward science.

Findings

The data generated from the TCS showed that the most intense concerns among the teachers are those concerns that focused upon Category II - Self-benefit Concerns. The teachers were consistently concerned about earth science competency at the beginning of the program, at midpoint, and at the end of the program. Three successive administrations of the STAI-A State Scale revealed a relatively high level of anxiousness toward the teaching of science, and it did not change throughout the program. On the SAS, the participants became more positive toward science between its first administration and the second; the participants' attitudes toward science also changed from the first administration of SAS to the third administration at the end of the program. Changes in attitude toward science were not detected between the midpoint of the second administration of SAS and the third administration.

Two additional courses such as those offered in SEARCH did not lessen the "traditional feelings of insecurity and incompetence toward science content" among elementary teachers. Concerns of the participants focused most intensely on "self," and expressed anxiety focused on the teaching of science. The authors surmise that a reduction of anxiety toward teaching science might enable the individual to focus upon pupil-benefit concerns. These concerns are especially desirable because of their relevance for student outcomes. Perhaps designing science content courses that may lessen anxiety toward the teaching of science should be considered.

The effectiveness of this program can be initially ascertained by the success of the participants in mastering the content of the courses and their success in making a transition from being an elementary teacher to a middle school earth science teacher. All participants successfully completed these courses with a final grade of A or B, and, of the 18 participants, 14 were assigned as middle school science teachers. Early reports indicate that they have been successful in making the transition from non-science major to science teacher with ease.

ABSTRACTOR'S ANALYSIS

Undoubtedly the purpose of SEARCH, an innovative retooling science program for elementary school teachers, is of particular interest to science educators, school administrators and teachers who may be considering a redirection of their careers into an area of teacher shortage. In effect, this paper is a report of efforts to document selected measures of concerns, anxiety levels and attitudes toward science among a group of individuals who were selected to participate in this program. The authors focused their attention on areas that have been a major concern to teacher educators in science as well as other areas. References to earlier work of the authors and others provided a framework for directing the investigation and the conduct of the program.

Traditional means of assessing program success via pre- and post-testing was not a major concern. However, successive administrations of the three instruments give the reader an understanding of the impact of the program on the participants, at least in three selected areas. At the conclusion of the report, the authors did resort to conventional measures of success, i.e., grades in the classes, placement in earch science positions, and observed success. Due to the nature and purpose of the program, the financial incentives, the participant selection process, and the need for middle level science teachers in this district, one should not be surprised at the results. Rather than a criticism, these circumstances should possibly be considered as conditions for similar efforts by others.

The instruments used in the study are recognized in the profession, and their use at selected points provides formative evaluations of the program. Without a comparison group and with subjects with a high degree of similarity, inferences of a statistical nature are not possible.

If one assumes that the purpose of the program was to cause positive changes in concerns, anxiousness, and attitudes, the program could not be considered very successful. Although this might have been and probably was highly desirable, the purpose was to retrain elementary teachers to become middle level earth science teachers. It did that, but the considerable amount of discussion and numerical data presented focuses the reader's attention away from this fact. This problem may be unique to this article, or it may be common to most efforts that attempt to describe a program while at the same time reporting data of a research nature. The intended purpose of an article is as important as the purpose of a study.

Since this report is a report of a training effort and not a research study, it is not possible to clearly determine its place or impact on an identifiable body of knowledge. However, documentation of a process to address a problem (teacher shortage) is extremely important. The results may indicate that teachers can be successfully retrained to teach science without removing some of the barriers that caused them to not choose this area initially. Would they be more successful if these barriers were removed or at least substantially reduced? Is it reasonable for a two-course sequence in earth science to have a significant impact on personal characteristics developed over 20 or more years? Would a program like SEARCH be as successful either in attracting participants or in the teaching act without the financial incentives and the "rigorous" selection process?

In effect, the authors have opened an area of investigation and practice that is timely and needed. Others who wish to pursue either of these lines would learn from the experiences of authors Crow and Barufaldi.

As a reader may surmise, the original report of a descriptive study of a retraining project for teachers by Crow and Barufaldi did not follow conventional research nor did it seem to provide a full description of the program that would permit replication. In effect, it was a mixture of a description and an evaluation of selected elements of the training program. To force this type of effort into a conventional research report was difficult for the abstractor and probably unfair to the authors. Hopefully, the reader of this expanded abstract and analysis recognizes this problem.

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Dreyfus, A., E. Jungwirth and P. Tamir. "Biology Education in Israel as Viewed by the Teachers." Science Education, 69 (1): 83-93, 1985.

Descriptors--*Biology; *Curriculum Development; High Schools; *Science Course Improvement Projects; Science Curriculum; *Science Education; *Secondary School Science; *Teacher Attitudes

Expanded abstract and analysis prepared especially for I.S.E. by Cheryl L. Mason, Purdue University.

Purpose

The authors sought to delineate the main concerns that teachers held concerning the 15-year-old Israel High-School Biology Project (IHBP) which is an adaptation of the BSCS Yellow Version textbook.

They specifically studied the following questions:

(1) How do teachers perceive the IHBP program?

(2) How satisfied are teachers with the situation as they perceive it?

(3) What changes in the system would teachers advocate?

Rationale

Based on the premise that the teacher is the key to proper implementation of any curriculum, the study addressed the subjective perceptions of the curriculum by biology teachers in Israel. It was thought that teachers may predicate their responses to a curriculum situation on concerns rather than on actual accomplishments.

Research Design and Procedure

Sample

The subjects included 110 teachers who comprised 25% of the total number meeting the following criteria:

a. currently teaching in 11th or 12th grade;
b. teaching experience of at least five years; and
c. currently preparing pupils for the Bagrut-examination; and/or have had such experience during the last three years. (A passing grade on the Bagrut test is necessary for admission to universities and most other post-secondary institutions.)

The schools in the sample were:

a. selective city-schools;
b. comprehensive urban schools
c. rural regional schools;
d. agricultural boarding schools; and
e. religious schools (excluding Kibbutz-schools).

Method. The design of the research was an ex post facto exploratory field study (Campbell and Stanley, 1966). The study consisted of three phases. Phases one and two involved interviews and an open-ended questionnaire. The purpose behind these phases was to secure what the teacher concerns were. The results of the interviews and questionnaire were used to supply the content for the final questionnaire, the results of this phase were reported in this article.

Final questionnaire. Part I of the final questionnaire consisted of 27 statements in five clusters. The clusters included statements concerning subject matter content areas, aspects of activities in and out of the classroom, student evaluation, and teacher concerns regarding the IHBP.

In addition, two questions concerning the teacher's perception and opinion about each statement were asked. Possible response patterns were as follows:

Perception	Opinion
(A) Accepted. Emphasis is strong.	(A1) It is good that emphasis is strong.
	(A2) It is bad that emphasis is strong.
(B) Rejected. Emphasis is not strong.	(B1) It is good that emphasis is not strong.
	(B2) It is bad that emphasis is not strong.

An analysis of the teachers' responses consisted of the following four components:

(1) Perception: A = true, B = not true;

(2) Opinion: A1 = true/good, A2 = true/bad,
B1 = not true/good, B2 = not true/bad;

(3) Satisfaction: Yes (A1 + B2) or No (A2 + B1);

(4) Desirability: (A1 + B2) or (A2 + B1) depending on whether the statement was positively or negatively formulated.

Also, for each of the 27 statements in Part I, the teachers were asked to respond on a 5-point scale (zero = irrelevant to response, 4 = extremely relevant) as to how the following six factors were involved in their answers:

(1) Preparation of students for the Bagrut examination.

(2) Motivation of students.

(3) Development of understanding of the methods of inquiry.

(4) Development of creativity.

(5) Development of understanding of the relationships between science and society.

(6) The imparting of various biological topics.

Part II of the questionnaire consisted of six statements related to the Bagrut (matriculation examination), and Part III used a 4-point scale (0 = no influence and 4 = extremely strong influence) to assess the influence of administrative, budgetary and safety constraints on attempting out of the school activities. The results of these two parts were not reported in this article.

Findings

Since ANOVA's across school types, teaching experience and educational background resulted in no statistical differences, the findings were reported on the basis of a total-study population.

Part I of the questionnaire was analyzed for the teachers' perceptions, opinions, satisfaction, and views about the desirability of the educational aspect(s) contained in the 27 statements. On ten of the statements, there were clear-cut majorities. Teachers agreed that the IHBP program did not include sufficient emphasis on philosophy and human biology, or on the social and cultural aspects of biology.

On eight of the statements there was a clear-cut majority in perceptions, but there was disagreement with regard to the desirability of emphasis put by the curriculum on areas such as philosophy, statistics, scientific inquiry, ecology, and indoor or outdoor activities.

Perceptions were divided on six of the statements, but there was no disagreement on the desirability of the strategies presented. Finally, for three of the statements there were divided perceptions, and disagreement on the desirability of the situation.

When the teachers indicated which of the six aspects of biology education influenced their opinion on each of the statements, motivation of the students was the most common factor (19 items). The remaining aspec[illegible] from second to sixth were as follows: preparation for [illegible] exam (14 items); understanding of inquiry (12 items); deve[illegible] creativity (10 items); imparting of biological top[illegible] [illegible]ems); and relationships between science and society (5 items).

Interpretations

The main findings were as follows:

(1) The teachers strongly indicated that they supported the laboratory/inquiry oriented approach and th[illegible] physiological slant of the IHBP curriculum.

(2) There was a demand for more flexibility in the curriculum, in order to meet individual students needs.

(3) Social and ecological aspects of biology, including the involvement of outdoor activities, were desirable but not sufficiently evident in the actual school situation.

(4) The teachers indicated that the Bagrut examination had a great impact on what and how they taught. They also suggested that the examination should not be the main means of assessment, since topics not included on the examination tended not to receive the attention they deserved.

(5) Most teachers wanted to be more involved in curriculum development.

(6) The discrepancy between teacher opinions and their actual teaching routine was partly explained by the demands of the Bagrut examination (actual or perceived) and by monetary and/or administrative constraints (actual or perceived).

(7) Since the Israeli school system is very centralized, teachers tended to blame the establishment for difficulties arising from the IHBP curriculum.

ABSTRACTOR'S ANALYSIS

The authors indicated that although the methodologies used in the study were of general applicability, the issues which were of concern to the teachers were obviously affected by the constraints of the educational setting. Perhaps teachers located in a different country would suggest different questions to be included in the final questionnaire.

As in most field studies with the ex post facto character, there was a plethora of variables and variance which were unaccountable. For example, the method of selecting the final sample of teachers was not described. The manner in which the teachers were chosen, and whether they were volunteers or not, would have an effect on the results. In addition, a balance should have been sought between the rural and agricultural teachers with respect to the academic city teachers, in order to reduce the disparity in numbers.

Although the specific educational setting tended to affect the generalizability of the results, the basic tenets behind this study were sound. Because teachers are at the core of any improvement effort, it is important to first ask them about their major concerns and then gear improvements towards meeting those concerns. An inaccurate assessment of a faculty can lead to failed efforts in any school.

Following this philosophy, the researchers sought to discern the subjective perceptions of the curriculum by biology teachers. The method of using perception and opinion to determine possible response patterns, plus the extent to which various factors were involved in their responses, seemed to be an effective way to compare teacher responses and to draw conclusions. However, the underlying reasons for the differences in perceptions could have been investigated further.

As the results indicated, secondary teachers tend to approach teaching and learning with a dependency on lecture and discussion techniques, and to focus on content more than on student effect. Rather than criticize, however, it is important to realize the reality of what teachers' work life looks like from their perspective and to acknowledge their dilemmas, tensions, and choices (Lieberman and Miller, 1984). People respond to their perceptions of reality, not to some objective reality (Spector, 1984). Due to Israel's centralized educational system and the mandatory Bagrut examination, teachers perceived that they were under a lot of pressure to cover content material.

Dreyfus, Jungwirth, and Tamir have addressed a very important issue in their study. According to Crocker and Banfield (1986), teachers play a crucial part in the translation of curriculum intentions into classroom experience. Because they interpret curriculum materials and features of the school and classroom setting in an interactive manner, there is a difference between intended and translated curriculum. In other words, values are drawn upon during the decision-making process that occurs when science teachers plan for instruction; there is pre-active decision-making, a process that has meaning within the teacher's frame of reference and not necessarily within the curriculum specialist's frame of reference (Aikenhead, 1984; Munby, 1984; Crocker & Banfield, 1986; Mason, 1986).

Case studies have demonstrated that curriculum innovators who view teachers as co-researchers in the curriculum development process were more successful, as contrasted with those who viewed teachers as recipients of new materials (Aikenhead, 1984). These findings were supported by the results of this study which indicated that the teachers desired more input into the curriculum, more freedom in their classroom and less emphasis on the results of the Bagrut examination.

Although the three phases of the project were informative, supportive classroom observations are recommended. Observational studies have shown that teachers often do not perceive their teaching and/or the pressures of the educational setting accurately (Mason, 1986). Finally, since the authors indicated that this study added an important dimension to previous studies of the Is··el High School Biology (IHBP), perhaps a paper which consolidates their findings would serve to illustrate the full picture of biology education in Israel and allow for more generalizability.

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