Reflections on Evaluating Innovative Curriculum Projects

Sandra Mathison
University of Chicago

Innovation is a much studied phenomenon in education.[1] So, too, have the evaluations of innovative projects been much studied and often deemed inadequate or inappropriate.[2] Having been the Evaluation Coordinator for the University of Chicago School Mathematics Project (UCSMP) for three years, I think the time is right to reflect on the nature of this innovative project and the ways evaluation has been formulated and used in this context.

The UCSMP is really several projects in one—a secondary textbook writing effort for grades seven through twelve, a primary curriculum writing effort for kindergarten through second grade, a teacher development effort aimed at making K–3 teachers better generalist mathematics teachers and grades 4–6 teachers math specialists, and a resource effort to expand the knowledge about mathematics pedagogy by making foreign research and curriculum materials accessible. It would be too cumbersome to discuss every part of the project, so my reflections will be based on the secondary textbook development and the teacher development projects.

Every innovator takes some particular perspective, either consciously or unconsciously, in the course of developing the innovation. There appear to be three perspectives on innovation: the technological, the political, and the cultural (House 1981). The first section of this paper will give a brief overview of these perspectives, followed by an analysis of the secondary component textbook writing and the teacher development project in light of these perspectives. As will be seen in the next section, the adoption of a certain perspective typically implies the adoption of predictable evaluation methods. The evaluations of these projects will be described and the relationship between innovation and evaluation in this context analyzed.

Three Perspectives on Innovation

House (1981) describes three perspectives from which innovation can be understood. He uses the word perspective advisedly to denote a "way of seeing" a problem rather than a rigidly formulated, closed system of rules, such as a scientific theory: "These action perspectives result from an acceptance of normative constraints about what is rational and acceptable. They limit the very language and concepts employed in the discussions and thereby give a certain value slant. The perspectives define the limits of rational choice itself. It is through these perspectives that choices are justified and legitimized. In this sense, people are dominated by the perspectives of frameworks that they adopt" (pp. 19–20).

The *technological perspective* is perhaps the best understood of the three perspectives and is exemplified in the research, development, and diffusion model. According to this model, research is conducted to generate new knowledge which is then converted into strategies to be used by teachers and ultimately disseminated to all teachers for their adoption. Regional labs funded by the United States Department of Education are based on this model.

In this perspective both the innovation and teaching are defined as technologies. Solutions to educational problems are conceived as techniques that, once developed, can be applied to most, if not all, situations. Innovations are necessarily replicable and are applicable to the same educational problem no matter where it occurs. This conception rests on the assumptions that educational change is a rational process, that teachers are essentially passive consumers, that there is consensus about goals and what is the common good, and that technological change is desirable.

Many educational change efforts have been based on this perspective, including the Follow-Through planned variations, the Comprehensive School Mathematics Projects, and, to a large extent, the University of Chicago School Mathematics Project. The emphasis on this perspective is not surprising, given an American cultural predisposition to value technology highly and to seek technological remedies for social problems. The attempt by American car manufacturers to replicate the conditions of Asian car manufacturing is an excellent example of this approach. The success of competitors can be understood by breaking the manufacturing process into component parts which can be replicated in American manufacturing plants. Cultural values are simply conceived as components that, if causal, can be adopted by Americans for the good of the company and the country.

The *political perspective* is also reasonable well understood; it has been used to explain the failure of many innovation efforts. The problems were seen as political, on both an individual and institutional level. In this view of innovation, the process of change is problematic—there are inherent conflicts in goals to be achieved and differing perceptions of whose interests should be served. The Illinois Gifted Program has been rendered intelligible using this perspective, which sees the progress of innovations as dependent on factional groups within schools competing and cooperating with one another (House 1974).

This perspective places the emphasis on the innovation in particular contexts because relationships among groups will to a great extent determine the degree and kind of educational change. Particular contexts may be affected by local, regional, and national politics. Indeed, this is often the case because change efforts are frequently funded by state or federal governments but administered locally. The political perspective focuses on negotiation and compromise among the players in the innovation game.

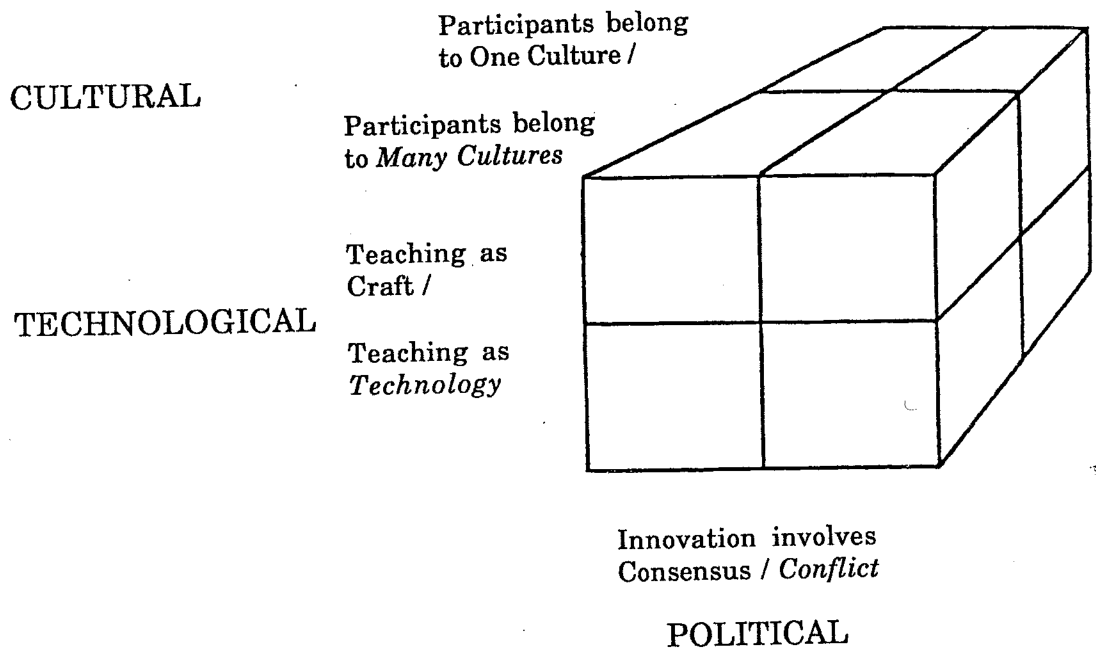
The *cultural perspective* is the least developed and takes an anthropological view of schools and educational change. Perhaps one of the most extended examples of this approach is Smith's and Keith's (1971), and the updated Smith, Kleine, Prunty and Dwyer (1987a, 1987b, 1988) ethnographic analysis of Kensington Elementary School. This perspective focuses on a particular context and what innovation means to the subcultures (e.g., teachers, school administrators, government agencies, and curriculum developers) within that context. Any effort to change education must acknowledge these subcultures, understand that they attribute different "meanings" to change efforts, and realize that there may be conflicts among the subcultures. Autonomy of subcultures and relativistic value positions are typical. As is true with the other perspectives, the cultural perspective can be used to think about innovation or to study the innovation process.

These three perspectives—the technological, the political, and the cultural—are presented as ideal types but, as House (1981) indicates, they are not necessarily independent. He specifies three dimensions along which the perspectives vary: 1) teaching as a craft or as a technology, 2) consensus on or conflict of interests, and 3) a one-culture or many-cultures view. Figure 1 illustrates these dimensions and the relationship of the perspectives to one another. Thinking about educational change in three-dimensional terms suggests that a particular innovation might have some attributes of different perspectives. House suggests that the technological approach will blend with the political and cultural perspectives. "The urge to introduce technical innovations into the school will continue but will take more cognizance of political and cultural realities it has often studiously neglected. More radical innovators will attempt pure political or culturally derived policies, but these attempts will be fewer and perceived as unusual" (p. 35). Still, a particular innovative project or study of it will likely take predominately one perspective over the others.

UCSMP and the Three Perspectives on Innovation

Any innovative project, while analyzable from different perspectives, takes a particular perspective on innovation. In this section of the paper, I will describe what I believe are the perspectives taken by the Secondary Component and the Teacher Development Project developers. I, of course, run the risk of suggesting a perspective that may not have been in the minds of the developers and with which they may disagree. However, I will attempt to give sufficient detail to make my categorization plausible. The evaluation studies of these aspects of the UCSMP will also be briefly described.

Figure 1. Relationships among the perspectives (Source: House 1981.)



The UCSMP Secondary Component Textbook Writing Effort

This aspect of the UCSMP is a good example of a project which assumes a technological perspective on innovation, although the developers are mindful of the political nature of educational change. What is the Secondary Component attempting to accomplish by writing a new mathematics textbook series for grades 7–12?[3] The first goal is to *update the curriculum* by including content such as statistics, probability, discrete mathematics, and work with three dimensions; emphasizing calculator algorithms, the use of computers, and realistic applications; de-emphasizing contrived word problems and complicated manipulations; and explicitly teaching a variety of problem solving processes. The project also hopes to *improve students' mathematics achievement* by writing texts readable by the average student and expecting that students will learn to read mathematics; setting high but reasonable expectations for pacing and content to be covered; and incorporating lessons from prior research and practice.

So, a series of textbooks is being written which prescribes a certain content consistent with professional wisdom about what kinds of mathematics ought to be taught (National Council of Teachers of Mathematics 1987) and pedagogical principles derived from scholarly wisdom and research. Examples of the latter are lessons on which teachers are exhorted to spend one day; the use of a modified mastery learning approach based on continuous review; writing problem sets that go beyond simple repetitious drill and practice; and the integration of instruction on the use of calculators and computers in lessons. Each of the textbooks in the series has virtually the same form (with the exception of *Functions and Statistics with Computers,* which is radically different from traditional and other UCSMP textbooks) and attempts to accomplish the same broad goals.

The development of these textbbooks proceeds in three stages that successively incorporate teacher feedback in the revision of the materials. Ultimately, the expectation is that school districts will adopt some or all of the textbooks in the series and that, through the use of these new updated texts, mathematics instruction and achievement will improve. Although teacher input is a very important part of the development process, once the texts are completed, concerns about teaching the materials should be minimized and the textbook should be a complete package for the teacher. Although the phrase "teacher-proof" is not quite apt, there is an implicit assumption that the textbook will be the primary force in determining both the content taught and many of the instructional strategies used.

Referring to Figure 1, we see that the textbook writing done by the Secondary Component can be placed in the box that is not visible in the three-dimensional drawing. Although the curriculum developers would perceive problems in implementing innovative curricula, the problems are logistical and not based on fundamental conflict over the process or content of the innovation. There is a single cultural entity with which to deal, although this culture has different roles, such as teachers, math coordinators, parents, and so on. Teaching is widely perceived as a technology with specifiable content and techniques, which can be derived from scientific studies of education.

The Evaluation of the Secondary Component Textbooks

The evaluation of these textbooks proceeds in three stages, the first of which is a pilot study. At this stage the curriculum materials are written by a team of authors (comprising college professors, practicing secondary teachers, and UCSMP staff) and simultaneously taught by authors and/or their close colleagues. Evaluation and development are inseparable at this earliest stage. The second stage is a formative evaluation study typically conducted with six to twelve teachers in the Chicago metropolitan area. During this stage teachers try out the materials, but the expectation is that significant revisions will be made to the scope and sequence of the textbook. Evaluation data to aid in this process are collected through regular meetings with teachers, teacher feedback in the form of diaries or annotations of the textbook, student feedback in the forms of opinion surveys and achievement testing, and some classroom observations. There are comparison classes using traditional textbooks to provide a context to make these data intelligible. The third and final stage of the evaluation is a comprehensive national field study. Teachers from various regions of the country agree to participate in an evaluation study of a given textbook, and a matched pair design, with each pair consisting of a traditional and a UCSMP class of similar ability, is set up. A variety of data collection procedures are used, especially survey forms, checklists, and achievement tests. Each site is visited once during the year, at which time classroom observations, teacher interviews, and school/district administrator interviews are conducted. The anticipated outcome of this study is a definitive statement on the value of the UCSMP textbook as compared to other traditional textbooks currently being used.

This evaluation process can be illustrated using the case of *Transition Mathematics* (TM), the seventh grade textbook. During 1983–84 Zalman Usiskin wrote and taught the text, and one other teacher also taught the materials. During the summer of 1984 the textbook was revised by a team of secondary mathematics teachers. An example of a substantive change made in TM was the organization of the end-of-lesson problems into sections called "Covering the Reading," "Applying the Reading," "Review," and "Exploration."

A formative evaluation of TM was conducted in twelve Chicago area schools the following year. This was the first time that non-project-affiliated teachers used these materials and the study aimed to employ the expertise of experienced mathematics teachers to critically examine the mathematics and pedagogy of the textbook. A great deal of time was spent meeting with teachers, observing classes, and interviewing students, but written reports emphasize student achievement test data. This is not to suggest other data were not used in the textbook development process; in fact, the component director found the quality of teacher meetings in the TM formative study to be unsurpassed in future studies. The test results confirmed the goals of the curriculum developers—TM students learned significantly more geometry and algebra than the comparison students, and there were no differences in the performance of TM and comparison students on arithmetic computation. Revisions were made to the textbooks, such as introducing fractions earlier in the book in response to the teachers' need to prepare students for algebra placement tests, and teacher's notes were written to reflect concerns about grading and reading.

The national field study of TM was conducted in 1985–86 with seventh-, eighth-, and ninth-graders in thirty-five schools across the country, although about half of the classes were in the Chicago area. The study was conceived as a "randomized field trial," meaning teachers would be randomly assigned to teach either TM or the traditional textbook. The focus of the evaluation in the planning stages was on student achievement, and the design called for using the same tests pre and post.

It was at the beginning of this study that I became the UCSMP Evaluation Coordinator, and during that year refinements and changes were made to the intent and design of the study. The scope of the study was broadened in several ways, including an examination of teachers' experience using TM, and the structure of the design was modified to include matched pairs of classes where random assignment of teachers was not possible.

Although the evaluation report focused on a wide range of issues, as with the formative study, student achievement test data, which were essentially confirmatory, received a great deal of attention. The differences in arithmetic skills when students did and did not use calculators were, for everyone, particularly interesting findings. Perhaps somewhat less attention was paid to the findings that dealt with teacher' difficulties in teaching TM, such as the salience of the concept of mastery in teaching mathematics at these grade-levels to these students. However, the Secondary Component Director termed the classroom profiles (one-page descriptions of each class including test data, site, and a narrative description of the teacher and class) "the best part of the report." All of the evaluation data were used in the process of preparing a final product—a textbook that would tell teachers what to teach and, in many ways, how to teach mathematics to seventh graders of average ability.

The evaluations of other subsequent textbooks follow the pattern for TM, although particular issues vary from text to text. Just as the textbooks generally have the same form and goals, so, too, do the evaluations of them. This is not surprising, given that the same individuals are developing and evaluating the textbooks. The similarity is also rooted in a shared technological perspective of innovation.

The Teacher Development Project

Identifying the innovation perspective taken by the Teacher Development Project (TDP) is less straightforward than for the Secondary Component textbook writing effort. Referring to the dimensions in Figure 1, I feel that the TDP takes teaching to be primarily a craft; however, the development of instructional strategies and materials for use with and by teachers suggests a residue of the technological perspective. It also seems that the TDP developers expect conflict, particularly between teachers and administrators, in innovating. What is less clear is whether the TDP developers adhere to a position of one or many cultures—whether groups involved in the innovation process can actually be thought of as subcultures with unique values and attributions of meaning. The TDP is a blend of the political and cultural perspectives, and I would place it in one of the blocks in the upper right side of Figure 1. The TDP is a good example of the blending of perspectives House predicted.

The TDP consists of two coherent parts—training for teachers of kindergarten through third grade ("MathTools for Teachers") and a "Grades 4–6 Mathematics Specialist Program." The intent is to better prepare primary grade teachers to teach mathematics to younger children and to train talented teachers of grades 4–6 to be math specialists. This intent is based on the belief that "significant differences between primary and upper elementary grades" exist (UCSMP 1987). The difference is that "beyond the primary grades, when the curricular content becomes more formalized, it is less critical for the child to have the same teacher for the entire day, and elementary teachers need a deeper understanding of mathematics than they ordinarily claim" (UCSMP 1987).

Generalist teachers of kindergarten through third grade are to be trained through a series of eight workshops, one a month over one school year. The expected outcomes are that teachers will increase the amount of time spent teaching mathematics, will use concrete materials, will integrate mathematics into the whole school day, and will use calculators to teach mathematical concepts and problem solving. In addition to the activity-oriented workshops, guidelines are provided for schools to establish school-based teacher networks. Ideally, these networks offer teachers an opportunity to share ideas and to break down the professional isolation of teachers. This training is designed and packaged so any school district could purchase and use "MathTools for Teachers."

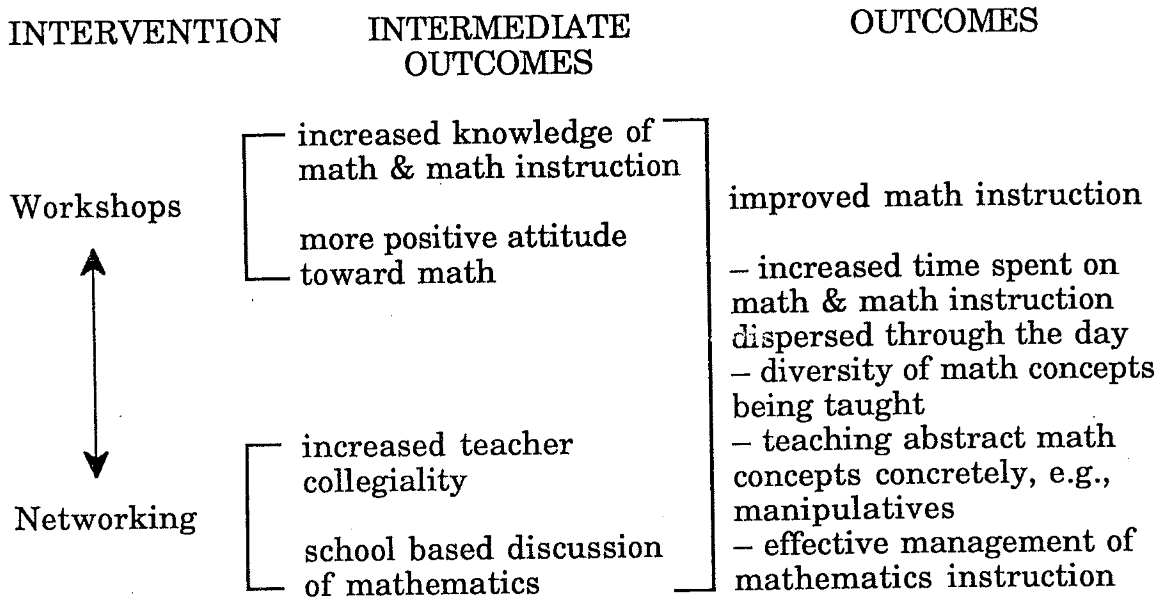
Similarly, a training package for the Grades 4–6 Math Specialists is being developed for implementation by school district staff. The training of math specialists is more extended than the K–3 teacher training and begins with a three-week summer institute, followed by monthly meetings during the next year in which teachers build their mathematical knowledge and begin testing ideas with their students. This is followed by another summer institute, after which teachers will be prepared to assume positions as math specialists in their schools. The responsibilities of these specialists are to teach mathematics to all students in grades 4–6 and to provide assistance to primary teachers who, ideally, will have gone through the TDP training.

Although there is a definite structure (referred to as a model) to the process by which mathematics instruction will be improved in schools, in the use of the training materials and the conduct of specific aspects of the training there is an understanding that adaptations must be and will be made. At the teacher level, the assumption is that teachers will leave workshops with different understandings and that they will all adapt what they have learned to their own instructional environment. For example, the K–3 training attempts to provide a variety of strategies and suggestions for teaching a single concept, and in this way each teacher can find something that is right for her. TDP developers perceive each teacher to be unique and to be using the projects in idiosyncratic ways, making it difficult even to say whether, for example, the math specialists have become what the TDP expects a math specialist to be. Likewise, the restructuring of schools to incorporate math specialists is assumed necessarily to vary from school to school, depending on local conditions.

Evaluation of the Teacher Development Project

The most extensive evaluation of the "MathTools for Teachers" was conducted in 1985–86, during which time about seventy-five primary

Figure 2. Evaluation framework for the UCSMP Teacher Development Project, 1985–86 (Source: UCSMP Evaluation Report # 85/86–TDP–11.)



teachers from ten Chicago schools were involved in the training. The evaluation was designed to focus on what we called "intermediate outcomes" and "outcomes" (see Figure 2). The rationale was that the success of the workshops and school-based networks could be assessed separately, but that ultimately the intended outcomes of the total training would have to be judged by examining what teachers did in their classrooms.

The evaluation aimed primarily at full description with attention to variations that the TDP director assumed to be natural. For example, the training package provides a "script" for the trainer to follow, but the director assumes any particular trainer will adapt the training to suit her strengths and the needs of her particular corps of teachers. During the 1985–86 evaluation, the ten schools were divided into two groups of five, each with a different trainer. At least two evaluators attended each workshop and subsequently wrote reports describing the content of the workshop, teachers' reactions, and differences between trainers. (In a separate study done during the summer of 1987, the Evaluation Component examined the first use of "MathTools for Teachers" by a school district trainer which illustrated local adaptation of the model (Parker 1987). Similarly, the evaluation described the different ways in which school-based networks were, and sometimes were not, implemented in each school. The evaluation included an analysis of possible explanations (including school climate, degree and type of administrative support, lack of teacher time) for the success or lack of success of the networks. As evaluators, we assumed this sort of analysis was consistent with the developer's views and would provide data to increase the likelihood that school networks would be successful in future uses of the "MathTools for Teachers."

The attainment of the TDP goals was examined primarily through sustained classroom observations. A sample of teachers was observed at three points in the year in an effort to document changes in teachers' use of project ideas and manipulatives over the school year. The issue was, for example, whether teachers increased the amount of time spent on mathematics, not whether they increased the amount of time spent on mathematics by 20% or 50% or whatever. The classroom observations were done systematically but without standards for judging teachers. These data, once compiled and analyzed, provided a full picture of teachers' classrooms, but during the school year the evaluators never seemed adequately to convey this information to the TDP director. This was more a problem of poor performance on the part of evaluators than a lack of interest in having data on the part of the TDP director. Consistent with her own evolutionary, developmental approach, the director was interested in "how it was going," in addition to the aggregated and systematics analysis of some 200 classroom observations. The evaluation concentrated too much on formal reporting techniques in a situation where the ongoing development of training materials would have been better aided by frequent, informal data analysis and reporting.

The training of math specialists has received less evaluation attention. This was partly a matter of limited resources during much of the time that the group of ten math specialists was being trained. However, at the point when the math specialists were ready to become fully functioning in their school, the Evaluation Component proposed that extensive case studies of the five schools be conducted jointly by the developers and evaluators. Given our understanding of the developers' assumptions about individual teacher and school variation and the importance of local adaptation, this seemed to be the most sensible way to proceed with the evaluation. We considered work such as the Case Studies in Science Education (Stake and Easley 1978) to be a good model. Although the case study idea was favorably received, ultimately there were insufficient resources to conduct such a study and the evaluation activities were scaled down. Conducting extensive case studies was also hampered by the unexpected and extended Chicago Public Schools teachers' strike. Data collection by the Evaluation Component focused on organizational changes in the five schools through school staff reports, and on the math specialist's perceptions of their experiences as math specialists. In retrospect, the evaluators could and should have contributed more to the development of training for math specialists. That we did not is at least partially due to the difficult challenge of providing useful evaluative data for a project which is naturally evolving and changing. The evaluation probably would have better served the TDP by being more responsive to changing informational needs, by focusing on short term evaluation issues, by being more active in setting evaluation issues, and by relying more on personal, informal reporting. Perhaps the evaluators assumed an excessively technological perspective of evaluation which conformed poorly to the cultural/political perspective of innovation taken by the TDP developers.

The Relationship Between Innovation and Evaluation

House (1981) suggests that particular perspectives on innovation presage particular methodological approaches: "The technological perspective usually conducts its investigations with psychometric instruments, such as achievement tests, attitude scales, or scaled questionnaires. The political perspective conducts its investigations primarily with semistructured questionnaires and interviews, a survey methodology. The cultural perspective lends itself to anthropological methods of investigation, such as observation, participant observation, and case study" (p. 28). The evaluations of the Secondary Component textbooks and the TDP suggest there is some truth to these relationships. The TM field study, for example, relied heavily on the use of teacher surveys and standardized opinion and achievement measures. The evaluation of the TDP relied heavily on interviews, unstructured questionnaires, and classroom observations.

What is interesting about this relationship between innovation and evaluation is that the evaluators are not the developers and need not assume the same perspective on innovation. And, although there is more blending of methods than suggested by House, the evaluation studies have taken on the dominant perspective of the developers. The collection of teacher diaries in the TM field study, for example, is not typical of a technological approach but does not overcome the basic psychometric approach. A partial explanation for the similarities in the innovation and evaluation perspectives is the need to collect evaluation data that make epistemological sense to the developers. If one assumes that evaluations are to be useful to curriculum developers, then there is a need for developers and evaluators to speak the same language—to share a view of what counts as evidence and the criteria for judging the value and worth of something. Evaluation is useless if it bypasses the innovator.

However, I believe this relationship is not a simple linear one. House contends that perspectives on innovation change and changes in methodology follow. "One uses different methodology in order to ask different questions, and then the different answers confirm the methodology and perspective. In other words, each perspective is confirmed by its own methodology" (pp. 28–29). Although I would agree that certain perspectives allow and support certain methodologies, I believe that evaluation can and should be more pro-active than House's view suggests. While it is necessary to utilize a methodological approach acceptable to the innovator (assuming the innovator is a primary audience for the evaluation), it is also possible to expand the innovator's view of allowable evidence and perhaps to influence the innovator's perspective. A good evaluation study must conform sufficiently to the innovator's perspective to be credible and intelligible, but it must also expand the innovator's definition of important issues and considerations in the educational change process. The challenge for evaluators is to find the right balance between speaking the innovator's language and introducing concepts and methodologies from different perspectives. Undoubtedly, the UCSMP evaluators have not fully met this challenge, particularly with regard to questioning the perspectives taken by curriculum developers. More could and should have been done; but this is hindsight—the lessons learned are for another day and the evaluations of future innovative projects.

In evaluating an innovative project, it is necessary to analyze the perspective taken by curriculum developers in order to design evaluation studies that will be meaningful to the developers. These studies provide alternative perspectives on innovation and methodologies that can make the process of educational change more intelligent.

Endnotes

1. See Fullan (1982) for a comprehensive review of the educational change literature in the United States, Canada, and Europe.

2. See, for example, McLaughlin's (1975) discussion of Title I programs; the House et al. critique of the Follow-Through evaluation (1977); the Farrar and House meta-evaluation of Push/Excel (1983); and Stake's meta-evaluation of the Cities-in-Schools Program (1986).

3. See Usiskin (1985) for a discussion of the goals of the Secondary Component.

The views expressed in this paper are those of the author and should not be considered an official statement by the University of Chicago School Mathematics Project and its directors.

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Biographical Note

Sandra Mathison received her Ph.D. from the University of Illinois at Urbana-Champaign, with a specialization in educational program evaluation she completed while a member of the Center for Instructional Research and Curriculum Evaluation (CIRCE).

Dr. Mathison is currently Assistant Professor in the Department of Educational Theory and Practice and Co-Director of the Evaluation Consortium at the State University of New York at Albany, where she teaches program/curriculum evaluation and qualitative research methods. Before joining the Albany faculty Dr. Mathison was the evaluation coordinator for the University of Chicago School Mathematics Project (1985–88). She has extensive experience in evaluation, including vocational education, social service programs, and personnel evaluation.

Dr. Mathison is an active member of the American Educational Research Association, the American Evaluation Association, and Phi Delta Kappa. She currently serves as the newsletter editor for the AERA SIG: Research on Evaluation and is the Program Chair for the AERA Qualitative Research SIG. Her publications include two edited volumes on program evaluation and numerous evaluation reports and journal articles.