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AUTHOR	Prather, J. Preston; Field, Maurice H.
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ABSTRACT

This study contends that there is a need for improvement of science education in the United States. It argues that although once a national priority, elementary science instruction now receives little emphasis in many schools. Consequently, many elementary students are deprived of an opportunity to build a sound science background for subsequent science studies. The purpose of this research was to illuminate and justify options for in-service teacher education programs to enrich the quality and quantity of science instruction in the elementary grades. The study indicated that an effective in-service program would require that both the instructional and administrative skills needed for reform be developed simultaneously within the existing structure of educational leadership. Further consideration indicated that such an objective should be readily attainable through joint training of teams of elementary teachers, principals, and supervisors of instruction. This research attempted to demonstrate the practical benefits of philosophical research as an efficient method of gaining insight into new program options from a synthesis of prior research. (Author/TW)

ENRICHING ELEMENTARY SCIENCE INSTRUCTION THROUGH JOINT TRAINING OF IN-SERVICE TEACHERS, PRINCIPALS, AND INSTRUCTIONAL SUPERVISORS

J. Preston Prather and Maurice H. Field
Center of Excellence for the Enrichment of
Science and Mathematics Education
The University of Tennessee at Martin
205H Gooch Hall, Martin, TN 38238
(901) 587-7166

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Abstract

There is a need for improvement of science education in the United States. Existing curricula and instruction have been declared largely inadequate, and there is intense pressure for reform. Several major studies in the late 1970s indicated that the problem is especially severe within the field of elementary instruction. Although once a national priority, elementary science instruction now receives little emphasis in many schools. Consequently, many elementary students are deprived of an opportunity to build a sound science background for subsequent science studies. The purpose of this research was to illuminate and justify options for in-service teacher education programs to enrich the quality and quantity of science instruction in the elementary grades.

Philosophical assessment of the status of elementary science instruction generated an innovative concept of in-service teacher education that culminated in a program for the enrichment of elementary science instruction. The study indicated that an effective program would require that both the instructional and administrative skills needed for reform be developed simultaneously within the existing structure of educational leadership. Further consideration indicated that such an objective should be more readily attainable through joint

training of teams of elementary teachers, principals, and supervisors of instruction. Although conceived from the perspective of elementary science education, it is reasonable to conclude that this strategy for team leadership should be applicable to all levels of school science instruction and to many other subject areas.

This research demonstrated the practical benefits of philosophical research as an efficient method of gaining insight into new program options from a synthesis of prior research. Analytical and speculative analysis of the issue of elementary science instruction provided an efficient overview of the problems involved and generated a new option for consideration in responding to an expressed teacher education need. This research approach provided a means to attain increased confidence in the efficacy of an option as philosophically justifiable prior to the commitment of time and resources to a particular course of action. This can be critically important to the maintenance of public credibility in an era of increasing educational accountability.

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Introduction

There is a need for improvement of science education in the United States (National Commission on Excellence in Education, 1983). Existing curricula and instruction have been declared largely inadequate, and there is intense pressure for reform (Hurd, 1986). Three major studies in the late 1970s indicated that the problem is especially severe within the field of elementary instruction (National Science Foundation, 1978). Although once a national priority, elementary science instruction now receives little emphasis in many schools (Mechling and Oliver, 1983). Consequently, many elementary students are deprived of an opportunity to build a sound science background for subsequent science studies. That trend runs counter to the National Science Teachers Association's contention that "we must insure appropriate science education for all citizens" (NSTA, 1982, p. 1).

Purpose of the Study

The purpose of this research, which was conducted at the University of Tennessee at Martin's Center of Excellence for the Enrichment of Science and Mathematics Education (CEESME), was to illuminate and justify options for in-service programs that teacher education institutions may offer to help school officials improve the quality and quantity of science instruction in the elementary grades.

The Procedure for the Study

Philosophical research methods are appropriate for initial enquiry into broad problem areas to synthesize points of view, illuminate options, and/or generate new ideas that may be compatible with the purposes and ideals of an institution, agency, or group. There are three major forms of philosophical enquiry: speculative, analytical, and normative. A combination of synthetic and speculative methodologies was selected as most suited for this study. A brief explication of philosophical enquiry is included in Appendix 1.

Philosophical assessment of the status of elementary science instruction generated an innovative and philosophically justified concept of in-service teacher education that culminated in a quasi-experimental program for the enrichment of elementary science instruction in rural and small school systems in Tennessee. This paper reviews that research and outlines the basic concept of the resulting program focusing on the events leading to the derivation of a new educational option through philosophical analysis of the problem of elementary science instruction.

Observations from the Study

Many elementary teachers feel unqualified to teach science and either devote little time to science instruction or ignore it, according to the National Science Teachers Association (NSTA, 1983). A national survey further revealed that participation of elementary teachers in National Science Foundation (NSF) programs for teachers has been very low. This may be largely attributable to the fact that most NSF programs are discipline-specific, but elementary teachers are typically generalists and teach all academic subjects (Weiss, 1978).

The Problem Of Elementary Science Instruction

Children are naturally inquisitive, and many of the things that interest them are relevant scientific concerns. However, given the current low level of interest and understanding of science among most elementary teachers, Stake and Easley (1978) concluded that few students were likely to experience even one year of substantial science instruction in grades K-6. Under such conditions, most of the nation's youth would be deprived of the immediate benefits of science education during the formative elementary years when they may benefit most from the thinking skills and learning processes promoted by science study. This represents a serious long-range threat to a culture wherein the average citizen's competency for living, working, and decision making is increasingly dependent upon a clear, basic understanding of the nature and social relationships of science and technology.

The challenge of elementary science education is clear. Changing times place changing demands on society, and society in turn places changing demands on education to provide learning experiences suited to those changing times. In Tennessee, changing societal expectations of science education were expressed in the Comprehensive Education Reform Act of 1984, which precipitated a science curriculum framework that mandated a "hands-on science" instructional approach for grades K-12. Societal expectations of elementary science education were further affirmed through the adoption of the Tennessee Science Curriculum Guide K-6, which contained more than 250 broad learning objectives related to science subject areas and concepts.

The mandated curriculum generated intense concern in many elementary schools for three reasons: Most schools lacked an adequate supply of science teachers to implement a program of the scope required; few of the elementary teachers who were teaching science felt comfortable with the idea of "hands-on science" teaching, which was very different from the way they had been taught science in high school and college; and no elementary text could be located that adequately fulfilled the mandated science curriculum. Furthermore, few rural elementary schools had up-to-date science texts and many teachers expressed concern about the lack of adequate science-related materials on which to base their instructional planning. To help overcome those problems, the Center of Excellence for the Enrichment of Science and Mathematics Education (CEESME) at the University of Tennessee at Martin, with the help of twenty-four experienced elementary science teachers, coordinated the development of a seven-volume Science Activities Manual K-6. The manual was correlated to the terminal instructional objectives of the Tennessee Science Curriculum Guide K-6.

While developing the manual, however, it quickly became obvious that more than new curricular materials would be required for teachers to make a successful transition to the mandated new direction in science education. Among most teachers, especially those with little or no training in science instruction methods, there remained a tendency to attempt to interpret and employ the manuals and other resources in terms of the traditional, student-passive instruction that characterized most of the science instruction they themselves had received. A subsequent informal survey of teachers indicated that most of them would require in-service training in "hands-on science" instructional techniques. To prepare such a program, the CEESME staff reviewed the literature on in-service teacher education to determine those instructional methods that had been proven most effective for in-service teacher education.

A review of research over the past three decades indicated that the National Science Foundation and other agencies had devoted billions of dollars to a variety of in-service programs for the improvement of pre-college science instruction, generally with very disappointing results (Yager, 1981). Speculative analysis of the situation, however, indicated that the crux of the problem may have been more a matter of local support for reform than either the quality of the training programs or the dedication and preparation of teachers. It appeared, for example, that many outstanding programs had been conducted and many capable and dedicated teachers had returned to their schools with increased skills and enthusiasm for constructive change. But it also appeared that many of those teachers found local education agencies less than receptive to their ideas because of a basic lack of understanding of the nature of science and the resources required for effective science instruction.

Numerous studies indicated the critical importance of the building principal's support in the success of any school program, but those same studies indicated that "many principals feel uncomfortable, even inadequate, with science. . . . While many principals want to improve science in their school's curriculum they wonder how and where to begin" (Mechling and Oliver, 1982, p. 4). On that basis, the CEESME staff speculated that inclusion of the building principal along with classroom teachers in a science training program would help to insure the administrative input and support required for success in educational reform.

Further study revealed that, whereas large school systems generally have supervisors of science instruction to assess local needs and resources and provide leadership in facilitating the administrative support and in-service training programs necessary to implement science education reforms, most small systems do not. A survey of Tennessee schools indicated that one supervisor of instruction was responsible for all subject areas in many rural and small school systems, and in most cases that supervisor had a limited science background. It therefore appeared equally important that the system supervisor of instruction participate in in-service science programs to insure an understanding of science education within that key dimension of the administrative structure.

Discussions with teachers and teacher educators further indicated that in-service teachers learn better when taught by the methods they will be expected to use in their own teaching. From this, it was concluded that the science instructors should employ hands-on instructional methods using model lessons from the Science Activities Manual K-6.

The Programmatic Result

On those bases, the CEESME concluded that an effective program for enrichment of science education in small school systems would require that both the instructional and administrative skills needed for reform be developed simultaneously within the existing structure of local educational leadership. Further speculation indicated that such an objective should be more readily attainable through joint training of teams of elementary teachers, principals, and supervisors of instruction from rural or small systems willing to make a commitment to providing local leadership for the improvement of elementary science instruction.

Speculative examination of the projected team leadership activity led to the conclusion that the program should provide participating teachers and administrators with the skills needed to assume a comprehensive in-service training role, beginning in their local school system. Further speculation led to the conclusion that adequate preparation for this role could prepare each participating team to train other teams outside their system. Further analysis indicated that instruction in the principles of adult education and leadership development should be provided in anticipation of a "ripple effect" of local leadership development culminating in improved elementary science instruction throughout the state.

A synthesis of research and evaluation in science and mathematics education by the U. S. General Accounting Office (GAO) suggested that programs to retrain teachers from other subjects to teach science and mathematics would be a viable approach toward overcoming the immediate teacher shortage in those fields, especially in the elementary grades, where teachers typically teach all subjects. The GAO report also indicated that "retraining programs sponsored by state education agencies

(SEA's) and local education agencies (LEA's) tend to have higher retention rates than university programs" (GAO, 1984, p. iii). "The high retention experienced by SEA and LEA programs is most likely attributable to more careful screening of applicants and to the fact that they are offered at little or no cost to participants" (p. 52). Further speculation on the basis of those observations led to the conclusion that the CEESME's intended program should be offered tuition free to elementary teachers interested in teaching science, and an independent selection committee should screen the team applications.

In summary, a review of research on science education and an assessment of the needs of teachers in the CEESME service area indicated that a combination of the university's teacher-education resources with features of SEA- and LEA-sponsored programs that contribute to enhanced teacher participation and retention would be appropriate. Working from that context, the project was conceived in terms of three training cycles over a three-year period, with each cycle involving nine 4-member teams for a total of 27 geographically dispersed, local educational leadership teams (54 classroom teachers, 54 principals, and 54 supervisors of instruction).

Each program cycle comprised two parts: 1) an Elementary Science Education Institute, which would provide an intensive program of academic preparation for the participating teams; and 2) a Field Phase, to be carried out by the teams in their respective school systems and educational development districts during the following school year. Further speculative analysis of the problems besetting past programs for science teachers indicated that many faltered because of a lack of follow-up once the teachers returned to the classroom. Therefore, a support system involving three field supervisors was planned to nurture the teams' field efforts throughout the three years.

The GAO (1984) report further indicated that "in the absence of substantial scholarship and subsistence payments, short and intensive programs seem to attract few students" (p. 56.) To help overcome this problem, the project planners speculated, provision for per diem to help defray student expenses should be added to the budget, and a $2000 honorarium should be included for each person completing the Institute.

From this speculative analysis of immediate program needs of elementary science teachers, a proposal for a project containing the indicated features was submitted to the National Science Foundation (NSF) and Tennessee Higher Education Commission (THEC). The project was funded, and the program began in February, 1987.

Implications for Science Education

Philosophical enquiry functions to examine purposes, justify fundamental assumptions and concepts, and illuminate options that are compatible with the aims and ideals of an institution, agency, or group. Ideally, it is a means for putting complex problems in the proper perspective to determine if change is appropriate prior to commitment of resources and time to a given course of action. It is also an efficient method of gaining insight from a synthesis of prior research and justifying options for possible subsequent application and testing. This research demonstrated the practical benefits of the speculative philosophical research methodology for approaching broad educational issues.

Analytical and speculative analysis of the issue of elementary science instruction provided a comprehensive and efficient overview of the problems involved and generated a new option for consideration in responding to an expressed teacher education need. Research of this nature should be equally applicable to other educational issues to help examine and justify options that educators may consider in attempting to respond to the growing pressures for substantial reforms in science education. Perhaps more important, this research methodology provides a means to help assure that, if chosen, an option is philosophically justifiable. This can be critically important to the maintenance of public credibility in an era of increasing educational accountability.

This research provided justification for a team training program concept that, based on the interim project evaluation (Prather and Hartshorn, 1987), promises to bridge the gap between school teachers and administrators that has been cited as the major deterrent to effective reforms in science education. The resultant team leadership development concept constitutes a programmatic option with many implications for in-service science teacher education. In the CEESME project, for example, each participating school system gained a unique resource--a local team of educators cognizant of both the instructional and administrative dimensions of science education program development. The clear channels of administrative and instructional communication alone should help those school systems overcome many hurdles in their quest for better science education.

Conclusion

Although conceived from the perspective of elementary science education needs in rural areas and small school systems, it appears reasonable to conclude that the CEESME strategy for developing a strong nucleus of local team leadership should be applicable to other levels and locales of science instruction and to many other subjects and problem areas. Since its inception, the concept has been adopted for two other projects dealing with computer education for Special Education students and the development of local programs for the prevention of drug and alcohol abuse.

Subsequent research on the outcome of those projects, and the completion of current research on the effectiveness of the CEESME project using statistical research methods, should provide an empirical basis for an assessment of the efficacy of the general program concept described in this paper. In the meantime, the philosophical research methodology employed for the study, which is summarized in Attachment 1, deserves careful consideration as a logical and essential first step in research programs dealing with basic educational issues.

List of Reference

General Accounting Office. (1984). New directions for federal programs to aid mathematics and science teaching. Washington, D.C.: United States General Accounting Office.

Hurd, P. (1986). Perspectives for the reform of science education. Phi Delta Kappan, 85(6), 353-358.

Mechling, K., & Oliver, D. (1982). Handbook II: The principal's role in elementary school science. Washington, D.C.: National Science Teachers Association.

Mechling, K., & Oliver, D. (1983). Handbook I: Science teacher's basic skills. Washington, D.C.: National Science Teachers Association.

National Commission on Excellence in Education. (1983). A nation at risk. Washington, D.C.: U.S. Department of Education.

National Science Foundation. (1978). The status of pre-college science mathematics, and social studies educational practices in U.S. schools: An overview and summary of three studies, Washington, D.C.: U.S. Government Printing Office.

National Science Teachers Association. (1982). Science-technology-society: Science education for the 1980s. Washington, D.C.: National Science Teachers Association.

National Science Teachers Association. (1983). Recommended standards for the preparation and certification of teachers of science at the elementary and middle/junior high school levels. Science and Children, 21(1), 65-70.

Prather, J. P., & Hartshorn, R.L. (1987, October). Leadership development program for the improvement of elementary science instruction in rural and small schools. Paper presented at the Second Annual National Rural and Small Schools Conference, Arlington, VA.

Stake, R., & Easley, J. (1978). Case studies in science education, Volumes I and II. Washington, D.C.: U.S. Government Printing Office.

Weiss, I. (1978). Report of the 1977 national survey of science, mathematics, and social studies education. Washington, D.C.: U.S. Government Printing Office.

Yager, R. (1981). The current situation in science education. In Staver, J. (ed.) An analysis of the secondary science curriculum for action in the 1980s (1982 AETS Yearbook). Columbus, Ohio: Ohio State University. (ERIC document reproduction number SE-03-0-586).

Appendix 1

EXPLICATION OF PHILOSOPHICAL ENQUIRY

J. Preston Prather

Philosophical research methods are uniquely appropriate for initial enquiry into broad problems to examine basic purposes, generate new ideas, and/or illuminate additional options that may be compatible with the basic purposes and ideals of an institution, agency, or group. Although philosophy is a common form of research, it is not typical of the empirical or quasi-empirical methods that characterize most educational studies. It is not listed as a research or evaluation methodology in many major educational references, and it generally receives only cursory mention in others. Consequently, its unique qualities are unfamiliar to many educators, and it is sometimes confused with other forms of enquiry such as historical, naturalistic, futuristic, or correlational research.

There are three major types of philosophical activity: normative enquiry; analytical investigation, which is sometimes called "critical analysis"; and speculative, or "synthetic," philosophy. Normative studies have as their end the justification of value judgments about what individuals, societies, and/or socio-cultural institutions may aspire to do; consequently, ethical and/or aesthetic questions constitute the predominant focus of this category of philosophical research.

Analytical and speculative studies aim to extend the limits of present human knowledge. Analytical research, which constitutes the majority of contemporary philosophical activity, functions to analyze and clarify the assumptions and concepts upon which a field of inquiry bases its conclusions. Speculative enquiry, on the other hand, seeks to expand the boundaries of present knowledge by synthesizing the conclusions of a field or fields and then filling in the gaps with speculation, or reasoned conjecture.

Philosophical research is unique in that it does not function _within_ a discipline but rather functions to think _about_ that discipline. It is not an appropriate method for solving problems _in_ science education, or _in_ history, or _in_ science, or _in_ religion, or _in_ anything else. Each discipline has its own unique problem-solving traditions for that purpose.

Empirical or quasi-empirical research methods, for example, are generally quite appropriate to determine if a particular goal or objective is practical or attainable. Philosophical methods are essential, however, when an institution, agency, or group needs to take a detached look at, or think objectively about, what it is doing to see if its ideas and/or anticipated actions are reasonable and compatible with its basic purposes and ideals. In other words, philosophical enquiry _about_ a profession's goals can illuminate those options that the group may reasonably consider, but _which_ options to choose and what actions to take are decisions that must be made <u>within</u> that profession.

Theoretical parameters, hypothetical constructs, and too-explicit goals are contrary to the nature of philosophical enquiry (many philosophers of science contend that such methodological constraints are also inappropriate for scientific research). The research goals must be general, the procedures open, and the field of enquiry unfettered by disciplinary bounds to allow maximum opportunity for reflection, imagination, inspiration, and discovery; and the conclusions should be as general as possible. The research should begin, proceed, and conclude as much as possible without hindrance from prior supposition. For instance, "if you . . . insist that all things <u>must</u> have something in common, you have gone at it backwards: First, find that common trait, then talk about it" (Reid, 1971, p. 7).

Philosophy serves two unique and essential functions: the justification of fundamental standards and purposes; and the assessment of basic concepts. In 1961, the editor of <u>The Science Teacher</u> highlighted the hazards of attempting to establish educational needs or goals without clearly established standards upon which to justify such actions:

> All of us are caught up in the "pursuit of excellence," but all too often, the pursuit becomes a mad rush to "do something," even though we are not sure that it is right.

. . . We seldom take the time to think and spell out what is meant by excellence.

(Carleton, 1961, p. 4)

Whether it be a unifying scientific idea such as the theory of evolution, or a specific educational goal such as scientific literacy, or a general ideal such as "excellence in education," philosophical research is a means of examining and justifying the basic presuppositions that undergird that concept. It is also a means of identifying alternatives and justifying options prior to committing irreplaceable resources and irretrievable time to a given course of action. A review of the history of science education from this perspective will shed much light on the problems of operating an enterprise with "only minimum attention to its philosophical underpinnings" (Hurd, 1982, p. 281).

Basic concepts, or ideas, are the intellectual tools of a profession, and philosophy is a systematic means of examining those tools and how they are used. It is a means of stepping back, so to speak, to make a detached assessment of an enterprise with regard to its overall purposes and its relation to basic social values and cultural norms.

Generally, however, philosophical evaluation of the basic concepts and standards that undergird a profession is not typical of day-to-day operations. Consequently, many professionals are unaccustomed to that sort of activity. This is not necessarily bad, however, so long as the need for such philosophical assessment is not ignored or forgotten. As a philosopher pointed out, "it is only natural and right that people should be more interested in using concepts than examining them" (Reid, 1971, p. 12).

> The worker who spends all his time improving his tools never gets his work started. Usually there is no great need to examine basic assumptions and basic concepts, just as usually most tools function well. But occasionally in all work, whether it is manufacturing or thinking, something goes wrong with the tools, and work on the job has to stop and work on the tools begins.
>
> (Reid, 1971, p. 12)

Using a similar industrial analogy, the physicist and science historian Kuhn (1970) concluded that, in any enterprise, "the significance of crises is the indication they provide that an occasion for retooling has arrived" (p. 76). Many educators claim there is a crisis in science education. If so, it is a clear signal that a philosophical assessment of the basic concepts of science teaching and learning is needed to see if they are the right tools for the job and if they are being used well.

There is a problem with "stopping to take a look," however, because science education is committed to action. There exists a contract, either implicit or explicit, between the science education community and the public--"the contract to teach science" (Broudy, 1973, p. 227). Fortunately, since philosophy does not fun tion in a discipline, it is not necessary to interrupt the teaching enterprise, as it is with some other forms of research, to seek justifiable options for change. Once the options are philosophically justified, the educational community may then select the most promising options and test them, hopefully with minimum risk and interruption of teaching, and apply them as indicated.

Philosophical enquiry, like any methodology, has strict limitations. It does not function to advocate action, to cause change, or to predict, or prophesy, or necessarily to modify the world. It functions to help put problems in the proper perspective so that it will be easier to understand "what reasons are good reasons for changing (things) or keeping things as they are" (Hirst and Peters, 1970, p. 131). It is a unique and systematic way to see if change is appropriate.

List of References

Broudy, H. (1973). Can research provide a rationale for the study of science? Journal of Research in Science Teaching, 10(3), 227-233.

Carleton, R. (1961). Editorial. The Science Teacher, 28(7), 4.

Hirst, P. & Peters, R. (1970). The Logic of Education. London: Routledge and Keegan Paul, Ltd.

Hurd, P. D. (1982). Transformation of science education: Challenge and criteria. Science Education, 66(2), 281-285.

Kuhn, T. S. (1970). The Structure of Scientific Revolutions (2nd Edition). Chicago: The University of Chicago Press. (Originally published, 1962).

Reid, C. L. (1971). Basic Philosophical Analysis. Encino, California: Dickenson Publishing Company, Inc.