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ABSTRACT

Case Studies in Science Education used a combined research approach of case study and survey to address the question of the status of science education in the United States. Nine experienced researchers with backgrounds in anthropology, sociology, educational psychology, and science education conducted eleven case studies. These field researchers used observation and formal and informal interviews to provide most of the data. Review of written materials added information. Interest was in discovering issues within each site and not in predetermined variables. The survey was designed to provide additional interpretations and information on the extent of generalizability of the case study data. A relatively innovative approach to survey research was taken in using issue findings as the survey's primary conceptual structure. Each issue was portrayed through a scenario (a contrived illustration with related questions) of the survey. Members of nine organizations who reviewed the study reports generally appreciated the combination of approaches. Drawbacks to case studies included report length and cost in time and money. Survey research could be done more cheaply and reach more respondents and result in broad coverage of some pre-determined properties. Greater use of the survey in combination with case study would give a broader and deeper portrayal of issues within a given setting. (YLB)

A STATUS STUDY OF PRECOLLEGE SCIENCE EDUCATION

METHODOLOGICAL REPORT

Jennifer McCreadie

The study to be discussed here is not in vocational education, but its methodological approach, or approaches, have significant implications for a "status study" in any field of educational endeavor. The question addressed was a broad one--what is the status of precollege science education in the United States? What is really happening in science, mathematics and social studies in classrooms across the country? Multiple approaches by three different research groups were used to seek answers to the question.

I'd like to tell you a bit about Case Studies in Science Education which used a combined research approach of case study and survey. It was part of a larger scheme which used a combination of three research methods to investigate the status of precollege science education in the United States.

In 1975, the National Science Foundation's Science Education Directorate issued three RFP's, all addressing the question of the status of science education in this country. The three approaches called for were a literature review, a national survey, and case studies portraying science, mathematics and social science teaching and learning.

Ohio State University's Center for Science and Mathematics Education was awarded the literature review contract under the direction of Stanley Helgeson. (The social studies review was subcontracted to the Social Science Education Consortium in Boulder, Colorado). Iris Weiss of Research Triangle Institute directed the national survey of educational practitioners to determine current science education materials and methods actually used. Bob Stake and Jack Easley of CIRCE at the University of Illinois were responsible for the case studies, and for the accompanying CSSE survey. The results of these efforts comprise seven volumes published by the Government Printing Office. (See references, p. 6).

Since the purpose of this symposium is to discuss methodologies, I'll focus on that aspect of these studies rather than substantive science education issues and findings. But I hope that some of you for whom the studies are new will look into them. I found myself going back to the studies frequently in preparing this paper. The methodology chapter of Case Studies in Science Education, by Jo Day and Bob Stake, was particularly helpful. After telling you more about Case Studies in Science Education, I'll discuss some aspects of my current research on the relative utility of case study and survey research methods, and the compatibility and usefulness of the combination of the two.

This is a transcript of a presentation prepared by Jennifer McCreadie for presentation at the AVA Annual Meeting on December 9, 1980, by James Pearsol. The author's address is CIRCE, 270 Education Building, University of Illinois, Urbana, Illinois 61801.

The case studies were conceived of by people at the NSF and by those who worked on them as a way to get an understanding of the details of science education in the context in which it is practiced, each of the school districts studied. The survey which was also part of this study was designed to ask some of the same questions, pursue some of the same issues across a larger sample of the nation's schools. The final report consisted of eleven case studies, a survey report, several conceptually-based chapters assimilating survey and case study information, and an executive summary. (See final page).

Initially, nine experienced researchers were chosen to conduct the case studies. Their backgrounds were in anthropology, sociology, educational psychology, science education and various subspecializations. Because of work commitments, some were already obligated to remain in certain areas. Sites within a drivable distance were selected for those people. Five more sites were chosen with an eye toward balancing geographic location; type of community--urban, suburban, middle-sized city and rural community; curricular orientation--innovative or traditional; and reputation of the science curriculum. Suburban sites were selected in the midwest, Colorado and Texas; rural settings in Alabama and Illinois; urban Massachusetts and the northwest, as well as a middle-Atlantic-seaboard city; and middle-sized cities in Pennsylvania and California. Anonymity of these sites and individual people in them has been maintained. An eleventh site, Columbus, Ohio, was added because of circumstances of crisis--a heating fuel shortage which closed schools in the winter of 1977. The study, School without Schools, by Jim Sanders and Dan Stufflebeam, was based on observations during February and into March, continuing for one week after schools were reopened. Because of the unique situation, anonymity of the site was not attempted.

Elsewhere, one field researcher went to each site--for periods ranging from four to sixteen weeks, some working full-time and others part-time. All visits took place during the 1976-77 school year, five during September to December, six between January and May.

A site visit team of four to six members visited each site for three days during the latter part of the field researcher's stay there. Their general purpose was to gather additional information and to challenge or confirm the field researcher's findings. There were three principal questions this study was intended to answer:

-What is the status of precollege science education and learning today?
-What are the conceptualizations of science and science teachers held by teachers and students?
-What happenings in school and community are affecting the science curriculum?

Field researchers and site visit teams alike were seeking answers to these questions.

The general methods of naturalistic field research were employed at each site by both the primary researcher and site visitors. Each took the role of observer-as-participant. Observation and formal and informal interviews provided most of the data, while review of written materials added information. Each researcher used whatever special techniques were characteristic of his or her own work. Efforts to standardize observations by using a structured checklist were not successful and were eventually abandoned.

Rather than predetermine variables to be investigated, the field researchers were interested in discovering the important issues within each site. Each case, or bounded system, consisted of a high school and its feeder elementary and junior high or middle schools. Some issues were anticipated on the basis of current news, professional judgment and field trials. These included such issues as the following: Back to the basics, declining enrollments, fiscal problems, the place of science in the curriculum and different conceptualizations of science. Not all of these were issues at every site, and there were others which emerged at one or more sites. The issues at each site, the concerns about which there was disagreement, provided a conceptual structure for the case report.

The issues also provided a framework for aggregating data across sites. Each case study portrayed a unique picture of science teaching and learning in a specific context. Yet there were patterns, too. There were common concerns which helped organize the most difficult job of assimilating such a vast array of information. Common threads helped weave together the fabric of these eleven diverse school districts across the country. And perhaps they are present elsewhere.

Much more information was gathered than could be included in each case report. And deciding which issues would be carried through in the assimilation chapters posed a considerable challenge. There were several bases for eventual inclusion of issues in the final report:

-commonness of an issue across sites
-relevance of an issue to questions raised in the RFP and in the proposal
-interest of staff in a topic
-departure from what the staff expected the situation was
-presumed usefulness to audiences of the final report.

The CSSE survey was designed to provide additional interpretations and information on the extent of generalizability of the case study data. (This survey is entirely separate from the larger survey conducted by Research Triangle Institute). A relatively innovative approach to survey research was taken in using issue-findings as the primary conceptual structure of the survey. Each issue was portrayed through what was called a scenario--"a contrived illustration, designed to establish the issue in proper context, and a number of questions relating to the issue portrayed" as it applies to the respondent's own school district. Although originally conceived as a means of posing the same issues in the same form both in the field by the case study researchers and in the survey for confimatory purposes, this proved to be unworkable. The survey orientation gradually changed from one of confirmation to one of gathering new information on key issues. As stated in the survey report (p. 18:2), its purposes were "threefold: to give confirmation or disconfirmation to the extended observations earlier made by the field observers in the eleven selected districts; to identify the diversity and nuances of views held by people in and around the classrooms in this country; and to obtain suggestions as to what steps might be taken by agencies such as the National Science Foundation to remedy the more tractable difficulties."

Survey instruments were designed for 22 groups of people: Teachers of social studies, science and math in grades 10 through 12, 7 through 9 and K through 6; curriculum supervisors in each content area; principals at all three levels;

superintendents; and high school counselors, students and parents. The form provided a different first page for each group which gathered demographic data about individuals and their districts, as well as responses to issues pertinent to that group. Each of the eight scenarios on pages 2 and 3 of the form was sent to two, three or four of the 22 groups of respondents. Three different fourth pages were printed on about one-third of all other forms each; the themes of these questions were concerns about education today, purposes of education, and problems in public school today. Each section had both forced-choice and free-response items. All together, 66 different forms were sent to approximately 3,800 people, a subsample of the sample used by Research Triangle Institute in their national survey which was part of the Status Study. The response of about 2,600 was just over 60 per cent, somewhat less than we had hoped for.

It can be said that the general character of the condition of science education in United States schools was consistent between the case studies and the survey. Certainly no major findings of the case studies were refuted by the survey. Divergence of opinion came about as to whether qualitative and quantitative research methods can yield confirmatory findings based as they are on different epistemological foundations. Some would say the philosophical differences are so great that the two approaches cannot look at the same objects and portray the same kinds of images. Some of us feel the divergence of method and epistemology is compatible, yielding complementary data which ultimately give a picture of greater richness and depth.

My inquiry into people's perceptions of a combination of methodologies has revealed reactions ranging from, "it's okay" to "it's an inspiration!" Frankly, I had anticipated much more resistance to case study and other qualitative research approaches than I encountered among people at the National Science Foundation in the Science Education Directorate, or among scientists and educators from professional organizations.

This last group of people were involved in a rather unusual activity. While NSF was one of the primary audiences of the Status Study (a label used to apply to the three large studies together), other target audiences were scientists and educators, as well as the general public. Some of the people at the NSF felt that the original reports, even the summary volume, would not achieve very wide circulation or readership. So they contacted organizations with large memberships and widely circulated publications and asked them to propose approaches to review and synthesis of the Status Study. Nine organizations produced such reviews: American Association for the Advancement of Science; National Academy of Sciences, National Research Council; National Council of Teachers of Mathematics; National Science Teachers Association; National Council for the Social Studies; Association for Supervision and Curriculum Development; National School Boards Association; American Association of School Administrators; and the National Congress of Parents and Teachers, National PTA. They vary in the extent to which they summarized, criticized and made recommendations for their own memberships. But they all inform of the existence, subject matter and aims of the Status Study. All but one of these reviews have been previously published in at least one form for their own organizations. This fall, all nine reviews came out in one Government Printing Office volume entitled, What Are the Needs in Precollege Science, Mathematics and Social Science Education? Views from the Field.

So when I mentioned talking with scientists and educators, it was the officers of these professional organizations and authors of these reviews to whom I referred. There was some criticism of each of the studies for one reason or

another. There were at least a few people who appreciated each study over the others, either for its research method or for its particular findings. But the vast majority of people with whom I talked appreciated the combination of approaches far more than any one on its own.

People approached the mass of data in different ways. Some began with one study, any one, and just read all three. Others dabbled until they found one whose style they felt most comfortable with and read a section of it, then searched for answers to questions or confirmation in the other two. Yet others began with the summary volume. And some admitted they never got beyond it. That brings us to a discussion of some of the strengths and weaknesses of survey and case study methods from the perspectives of both the audiences and researchers--in a moment.

One final thought on the use of the reports. I had anticipated that people would be accepting of the method of a literature review and find the information at least somewhat useful as a backdrop for the other studies. I found this to be the case. I had anticipated that readers would be most accepting of the survey method and find the report very useful. This was true for some. I had anticipated some strong resistance to the case study approach in general and to this study in particular. I did not find that to be the case. When people wanted to know what is really happening in science education, they sought any information available--in this case, all three studies. Many came to rely heavily on the Case Studies in Science Education report whether they were interested from a policy or curricular or administrative or interest perspective. They found it informative and interesting, even exciting! They verified case study observations in the CSSE survey as well as RTI's larger survey. Some also went to the literature review or even to a primary source. But some did not go beyond the case studies. Several relied most heavily on the case studies, but appreciated the opportunity to fill in data from the survey. In this sense, I think both interest and the need for information were better served by combining methods than by having one stand alone.

Now, to the drawbacks of the study. In any instance, a case study might be longer or shorter than the report of another method. In this case, a seven-large-volume report was overwhelming to many. One of these volumes contains a summary of each of the other reports, which readers found helpful. But it is also harmful in the sense that the reader who stops there misses the richness of detail in the original reports. In the case of all the studies, the reader loses the raw data and the opportunity to make her or his own interpretations and inferences. This is a particular loss with case studies where the real texture of a setting or an event can only be portrayed in the original report--no summary can do it justice. And those who read through the whole study concur. But we are left with the problem of limited time, which all of us encounter daily, and the question of how to balance the value gained from reading a study against the time saved in scanning a pre-digested summary.

Case study is a research method which is costly in time and money, and it can have only a small scope at one time. The time in the field, time sorting information, choosing what to include and finally writing--it took two to three times as much time afterward as was spent "in the field." Bob Stake has suggested that six times is a more accurate estimate when one considers the assimilation across multiple case studies. But the richness of detail, the whole picture--the understanding of the case, be it a classroom, school district, a program--which the reader forms cannot otherwise be achieved

without being there. This is not always an appropriate or feasible research approach. But when you want to know what is really happening, from the perspectives of the different people involved, what the issues are, this is an appropriate mode of inquiry. With the right researcher. This isn't an approach just anyone can do. It takes training, experience, writing skills and a gift for observation. But it can be done.

Survey research can be done more cheaply, can reach more respondents and the result is a broad coverage of some pre-determined properties. If that's what you want, that is the best way to do it. There is room for more development of the conceptual structure as a basis for survey, exploration of some issues in greater depth. More use of the survey in combination with case study can give both a broader and deeper portrayal of issues within a given setting.

References

It is suggested that the Government Printing Office is the best source for printed copies of the Status Study reports. These can be ordered by title only, but inclusion of stock number and price (when available) is helpful. The address is: U.S. Government Printing Office, Washington, D.C. 20402. A limited number of the case study volumes, and of some of the individual case studies are available from CIRCE, 270 Education Building, University of Illinois, Urbana, Illinois 61801.

- The Status of Pre-College Science, Mathematics, and Social Studies Educational Practices in U.S. Schools: An Overview and Summaries of Three Studies.

  GPO Stock Number 038-000-00383-6, $3.50

- Case Studies in Science Education. The Case Reports.

  GPO Stock Number 038-000-00377-1, $7.25

- Case Studies in Science Education. Design, Overview and General Findings.

  GPO Stock Number 038-000-003763, $6.50

- Report of the 1977 National Survey of Science, Mathematics, and Social Studies Education.

  GPO Stock Number 038-000-00364-0, $6.50

- The Status of Pre-College Science, Mathematics, and Social Science Education: 1955-1975. Science Education.

  GPO Stock Number 038-000-00362-3, $4.25

- The Status of Pre-College Science, Mathematics, and Social Science Education: 1955-1975. Mathematics Education.

  GPO Stock Number 038-000-00371-2, $4.50.

- The Status of Pre-College Science, Mathematics, and Social Science Education: 1955-1975. Social Science Education.

  GPO Stock Number 038-000-00363-1, $6.25

- What Are the Needs in Precollege Science, Mathematics, and Social Science Education? Views from the Field. (National Science Foundation, Office of Program Integration, Directorate for Science Education, SE 80-9).

Please consider the following "correspondence"

Dear District Administrators,

The PTA-Council is thinking that it would like to set the theme for next year's meetings as something like "Putting the Curriculum in Uniform." We want to stress the need for uniformity of teaching across the district and the need for encouraging learning that leads to good employment opportunities. Please let me know your reaction to this tentative choice.

Respectfully, Willa Petrun, President

Dear Mrs. Petrun,

You will be hearing from others on the staff. For myself, I am pleased with your choice. Discussion of this theme will help draw attention to our objectives-based curriculum and the importance of providing equal opportunity for learning in each of our schools. If we are going to be fair, we must be uniform.

Sincerely, Jarvis Shattuck, Superintendent

Dear Willa,

I look forward to working further with the Council. I think the title, "Putting the Curriculum in Uniform," is corny and hope you find a better one, even if the topic is "uniformity."

I am disappointed, I must admit, that you did not choose the theme sponsored by Mr. Perez, "Where is our Science Program?" I feel that more emphasis on uniformity is going to further erode support for our college-prep program. We have lost support from the Board because we do not have their endorsement on a set of objectives for the sciences. They don't fund what we don't specify. I hope that the Council will give Mr. Perez's proposal further review.

Your "favorite" science teacher, Foster

Dear Ms. Petrun:

Thank you for giving us the opportunity to influence your consideration of themes for next year. In as much as the state legislature will be voting on bills to create a Competency-Based Diploma, I think we should review our entire philosophy of curricular uniformity in the district.

Uniformity could be an obstacle to providing an educational program tailored to each student's home-culture, talents, and aspirations. Uniformity could diminish the flexibility we have had in our alternative school and our magnet school. We should be discussing uniformity this year, and of course, we should recognize that too much of it can be as troublesome as too little.

Yours truly, Mavis Cooper, Principal, Central School

1. These letters summarize some of the concern about the curriculum. Some people are wanting courses to be more uniform, so that, for example, all sixth grade math courses and all American history courses are alike. What do you think about it?

_____I think that much more uniformity is needed
_____I am opposed to a high degree of uniformity
_____I would like more uniformity, but getting it will cause problems too
_____other: (please explain):

2. Supt. Shattuck implied that the same courses in different schools have to be alike if the school system is to be fair. Do you believe this is so?

T

3. In your own community, generally speaking, ...
...how large a voice do parents have in school goals? ___large ___small ___none
...do school officials respond as these three did here? ___yes ___no ___don't know
...do most parents want more "uniformity" across schools? ___yes ___no ___don't know

4. Do you agree with the concerns Mavis Cooper raised with regard to "uniformity?"
_____yes _____no _____other (please explain):

5. Foster seems also to be suggesting that the science curriculum is competing with the objectives-based curriculum--rather than being supported by it. Do you feel that funding for the one, if spent properly, would support the other? Or do you feel that districts just have to make hard choices between traditional and objectives-based studies?
_____The methods and goals of traditional and objectives-based curricula are relatively independent; therefore, they compete for funds.
_____The methods and goals of traditional and objectives-based curricula are highly related; therefore, they do not really compete for funds.
_____Other (please indicate):

6. Do you agree with Willa Petrun that schools should give more emphasis to studies that lead to employment opportunities?
_____ yes _____ no _____ I don't know

7. In one city recently science teachers in elementary, junior high and senior high schools expressed a strong desire to clarify what should be taught in each grade. What do you think are major reasons teachers seek such clarification? (Check one or more)
_____to make their jobs more manageable
_____to locate the blame when deficiencies are found
_____to make clear to students what is expected of students
_____to persuade Board and Community to support some areas better
_____to select the best text materials from the huge supply
_____the reasons are different from community to community
_____there really are no reasons; maybe it's a "panic" response
_____other (please specify):

8. Should school districts set some minimum competency in science for all students to attain in order to graduate from high school? ___Yes ___No ___I don't know

9. Please rank the importance of responsibilities of a science curriculum supervisor--as you would like it to be. Rank "1" as most important on down to "5" as least important.
a. _____assist teachers with problems they are having with teaching
b. _____supervise the collection of student performance data
c. _____assure that a high level of subject matter content is maintained
d. _____provide information about different teaching methods and materials
e. _____assist administrators in getting funding for programs

10. In your district who is the person (or who are the persons) most knowledgeable about whether the curriculum needs improvement of one kind or another?