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SURVEY METHOD AND ITS USE IN RESEARCH IN GENERAL MATHEMATICS

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Abstract

The author (1) considers survey research, both in general and educational contexts, and outlines the potential utility of combining survey methods and observational fieldwork in studying different aspects of the same phenomenon, and (2) provides background for, and a description of, the survey phase of IRT's General Mathematics Project.

Survey Method and its Use in Research on General Mathematics[1]

Gabriella Belli[2]

This paper is presented in two sections. The first considers survey research, both in general and educational contexts, and outlines the potential utility of combining survey methods and observational fieldwork in studying different aspects of the same phenomenon. The second provides background for, and a description of, the survey phase of IRT's General Mathematics project.

Survey Research

Three basic modes of data collection in social science research are observation, experimentation, and survey. Each is best suited to particular research purposes and displays advantages when properly aligned with research purpose. Observations in the natural setting begin with the assumption that the behavior under investigation is complex and must be considered and interpreted in terms of the contexts within which it is embedded. The main objectives of experimental research are to discern variables that behave in a law-like fashion and to discover the laws governing their variation. The rationale underlying survey research differs from that of experimental research in that it stems from a need to study the effects of social forces not under the control of the investigator.

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[1]Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, 1979.

[2]Gabriella Belli is an intern with IRT's Teaching of General Mathematics research group.

Two major types of surveys are descriptive and explanatory. The former aims at providing a characterization of the population from which the sample was drawn on some relevant variable or variables by reporting descriptive statistics. The latter is concerned with developing theoretical statements about the relationships among variables or about processes. Both types may be further subdivided according to whether or not they incorporate the element of change within the scope of the investigation. Static, or time-bound studies, which involve examining and relating distributions of responses to two or more questions referring to the same point in time, serve to operationalize concepts and aid in the construction of scales, indices, or typologies. Time-ordered studies, which examine associations between variables temporally ordered with respect to each other, implicitly assume the existence of a causal relationship and attempt to examine it (see Glock, 1967).

Survey research is based on an inherent link among three distinct elements: the design of the survey, the analytical operations to be performed, and the investigator's purposes. Ideally, design should incorporate methods of analysis. Consideration should be given to available techniques, types of data to be collected, and the level of measurement required prior to data collection as part of defining the survey objectives.

As stated in a current text on survey analysis, "Data description, data reduction, the identification of typologies, the identification of latent dimensions, and the building of predictive models are all important aspects of survey research" (O'Muircheartaigh & Payne, 1977, p. 29). This research tool may be fruitfully employed to generate hypotheses and to estimate the magnitude of relationships as well as to test hypotheses

formulated prior to the analysis. It can provide information on individuals as well as on larger collectivities. It may also be used to study social problems or change over time.

The universe under investigation may constitute a population of people, organizations, or communities. The unit of analysis is thereby modified to fit each situation. The respondents may serve as subjects, giving information about themselves, or as informants, providing information about organizations or contexts known to them. Data collection involves either mail questionnaires or interviews, which may be by phone, personal, or of the focused group type.

For the same amount of monetary expenditure, mail questionnaires facilitate gathering a greater volume of data than do interviews. They are also more expedient in terms of time and labor. A limitation of mail responses is the inability of the researcher to request clarification or to control for non-response on selected items. While interviews help eliminate these problems, the possibility exists for the interviewer to lead the respondent's answers, often unconsciously. Also, particularly if the subject is a sensitive one, the respondent may be less likely to answer honestly in a face-to-face encounter.

Regardless of these differences, when compared to other modes of data collection "survey methods are highly efficient in bringing in a large volume of data with a relatively low expenditure of time and effort" (Coleman, 1978, p. 75). With the advent of sophisticated methods of multivariate analysis and the aid of the computer, survey research has developed from its original use in "polling" to a tool used to provide insight into problems of complex human processes.

A problem indigenous to survey research is the definition of the population of interest and the compilation of a sampling frame accurately determined from that population. In educational research, this problem is minimal. The population of interest may easily be defined as administrators, teachers, or students in particular grade levels or school districts. These groups are readily available to the researcher and may easily be contacted, thus eliminating one area of concern in this type of work.

The most prevalent use of survey methods in education has been in the descriptive domain to provide information on current practices. As stated previously, survey research need not be limited only to such descriptive tasks (see Silvey, 1975). Along with its use in theoretical or explanatory work, there is great potential to accomplish broader research aims through the collaboration of survey and qualitative fieldwork techniques.

Observational fieldwork studies can contribute to surveys by providing a rationale for the design and may be used as a qualitative pretest to improve questionnaire construction. Fieldwork results can function as the basis for the theoretical structure guiding analysis of survey data. Furthermore, fieldwork can be useful in validating certain aspects of survey results, in clarifying puzzling responses, and in assisting in the interpretation of statistical findings. Likewise, surveys can contribute to fieldwork by providing a statistical profile of the population of interest, thereby assisting in the selection of appropriate groups for observation. Where demonstrable relationships exist between survey results and observational results, surveys can add strength to single observations by suggesting the generality of those observations. They can also be useful in verifying observations and conclusions drawn from fieldwork

studies (Sieber, 1978). Together, these methods may provide a basis for explaining the educational phenomenon under investigation and be used as a foundation for theory building.

Survey of Placement Practices

Research on teacher expectancy indicates that differential expectations influence teacher behavior and that the resulting differential treatment produces subsequent student behavior in accord with the intial expectation (see Brophy & Good, 1970). A rival hypothesis states that the causal link may be in the opposite direction; that "current student achievement influences teacher behavior and teacher expectancy" (West & Anderson, 1976, p. 626). Students generally enter general mathematics[3] classes with pre-established low levels of achievement and teachers' initial expectations are low. Thus, regardless of which model is the more accurate descriptor of reality, the resulting environment is not conducive to success.

To compound the problem, many students in general math classes have poor attitudes toward the subject. Although not conclusive, research in the area of attitudes and achievement points to a positive correlation between these two variables (see Aiken, 1970, 1976). A nationwide survey of high school students' perceptions of their math teachers supported the claim that "Students' attitudes and learnings are directly influenced by the personal qualities of teachers and by the classroom climate they create" (Cooper & Petrosky, 1976, p. 227).

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[3]The term "general mathematics" is used here to indicate any ninth-grade non-algebra course. This would include courses entitled Basic Math, Remedial Math, Fundamentals, Applied Math, Pre-Algebra, and the like. Although their titles and their content vary, their students all evidence similar problems: low math ability, poor motivation, and a general dislike for mathematics.

Discussions with teachers about their general math classes indicate feelings of frustration and perceived difficulty in managing and teaching such courses.

During the past year, IRT researchers have been studying several general mathematics classes. The investigations revolve around three central questions: (1) How are students placed in general mathematics? (2) What are their experiences in those classes? and (3) How might teaching be improved to help these students? Fieldwork and survey methods are being combined in attempts to answer these questions. At various stages in the study, each is instrumental in providing direction for the other. Ultimately, the aim is to use the combination of results to formulate conclusions and to derive guidelines for improvement of practice. The focus of this section of the paper is on the student placement question and on the use of a questionnaire to help answer it.

One study has shown that the placement of students in classes of varying ability may be functionally related to their success or failure. Tuckman and Bierman (Note 1) randomly split a group of junior and senior high school students, moving one group into higher ability classes and keeping the other group in lower ability classes. The students thus transferred produced better scores on standardized achievement tests than those retained in lower groups. More significantly, 54% of the transferred students were assessed as having been successful and were later recommended for retension in these higher ability groups. Students remaining in the lower groups were not so favorably assessed, and only 1% was recommended for transfer into higher groups.

The fact that initial placement of students in one group or another may be a crucial factor related to their success in the course and possibly to their continuing in mathematics raises two questions: (1)

Who makes the placement decisions? and (2) How are students placed in various courses? Knowledge of how and by whom the placement decisions are made is needed to provide a basis for studying the correctness of placement and for improvement of the decision process. Therefore, as a first step, a questionnaire was constructed to ascertain high schools' placement policies for ninth-grade mathematics. The sample for this study was randomly selected from a four-level stratification of Michigan high schools. Strata were constructed based on school size and 200 schools were chosen. The reason for this stratification was to enable the comparison of policies across schools of different sizes. That differences due to school size might exist seems plausible since teachers and counselors in schools with smaller enrollments should have a better opportunity to know the students and be able to base their recommendations on a wider range of criteria than might be possible in larger schools.

Directed to chairpersons of mathematics departments, the questionnaire asks about the frequency of use of nine criteria for making the placement decision (see Appendix). These criteria were chosen to reflect four main areas of potential input to the decision: (1) mathematics pretests, (2) teachers' or counselors' recommendations, (3) parents' or students' requests, and (4) grades. These criteria are then rank ordered in terms of their importance to the decision of student placement. Information is requested about who makes the final decision and about the extent to which decisions may be changed during the course of the school year. The responses to these questions will provide documentation of current practices in making placement decisions for ninth-grade mathematics, both in terms of primary responsibility for the decision and of most commonly used criteria.

A secondary purpose of this study is to document the relative frequency of student placement in general mathematics in Michigan. To this end, chairpersons are asked to provide enrollment figures for their school, for the ninth-grade, and for each of various mathematics courses offered in their school at the ninth-grade level. Also requested is a list of mathematics requirements for the college and non-college bound student. From this set of responses, the percentage of students who take various general mathematics courses may be calculated and compared to the percentage of students in other mathematics courses. Knowledge of the requirements for the college and non-college bound student will provide an indication of the lower bound for high school math education.

The determination of existing practices is a necessary first step prior to any intervention or improvement. An analysis of varying mathematics requirements and placement criteria may uncover patterns or relationships between the variables of interest. For example, relationships may be examined between initial criteria used in placement decisions and the extent to which course changes are possible during the school year. Results from this stage could alter further investigation by the general mathematics project. For example, if it becomes evident that the primary responsibility for student placement in ninth-grade rests on teachers' and counselors' recommendations, it would be necessary to examine how they assess the students and how they decide on future course placement. However, if the decision of which course to take is primarily made by the students themselves, the direction for research would be to consider what cues students use in making this decision and their reasons for doing so. Since an ultimate aim of this project is improvement of practices, the information gained through this study will help direct future work.

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