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ABSTRACT

Collaborations between teachers and researchers at summer workshops were studied. The workshops were part of a project of the American Federation of Teachers and the Learning Research and Development Center of the University of Pittsburgh (Pennsylvania) to enhance mathematics education by making information about the latest research available to the teaching community. The focus was on the contrast between the workshop in 1988 and that of 1989. In 1988, it was evident that the dialogue between researchers and the three teachers necessary to accomplish project goals had not been achieved. This workshop's product--a document summarizing research for dissemination to teachers--was not the desired synthesis of ideas, and the atmosphere seemed to hinder teachers' opportunity to discuss content areas. In 1989, teacher selection procedures were changed, two additional teachers participated, and interactions were designed to be less formal and to recognize that teacher participants were operating with a store of knowledge and a strong sense of what was important. Analysis of the videotaped dialogues from both years indicated the increased engagement of all parties with the substantive content of the research. This second workshop's product document was a better synthesis of the ideas discussed and was useful in the dissemination of the ideas by teacher participants in workshops for other teachers. Two tables and eight bar graphs illustrate the study. An appendix describes the sampling design used. (SLD)

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Interpreting Research for Practice: A Case of Collaboration

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Major reform of mathematics education, restructuring of schools and the teaching profession, and dramatic demographic shifts in the teaching population are three converging trends. Preservice and in-service education are beginning to reflect and build on these trends. Further, the nature of research on teaching is also being transformed. One example of this is a collaborative project between the American Federation of Teachers (AFT) and the University of Pittsburgh's Learning Research and Development Center (LRDC). The former organization is one of the two major teacher unions and the latter is one of the 15 or so federally supported educational research centers. This project, sponsored by the National Science Foundation, is titled Disseminating New Knowledge About Mathematics Instruction and Learning. The immediate objective of the collaborations is to make available to the teaching community information about the latest research and debates in mathematics education. The longer range goal is to establish an effective process for further collaboration. The AFT is drawing on its established, highly effective, and extensive network for dissemination of research information by teachers. The original forum for the collaboration is an annual, one-month workshop at which research around specific topics (e.g., fractions, decimals, mathematical intuition, estimation, addition, subtraction, problem solving, multiplication, division) is interpreted, transformed, and synthesized into a resource document for practicing teachers.

While the motivation and inspiration (and no doubt the funding as well) of this project is an outgrowth of the current efforts at educational reform, it is a project that has deep roots in the missions of both the AFT and LRDC (Bickel & Hattrup, 1990). Both organizations have had long records of implementing change in schools. Collaboration was a natural course of action for both institutions. The LRDC component, therefore, approached this current effort with a desire to not only accomplish the primary goal, the dissemination of research information, but to understand at several different levels how the collaboration process was working? Could we improve our own practices as we went along?

This paper is about the knowledge we have gained concerning the collaborations between teachers and researchers during the summer workshop periods. The focus is on a contrast between the first and second years' workshops.

After the first workshop in 1988, it was quite clear that the type of dialogue between researchers and teachers which would accomplish the goal of having teachers make available to other teachers an emerging and evolving body of research had not been achieved. A we/they (researchers/teachers) atmosphere had been unintentionally fostered; there was little or no negotiation of meanings about the mathematical topics under discussion. The "product", a document summarizing the original research into a narrative form suitable as a resource for teachers, was not all that it could be; it was essentially a set of quotes from original research pieces rather than the desired synthesis of ideas. There was no clear-cut avenue for revising or reformulating the "product", and the process of establishing strong communication links was left a bit in the dust. An environment that would foster the desired level of communication had not been established.

In 1988, the motivating force behind the planning and organization of the workshop was an effort to demystify the culture of the research community - to make it accessible to the teaching community. In retrospect, it appeared that our preparation and planning built on the strengths of the researchers' knowledge base rather than on the strengths of the teachers' knowledge base. The atmosphere we had created for dialogues (i.e., working in the researcher's world) seemed to actually hinder the teachers' opportunity to discuss content issues, one of the main purposes of the dialogues. On the basis of input obtained from the 1988 teacher participants as part of the evaluation process and the reflections of the researchers, several changes were initiated for the second year's workshop.

For the second year's workshop in 1989, the research team at LRDC in conjunction project members from the AFT changed all of the following: the teacher selection procedure (requiring applicants to write a summary of a research paper and design lessons); the number of teacher participants (increasing the number from three to five); the role of senior research staff (lessening the structure of events and increasing the time for less formal interactions); the role of the participants in determining agendas (increasing their opportunities to alter events on a day to day basis); and, most significantly, the focus of the discussions between teachers and researchers (from discussing specific research reviews in terms of the interpretations of the mathematical ideas contained therein to discussing research reviews in terms of the implications for instructional practice). This change in the focus of the dialogues was made in order to place the discussion in a context which recognized that the teachers were operating with an extensive store of pedagogical knowledge and a strong sense of what was sensible and important. The attempt was made to shift the focus from a goal of understanding the

research chapter (a goal which is quite common in the research community) to one of understanding instructional practice in light of research findings. The analyses of the collaboration were designed to see what effect this change of goals had on the interactions among the participants.

This paper focuses on one specific aspect of the collaboration, the dialogues which occurred during the workshops, in the hope that it will provide evidence for or against the efficacy of these changes. These dialogues that occurred between researchers and teachers during the workshops were analyzed. The central question is: How does one build constructive discourse among researchers and teachers so that a shared knowledge base is created that enhances the professional practice of participants of both communities?

We begin with a brief overview of some of the issues that are relevant to the goals of this project on a broad scale. We continue with a discussion of the structure of the project and the major aspects of change from year one to two. We then discuss the analysis of a sample of the discourse that occurred during the two summer workshops, and conclude with some comments about the implications of these findings for building a genuine partnership between teachers and researchers. The objective for the partnership is the development of an improved knowledge base and a process for constructive discourse that will in turn contribute to more effective practice and more effective research.

Background of Issues

At the 1986 AERA annual meeting, Mary Hatwood Futrell, then president of the National Education Association, called for teachers and educational researchers to "forge an alliance for educational progress" (Futrell, 1986). She argued that teachers need the technical knowledge provided by the researchers and that researchers need to understand the reality of classrooms.

She urged both communities to make a concerted effort to move research through the classroom door. Others have made similar arguments that practitioners can benefit from the research findings and that the researchers can benefit from the wisdom of practice.

In a recent article in Phi Delta Kappan, Albert Shanker, president of the AFT, describes a proposal for the Incentive Schools Program, a plan "to establish a voluntary, nationwide, multi-year competition open to every school in the United States " (1990, p. 354). He envisions that this program would provide incentives for teams of educators (e.g., teachers, researchers, administrators) to work together to improve student learning and to build the capacity for self-renewal into the schools. Since 1985, Shanker (1985, 1986, 1990) has advocated a restructuring of our educational system. He argues that the traditional model of education is no longer valid or viable as a means for preparing students for the intellectual demands of the current technological society. The team approach may be a viable alternative.

William Kyle (1990) in a recent newsletter from the School Mathematics and Science Center (SMSC) at Purdue stated that, "The social context of schooling demands a research agenda in which collaboration [between researchers and teachers] and relevancy are stressed around a vision that celebrates not what is, but what can be!" (p. 3). He continues with the statement that, throughout the '90s, SMSC will continue to establish "alliances to assist teachers in their professional endeavors" (p. 3). Shulman (1987), as he discussed the necessity for interaction between theory-driven and practice-driven research, asserts that "the wisdom of practice [may] enrich and inform us all" (p. 385). Leinhardt (1990), in building on that line of work, has indicated that not all practice is wisdom just as not all research should or can lead to practice.

Moving research through the classroom door is no simple task, however. Larry Cuban's (1990) recent article in the Educational Researcher includes an exceptionally dramatic diagram reflecting the difficulty of this task. In his figure, the lines depicting educational reform efforts undulate like waves with peaks and valleys reflecting the fluctuation of interest and effort in reform movements over the years. The dramatic feature in the figure is the line depicting classroom practice. That line is absolutely horizontal, indicating no change in classroom practice over the same period of time the waves of reform were ebbing and flowing around it. Cuban argues that classroom practice remains unchanged because the decentralized structure of the educational system gives teachers autonomy in their classrooms. The links between a school district's administration and classroom instruction are loose. Teachers can change or not change their instruction as they see value for their class. Some signs of reforms may be evident at a superficial level (e.g., different standardized tests, new equipment, new formats for writing lesson plans) but "seldom are the deepest structures of schooling that are embedded in the school's use of time and space, teaching practice and classroom routines fundamentally altered" (p. 9). Cuban claims that this loose association between administration and teacher is maintained because it is mutually beneficial. The superficial changes project an image to taxpayers of meeting valued external pressures, thus maintaining the district's credibility, an important concern of the administration. By limiting the pressures placed on individual teachers to change their practice, the administration retains the teachers' support, an equally important concern.

David Cohen (1987) concurs with Cuban that reforms have had minimal effect on classroom teaching, but disagrees with him on the reasons for this lack of influence. Cohen eloquently discusses the inadequacy of several

explanations for the lack of change in public school instruction (i.e., teachers have a limited influence on the conditions of teaching, the reform movements were flawed in some critical way, the fact that public schools lack competition discourages incentives for change). He suggests that the kind of teaching advocated by reform movements, what Cohen terms adventurous teaching, is a very risky business for the teacher and runs counter to our traditional ideas about the nature of knowledge, learning, and teaching. Adventurous teaching requires the teacher to increase the level of uncertainty during instruction, both in pedagogy and the exploration of the content of the discipline being taught. It enhances the teachers own vulnerability before the students. Reformers and researchers have not concerned themselves with the question, How difficult is the task? They have operated on the assumptions that "adventurous teaching can be had anywhere" (Cohen, 1987, p.14) and that "adventurous teaching would be easy because adventurous learning was natural" (Cohen, 1987, p. 33). Those assumptions are questionable. As Lovely Billups of the AFT has said, "Enslaved minds cannot teach liberation." We are unlikely to have teachers teaching exploration and growth while teachers themselves are still enslaved by their treatment, training, and beliefs.

Another position to take on the matter of the link between change and the reforms is to consider which aspects of the reforms are the focus of our attention. It can, for example, be argued that prior to 1958 there were few if any curricular objectives, that behavioral checklists were unknown, that criterion and curriculum based testing had no name let alone presence, that decentralization of New York City's schools had not been suggested, and that the majority of the schools in the south were segregated. One could suggest that twenty years later in 1978 curriculum objectives pervaded lesson plans, text books, and national exams. Curriculum imbedded tests were frequent as

were massive district testing. New York was decentralized, and the desegregation in the south was more advanced than in the north. These are not merely superficial changes. They are, however, changes that are inconsistent with the Deweyian progressive philosophy with all of its profound implications. The changes leave many of the power relationships in schools unaltered, but the canon and its form have been touched.

The criterion and curriculum referenced tests and the self-paced, individualized instruction emphasis in the late 1960s and early 1970s did change classroom instruction in many settings. The increased attention to manipulative materials, hands on activities, and exploration were not necessarily superficial changes in all cases. Some individual teachers integrated those ideas into their instructional planning even after the open classroom experiments ended. The changes were not widespread, however.

In addition, we must recognize that excellence in teaching mathematics was not invented yesterday. Many teachers teaching under a different rhetoric of reform have experienced massive successes and they rightly have a sense of pride about those successes. We cannot declare massive failure for the old as a justification for the new. Some of the old is not so old, and much is not failing. The fact that some aspects of classroom instruction have remained unchanged is not necessarily bad!

Researcher-Teacher alliances

A collaboration is a complex undertaking. Forging the alliance between the research and teaching communities is not simple. Researchers and teachers operate in very different worlds. The facile move of declaring teachers to be researchers is to both denigrate the status of the real work of teachers and to lie about the intricacies of careful research. Although each group shares the goal of enhancing the learning of students, they come to that

goal from different perspectives. The researcher is concerned with research and the production of new knowledge. The teacher, on the other hand, is concerned with teaching and preparing students for additional education and work.

A variety of programs throughout the country have and are attempting to forge that alliance. Universities commonly sponsor professional development programs (Carpenter & Fennema, 1988; Cobb, Yackel, & Wood, 1988; The Ford Foundation, 1987; QUASAR, 1990; MAPS Update, 1990; Silver, 1986). These programs incorporate different models of collaboration between teacher and researcher. Some programs take on an "information dissemination" atmosphere in which research findings are provided to the participants and the participants incorporate into their instructional lessons as little or as much of that information as they choose (e.g., Wisconsin - Cognitively Guided Instruction: Carpenter & Fennema, 1988). Some programs attempt to develop leaders who will share their new knowledge with their colleagues and act as a resource within their own school buildings or districts (San Diego Mathematics Project: Silver, 1986; Pittsburgh Mathematics Collaborative: Salmon-Cox & Briars, 1989; Urban Mathematics Collaboratives: The Ford Foundation, 1987). Some programs focus on the development of student classroom activities for individual teachers to incorporate in their own instruction, allowing the issues related to various models of learning to be discussed in the context of the development of the activities rather than as prerequisite knowledge (Cobb, Yackel, & Wood, 1988). Still other programs involve specially selected individuals working one-on-one with university faculty members for a period of a semester or a year (e.g., AFT Visiting Practitioner program, School Mathematics and Science Center Master Teacher-in-Residence Program at Purdue).

School districts sponsor professional development sessions, which bring the research findings to the practitioner but do not involve a teacher/researcher dialogue. In Pittsburgh, the Schenley Teacher Project at the high school level and the Brookline project for elementary and middle school teachers are programs that systematically provided in-service training for all teachers in the school district about effective instructional methods based on research findings. These programs are organized, taught, and monitored by teachers for teachers. Researchers do not engage in the discourse.

In some situations, researchers are also teachers. For example, some university faculty who conduct research and teach prospective or veteran teachers in schools of education also teach in public school classrooms (e.g., Deborah Ball, Magdelene Lampert, Suzanne Wilson). In other situations, teachers are also researchers. In these cases, the dialogue between researcher and teacher occurs within the same individual and, importantly, with both other teachers and other researchers.

The NCTM Curriculum and Evaluation Standards document (1989) represents a major effort to disseminate mathematics' education research to the classroom teacher. The approach to teaching mathematics advocated by NCTM is a synthesis of current research thinking in the fields of cognitive psychology, learning theory, and mathematics education. A concerted effort is being launched by NCTM to hold a variety of in-service training sessions across the country to facilitate the implementation of the standards. In September of 1989, the Mathematics Teacher, an NCTM publication, introduced a new section into its publication entitled "Implementing the Standards" (Schoen, 1989) to increase communication between the research and teaching communities.

As evidence from the discussion above, a variety of models have been and are being used to move research through the classroom door to make available to the teaching community the latest research in mathematics education. It may be that Cuban and Cohen have accurately identified some of the reasons for the slow progress in changing classroom practice. Another explanation may be that the models employed have not facilitated change to the extent expected. Many of the efforts at teacher-researcher interactions have reported changes in classroom behaviors and student performance (Carpenter, Fennema, Peterson, Chiang, & Loef, 1990; Wheatley, 1983). Some of the efforts are concerned only with providing information to the teacher; the dialogue between researchers and teachers is limited, if it exists at all. If constructive dialogue does not occur, can these situations be considered a collaboration? (see Bickel & Hattrup, 1990, for a detailed discussion of characteristics of collaboration.) Many in-service programs are simply traditional teaching situations with researcher as teacher and teacher as student--a situation in which an attempt is made to pass information from the knower to the receiver. The spirit of Futrell's call (1986) for greater contact between researcher and teacher is to encourage a dialogue, a collaboration, the feeling of collegiality. By analyzing the dialogues between researchers and teachers, we hope to take one step toward shedding some light on characteristics that facilitate the collaborative process.

Structure of the project:

The project is organized around teams of researchers, teachers, and AFT staff. Experienced teachers selected from AFT school districts from around the country work together with researchers from LRDC to develop materials that will eventually be disseminated to teachers nationwide through the AFT's

Educational Research and Dissemination (ER&D) network.[1] The materials that are developed are associated with a particular mathematics topic. In the summer of 1988, the topics were fractions, decimals, and proportional reasoning. In the summer of 1989, the topics were addition, subtraction, multiplication, and division. The development of the materials for a particular set of math topics begins with a summer workshop session and ends about two years later when those materials are ready to be disseminated nationwide through the ER&D network. All materials developed so far are in draft form being used in pilot-testing sessions in the home school districts of the teachers and in six sites across the country[2]. Three teachers participated in 1988 and five teachers participated in 1989.

An elaboration of the events from birth to maturity of these materials will clarify the collaborative process involved in this project. The work begins in a four week summer workshop held at LRDC in Pittsburgh, PA. It continues with work on the design of teacher training manuals and then is field tested in the teachers' local schools. The materials which are designed at LRDC during the workshops are built around translations of a set of commissioned chapters on research on specific mathematics topics. These chapters are written by mathematics education experts and are intricate syntheses of large bodies of work[3]. (Leinhardt, Putnam, & Hattrup, in press)

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[1]The ER&D network exists in approximately 400 sites around the country. At these sites specially selected and trained AFT members conduct training sessions for colleagues in their area. These training sessions are designed to promote professional growth and change instructional practice. Training programs already in place deal with issues such as Cooperative Learning Groups, Classroom Management, Beginning of the Year Routines, Praise, and Time on Task.

[2]The sites areAlbuquerque, N.M., San Francisco, CA, Dade County, FL, Anderson, IN, Gary, IN, and Hammond, IN.

[3] The book consists of chapters on Number Sense & Estimation, Fractions, Decimals, Addition and Subtraction, Multiplication and Division. The authors synthesized current research in the particular topic areas.

During the summer workshop, seminars designed to supplement the original chapters are held. The end product of the summer session is a draft of a narrative summary of the major ideas discussed throughout the workshop and the relationship of those ideas to classroom instruction. The organization, structure, and content of the collaborative document reflect the efforts and ideas of both the research and teacher participants. This document is used by the participating AFT teachers during the fall in informal sharing sessions with their colleagues in their home schools. This activity is followed up by two additional one-week meetings during the academic year to evaluate the process. Collaboration is a time consuming activity.

The goal for the project is two-fold. One part is to help the teachers understand the latest ideas about teaching and learning particular topics so that they can implement some of these ideas in their own teaching situations. That part is the common, standard goal of most in-service training programs being conducted anywhere in the country. In most cases, training sessions occur, teachers participate in activities, and they leave the workshop, implementing as little or as much of their new found knowledge as they choose. Follow-up on implementation into instructional practice is the exception rather than the rule. As noted above, researchers and teachers meet for two week long workshops, one in January and one in May, for the purpose of sharing experiences that occurred between meetings and reflecting upon courses of action that would be appropriate. Phone conversations during the interim are encouraged.

The second part of our goal is to create resource documents and training activities that will be used to convey to the classroom teacher specific ideas about teaching and learning a particular topic. It is this aspect of the project that makes it different from most other teacher/researcher collaborations. A

single product, if you will, is to be produced by the group. That product is the critical link between the research community and the teacher in the classroom. The quality of that product -- its ability to create successful in-service programs -- is the key to the success of the project. If the document does not convey information accurately and in a comprehensible fashion and if the training activities do not facilitate changes in instructional strategies then our efforts have not been successful.

Let us emphasize that collaboration is a complex activity. Consider this scenario. Two or three members of your own discipline are to collaborate with two or three members of a related discipline. None of the participants have met. Further, although both groups respect each other and share a sincere desire to work together effectively, the groups have fundamentally different values and rules for acting in such situations. The roles of action, revision, criticism, and suggestion are vastly different in the two communities. This should give you some understanding of the difficulty of the task.

Methods

Scientific reasoning is based on careful data collection and equally careful control and manipulation of specific variables to track the effect of changes made. Applied social science in the service of reform rarely has the capacity for such rigor. As indicated earlier, the central change in the workshops from 1988 to 1989 was the orientation and definition of the task. The specific changes that were made to achieve these shifts in focus include changes in the teacher selection procedure, the number of teacher participants, the role of senior research staff, the role of the participants in determining agendas, and the focus of the dialogues between researchers and teachers.

The initial orientation in 1988 was to develop an understanding of the theory associated with the mathematical structure of a particular topic domain (e.g., fractions). In the second summer, the orientation was to develop an understanding of the instructional implications of the research ideas and then consider the rationale for these instructional practices. The task was defined to be the creation of a document that would include a rationale for the recommended instructional techniques. The purpose of making that change was to anchor the discussion in the teaching/learning space rather than in the research space. A second reason was to begin to develop a language of exchange among teachers which would permit the continuation of teacher to teacher dialogues.

In an effort to trace the course of our workshops we have two solid data bases: videotapes for almost all of the summer workshop sessions for both years and all final drafts of documents resulting from the workshop experiences. Impact beyond the workshop experiences, unfortunately, has not been as well documented.

The videotaped sessions have been catalogued by date and activity; a running log of the content of the discourse that occurred during a session was noted. Each type of activity can be considered a ribbon of a particular color from which we will sample. Playback counter numbers on a single, high quality Panasonic VCR unit have been used to index segments on the tapes. All sessions were classified as belonging to one of the following categories: orientation sessions, guest lecture seminars, author sessions, teacher/researcher dialogues, or planning/evaluation sessions. Orientation sessions designate the initial session held between researchers and teachers on the first day of the workshop. This was a time for researchers to orient the teachers to the project and their role in it. Guest lecture seminars were

sessions during which individuals led discussions on particular topics considered to be relevant to the task at hand. In some cases these topics were determined solely by the research community; in other instances, the teachers had input into the focus of the discussion. Author sessions were those in which the author of one of the commissioned chapters from the Leinhardt et al. book engaged in a face-to-face interaction with the teachers discussing the ideas in the chapter, clarifying issues, and answering the teachers' questions. In some cases, the authors had prepared a formal presentation as a starting point for the discussion. Teacher/researcher dialogues were sessions specifically designed for the participants to discuss issues and ideas. The planning/evaluation sessions included sessions in which the focus was on planning future activities and evaluating past events (e.g., planning the agenda for an author's visit, planning the next day's distribution of labor, evaluating the pros and cons of previous events). In addition, discussions concerning the planning of events often occurred at the beginning or end of sessions designed for other purposes. Such segments of a session were included in the Planning/Evaluation category. From this database a sample of dialogues was selected for coding. The details of the sampling are contained in Appendix A. Essentially all the video taped sessions for each year (approximately 37 hours in 1988 and 51 hours in 1989) were divided into segments approximately five minutes in length. These segments became a sampling base, since directly coding the entire database was prohibitive.

The changes implemented in the structure and format of the 1989 workshop were designed to create a context that built on the knowledge base of the teachers, one in which they would have the opportunity to discuss their own practice and its relationship to the issues involved in the research chapters. Our hypothesis was that this context would facilitate the teachers'

contribution to the dialogues in general as well as increase opportunities to discuss the mathematics. Consequently, we predicted an increase in the amount of discourse teachers contributed to the dialogues across all categories. We also predicted that during seminars, author interactions, and teacher/researcher dialogue sessions, an increase would occur in the amount of time conversations dealt with mathematics rather than other general issues not related to the content. The nature of the orientation and planning sessions precluded any conversations about mathematics. In addition, we were interested in whether the focus of the dialogues shifted both when conversations dealt with mathematics and when they dealt with non-mathematical issues.

Coding

Five aspects of the dialogues that occurred during the summer workshops were identified as indicators of shifts in the dynamics of the interactions, WHO, WHAT, FOCUS, FORM, and PATH. These five classifications formed the basis for our coding system. WHO refers to who was speaking at a particular point in the dialogue, a researcher (R), a teacher (T), an AFT representative (A), or no one (S)[4]. WHAT and FOCUS refer to the content of the dialogue. WHAT reflects whether the speaker was discussing mathematics (M) or some other topic (O). FOCUS is a subdivision of the WHAT classification. If the content is mathematics, FOCUS reflects whether the dialogue was about an explanation or example (E), about teaching (T), about students (K), about curriculum (C), or a query (Q). If the content is a topic other than mathematics, FOCUS reflects whether the dialogue was about the task to be completed (T), about general teaching (G), about planning (P), about self (S),

[4] The S represents Silence as well as situations in which many people were talking at once and no substantive exchange of ideas occurred.

or about students (K). A fourth aspect of the dialogue, FORM, identifies whether the speaker is asking a question (?), making a statement (S), or answering a question (A). The final classification, PATH, identifies whether the speaker is continuing the ongoing conversation (C), initiating a new idea (I), or redirecting the conversation (R). The data relating to the FORM and PATH classifications are not reported here because they provide no insights into improving the structure of a collaborative effort between researchers and teachers.

Each of the five-minute sample segments was divided into ten 30 second intervals. Each of these 30 second intervals was coded with a five-element code reflecting the five aspects described above. For example, if a researcher (R) was talking about a topic other (O) than mathematics that related to the task (T) at hand and the sentences used were mostly statements (S) that were continuing (C) the general trend of the dialogue, that 30 second interval would be coded ROTSC. The percentages for each of the classifications in the coding scheme were determined for the five-minute segment. About 10 percent of the tapes were coded, 3 hours and 40 minutes out of 37 hours from 1988 and 6 hours and 5 minutes out of 51 hours from 1989.

To determine the results for the WHO classifications, average percents were computed for each type of session for each group (i.e., Researcher, teacher, AFT, Silence). The overall average is a weighted average, computed by giving weights to the different types of sessions proportional to their part of the total sample of segments. For example, the Seminar segments in 1988 contributed 13 out of 44 segments for a weight of .30.

Results/Discussion

Table 1 shows a summary of the results of the coding on the WHO and WHAT aspects of the discourse of the tapes from the two workshops. The

results indicate that across all categories researchers talked less in 1989 than in 1988 (57% vs 76%, respectively); teachers (21% vs. 30%, respectively) and the AFT representatives (0% vs. 12%, respectively) talked much more; while silences were about the same (3% vs 2%). Further, in 1989, more of the time was spent discussing mathematics (43% compared to 25% in 1988) and less time was spent talking about other things (55% to 72% in 1988).

Insert Table 1 here

Figures 1 and 2 show a breakdown of who was contributing to the discourse by type of session for 1988 and 1989, respectively. In 1988 researchers talk more than the teachers in all types of sessions, but in 1989 the researchers talk more only in the Seminar, Author, and Planning sessions. In addition, in 1988 the gaps between researcher and teacher contribution ranged from a low of 15% (Dialogues: 56% researchers compared to 39% teachers) to a high of 90% (Authors: 92% researchers compared to 2% teachers). In 1989, the gap ranged from a low of 6% in Planning (36% researchers to 30% for teachers) to a high of 42% in Seminars (72% researchers and 28% teachers). Not only did the gap between the percent of time researchers and teachers talk dramatically decrease but teachers talked more than researchers in the Dialogue session (53% teachers to 36% researchers). This shift is almost a reversal of the 1988 percents (39% teachers, 56% researchers).

Insert Figures 1 and 2 here

A comparison of the figures also shows evidence of the increased involvement of AFT personnel in the discussions. In 1988 the AFT personnel were directly involved in three of the 20 days of workshop activities. The lack of their presence is reflected in the data in that the AFT personnel did not contribute to the discourse in any of the sampled sessions. In 1989, AFT personnel were present about eight of the 20 days. This increased involvement is reflected in the data which show that the AFT personnel contribute to the discourse in each type of session except the Seminars at which they were not present.

Of particular note is the almost equal contribution of all three groups (i.e., researchers, teachers, and AFT) to the Planning sessions in 1989. These data reflect a shift toward the desired goal of developing a meaningful collaboration among project participants. One should note that an equal split between researcher and teacher talk is not expected in the other four types of sessions. The nature of the summer workshop, teachers learning about the latest research findings from authors of the commissioned chapters and from researchers in seminars, encourages more talk by researchers. However, the goal of developing a collegial relationship suggests that the difference be minimized.

Figures 3 and 4 focus on the content of the discourse during the workshops. Coding of the videotapes dichotomized the content into Mathematics and Other topics. The changes implemented for the 1989 workshop structure and orientation were intended to accomplish two goals: facilitate greater teacher contributions to the discourse in general and to increase the amount of discourse related to mathematics. The results shown in Figures 3 and 4 indicate progress toward those goals.

Insert Figures 3 and 4 here

Figure 3 shows the results for the 1988 workshop; Figure 4 shows the results for the 1989 workshop. The discourse contributed by each of the groups (i.e., researchers, teachers, and the AFT) is represented separately as a bar worth 100%. In each case, the darkened section of the bar represents the percent of the total discourse related to Mathematics and the clear section represents the percent of the total related to discussions on Other Topics. In 1988, when researchers were talking, the discourse focused on mathematics 28% of the time and on other topics approximately 72% of the time. When teachers were talking, the discourse focused on mathematics 12% of the time and on other topics 88% of the time. The AFT was not represented in our sample for 1988.

These percentages contrast sharply with those for the summer of 1989. When researchers were talking in 1989 (Figure 4), 43% of the discussion focused on mathematics and 56% on Other Topics (The sum is less than 100% because of rounding). When teachers were talking, 51% of their contributions focused on mathematics and 48% on other topics. The split between talking about Mathematics and Other Topics progressed toward a more equal distribution from 1988 to 1989 regardless of whether teachers or researchers were talking. This shift signifies increased engagement of all parties with the substantive content of the workshop research resources.

The AFT was represented in our 1989 sample and their contributions, not unsurprisingly, focused 100% on Other topics. The representatives of the research and teaching communities are expected to be responsible for the substantive mathematics involved in the project. The role of the AFT representatives is to contribute expertise about the ER&D network, to help plan

and prepare teacher training and resource materials, and to provide organizational support for the teachers in the project, all areas which would be coded as Other.

Additional analysis classified the FOCUS of the mathematics discourse into five categories: Explanations or examples, teaching, students, curriculum, and queries about the mathematics. Figure 5 shows the comparison of the breakdown for these classifications for the teacher's mathematics discourse in 1988 compared to that in 1989. Not only did the amount of discourse about mathematics increase from 1988 to 1989 for teachers (12%, Figure 3, to 51%, Figure 4), but the range of topics included in those discussions expanded. In 1988, approximately half the teachers' remarks (47%) focused on explanations or examples with the remaining half split between teaching (25%) and queries about mathematics (28%). In 1989, the discourse ranges across all five of the categories with the major emphasis on the teaching of mathematics (56%). This shift is in the desired direction because the changes in the orientation of the workshops were made in an attempt to focus discussions on areas that dealt with the teachers' knowledge and expertise. Obviously, the teaching of mathematics is an aspect of the teachers' expertise.

Insert Figures 5 & 6 about here

Figure 6 shows a similar comparison for the researchers in those two years. Although the discourse on the part of the researchers for both years was distributed across all the mathematics' categories, there is a shift away from explanations and examples, 58% in 1988 down to 39% in 1989. The 58% is not surprising since the role of the researchers in many of the sessions in 1988 was that of instructor. The attempt was made in 1989 to change this role

to a more informal collegial relationship rather than one of instructor and student. The data support success as they show a shift in that direction. In addition, there is a shift toward talking about teaching (20% in 1988 increased to 39% in 1989) and talking about students (10% in 1988 increased to 15% in 1989). Again, these data indicate the focus of the discussions was in areas where teachers and researchers could contribute their different perspectives to the conversation. Researchers bring the knowledge gained from empirical studies about effective practice, about the structure of the mathematics, and theories about how students learn. The teachers bring the knowledge gained from the realities of the classroom setting about effective practice, the reactions and interactions of students in a school setting, and the demands placed upon teachers by district and state regulations.

A similar analysis was done when discourse related to topics other than mathematics. Figures 7 and 8 show a comparison of the distribution of the discourse in 1988 with that in 1989 for the teachers and the researchers, respectively. The five classifications which were coded are: discussing the general task of preparing the resource and training materials (Task), describing general teaching strategies (Gen. Teach), planning task related activities (Planning), describing their own experiences (Self), or reporting on students' learning in their own classes in a general way not related to the teaching of mathematics (Students).

Insert Figures 7 & 8 about here

The teachers' conversations in 1988 were dominated by discussions about the Task (66%) and Planning (21%) as were the researchers (Task 59% and Planning 23%). In 1988, this time was necessary because neither a clear vision of the task nor what form the training materials might take had been conveyed to the teachers. This approach was taken intentionally in 1988, partly because the LRDC researchers as organizers of the workshop did not have a precise definition of the task and how it would be accomplished, and partly because of a desire to allow the teachers to contribute their own vision of the task to the process. In fact, a special effort was made to avoid defining any details about the resource and training materials. The descriptions of the products that might result from the workshop were extremely general and open ended. Statements to the teachers included comments such as, "you can create whatever materials you believe will best convey to your colleagues the ideas in the research. These materials may take the form of videotapes, text narratives, or demonstration lessons or whatever you choose." The teachers were encouraged to maintain a broad view of the products believing it was best to allow the teachers to define the task for themselves. In retrospect, this approach was a serious mistake. Too little structure and definition of the task were provided, especially when the task was presented in a context foreign to the teachers.

In 1989, the teachers' contributions to the discussions were spread more evenly across Task (25%), General Teaching (27%) Planning (26%), Self (13%) and Students (9%) (see Figure 7). Researchers' contributions to the discussions in 1989 were also more evenly distributed across the classifications (see Figure

8). The contrast in the data between the two summers is again encouraging in terms of suggesting that the changes implemented moved the discourse in the desired direction, namely an increased attention to teaching. The greatest increase for the teachers (1% to 27%) as well as researchers (11% to 21%) occurred in the General Teaching category.

By 1989, a much clearer vision of the process and the products had emerged. The orientation session lasted three hours in the summer of 1989 as compared to one hour in the summer of 1988. Representatives of the AFT as well as the LRDC community articulated the task and the role the teachers were expected to play in accomplishing the task, described the goals of the project, and conveyed their views on how the project fit with the goals of their respective institutions. Although we cannot draw direct causal relationships, we believe the difference in orientation sessions as well as the restructuring of the focus of the dialogues may have influenced the decrease in time spent on the task and, thus, in turn, influenced the increase in time spent discussing general teaching.

To summarize, collaborations between researchers and teachers are complex, time consuming activities. Grounding the dialogue and the tasks in a context that builds on the knowledge base of the teachers and one in which their expertise can contribute to the dialogue seems to facilitate the process. When conversations focus on teaching and learning mathematics, then the research findings which provide new information about effective instruction can be interpreted by the teachers in the light of their practitioners' expertise. When workshop sessions emphasize informal, collegial conversations, more equal contributions to the discussions are facilitated. In contrast, a less effective model seems to be one in which the teacher is exposed to information about research presented by a researcher in much the same

fashion as students are exposed to information by teachers. The structure implemented in the summer of 1989 seems to encourage active participation by teachers and productive interactions between researchers and teachers. In addition, the combination of changes instituted for the 1989 workshop facilitated increasing the proportion of the conversations that dealt with mathematics the substantive content of the project.

We take these data as evidence that progress toward our goal of establishing a true collaboration was greater in the second year than in the first. We conclude that the changes instituted helped to build an environment in which ideas about teaching specific mathematics content could be discussed and in which collaboration could be facilitated by constructive discourse.

In 1989, the product, a document summarizing the original research, became a synthesis of the ideas discussed during the summer. The time and energy required to develop such a product, however, was significantly more than predictions made early in the project. The knowledge gained during the summer workshop and the refinement of those ideas continued throughout the 1989-90 school year as the collaboration between researchers and teachers continued. The synthesized ideas were articulated in a resource document written for teachers by the workshop participants. The document is entitled *Thinking Mathematics, Vol I Counting, Addition, and Subtraction*. In addition, training materials were developed and used in August of 1990 by the teachers to disseminate the research ideas to colleagues in six sites around the country through the AFT's Educational Research and Development network. During the 1990-91 school year, collaboration continues among the AFT, the teachers, and the researchers to revise and refine this first volume. A second round of collaborative efforts began in the summer of 1990 on the topics of multiplication, division, problem solving, number sense, and estimation. A

second resource document, *Thinking Mathematics, Vol. 2 Multiplication and Division*, is currently in the development stage.

Developing respect, trust, and a collegial relationship so that new knowledge can and will be utilized takes considerably more time and effort than originally thought. Interpreting research for instructional practice and actually implementing change seems to be possible when the model of collaboration encourages an environment with an orientation toward informality, collaborative planning, and the teachers' area of expertise and when the collaboration continues with support and follow up over an extended period of time.

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APPENDIX A

Sampling Design

The videotape data base consisted of a set of 11 videotapes from the summer workshop of 1988 and a set of 18 videotapes from the summer workshop of 1989. Using a Panasonic AG-500 Monitor/Player, a catalogue of the events on each tape was created, identifying the general dialogue that was occuring on the tape by date, time, counter numbers, and speakers. From this catalogue listing, events recorded on the videotapes were classified by counter numbers as belonging to one of the following categories: orientation sessions, guest lecture seminars, author sessions, teacher/researcher dialogues, or planning/evaluation sessions. Any segments of tape that contained non substantive events (e.g., participants coming into or leaving a room, social discussions unrelated to workshop activities) were eliminated from the sampling pool. Each section of videotape belonging to a particular category was divided into segments of 100 counter units (100 was selected because it designates approximately five minutes of videotape). For each year, the total number of segments for the entire sample as well as the proportion of the sample in each category was calculated. Ten percent of the total number of segments was deemed appropriate and manageable as a sample size to analyze.

The overall sample size of 105 (44 for 1988 and 61 for 1989), was proportionally distributed over the five categories based on the percent of the total amount of tape assigned to each category within each year. Table A-1 shows the distribution of samples across categories.

Table A-1

Distribution of samples across categories

Category	1988		1989	
	Percent of recorded tape	Sample size/total # of tape segments	Percent of recorded tape	Sample size/total # of tape segments
Orientation	3	1/14	5	3/30
Seminars	29	13/123	38	24/233
Dialogue	29	13/123	12	7/70
Authors	26	11/109	28	17/173
Planning/Evaluation	13	6/53	17	10/102
Total	100	44/422	100	61/608

For example, line three of the table shows that during the 1988 summer workshop 29 percent of the videotape recorded sessions dealt with dialogues between researchers and teachers. Consequently, 13 segment units were selected as a sample (29% of 44 = 13). For the 1989 tapes, dialogues constituted 12 percent of the recorded sessions. Consequently, seven segment units (12% of 61 = 7) were selected for sampling. A systematic sampling procedure, based on the sampling units of 100 counter segments was employed to select the sample segments. In order to identify the exact segment of tape used in the sample, the first phrase of speech for each segment as well as the beginning and ending counter numbers were recorded when the coding occurred.

Table 1

Summary of percent of discourse contributed by different groups and the content of that discourse during the 1988 and 1989 workshops

	1988	1989
WHO		
Researchers	76%	57%
Teachers	21%	30%
AFT	0%	12%
Silence	3%	2%
WHAT		
Mathematics	25%	43%
Other	72%	55%
Silence	3%	2%

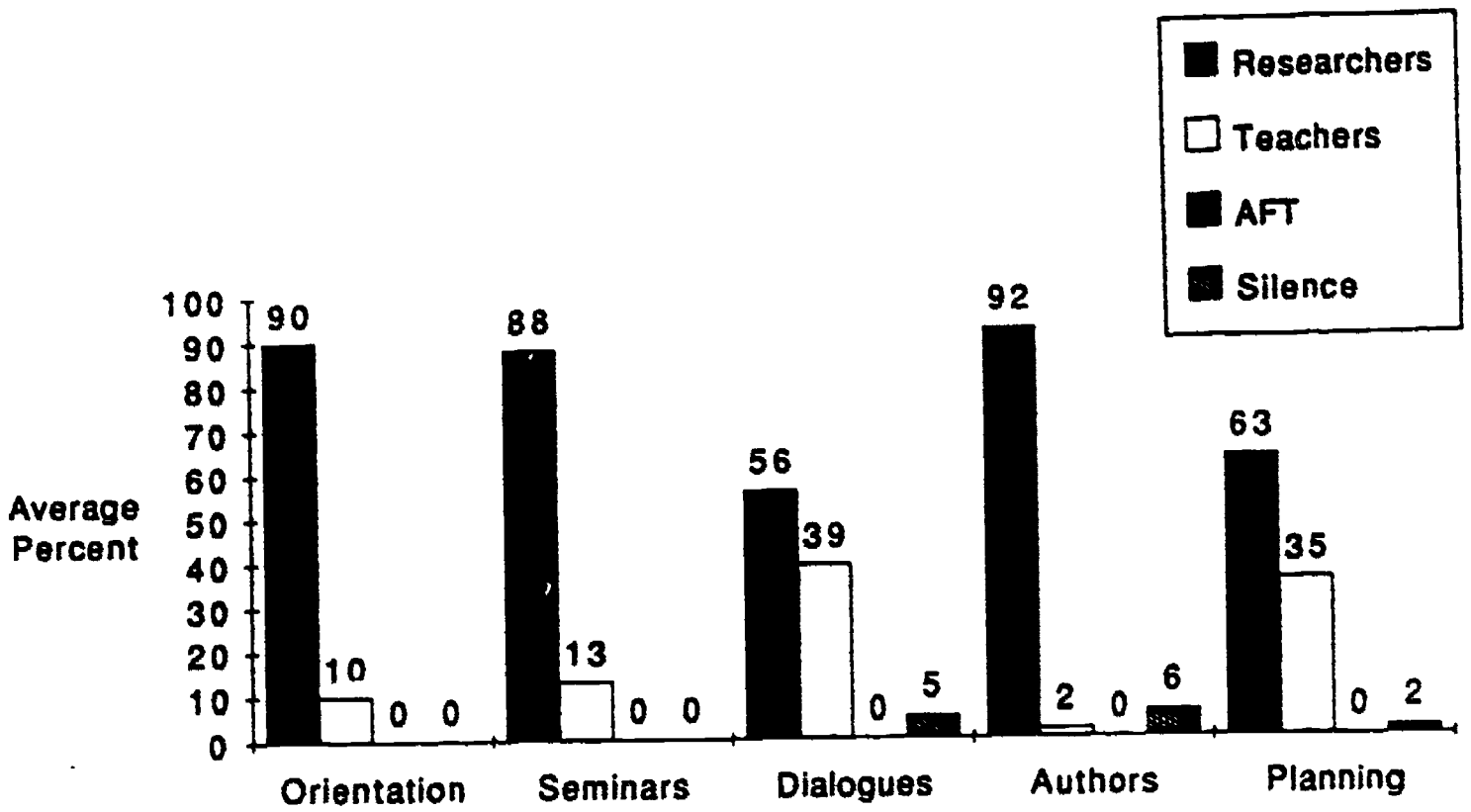

Figure 1. 1988 Summer Workshop: Comparison of amount of discourse contributed by various groups in different sessions

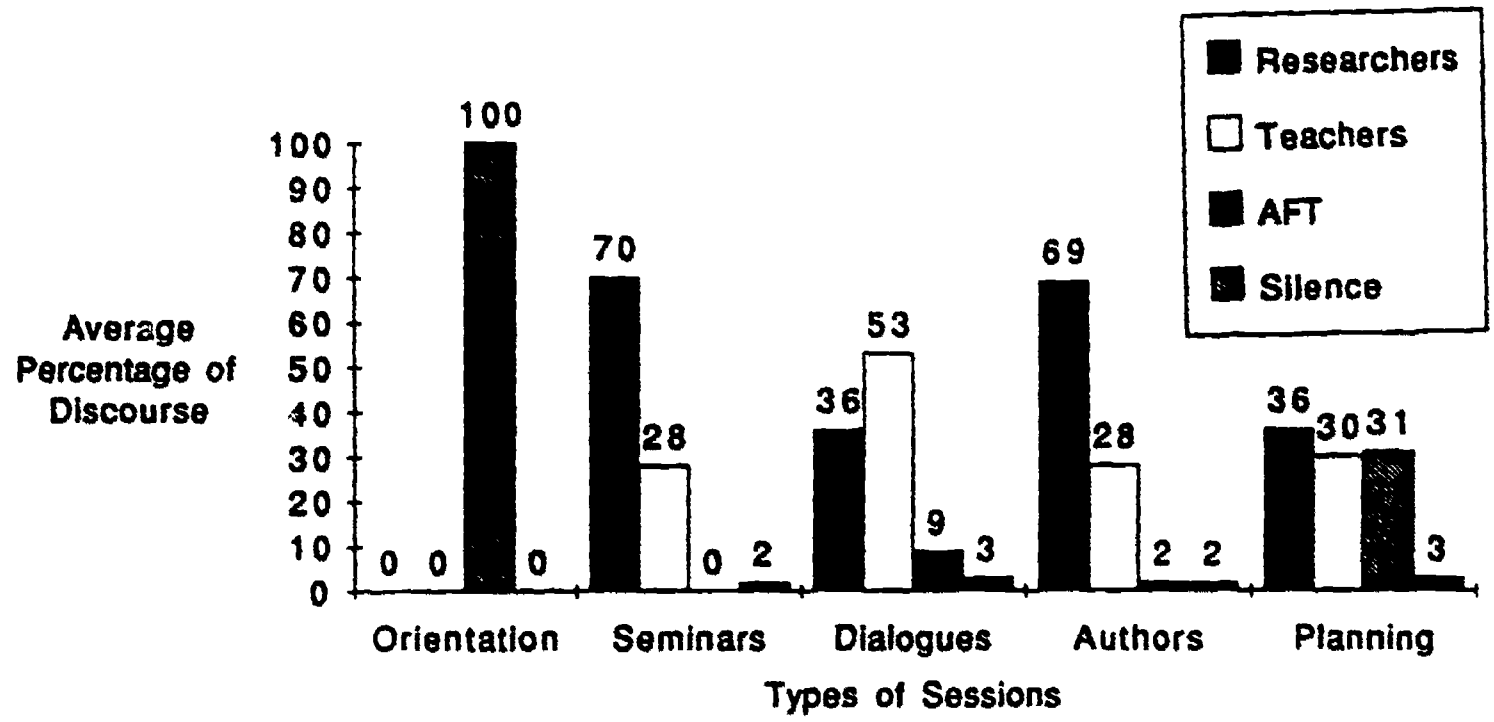

Figure 2. 1989 Summer Workshop: Comparison of amount of discourse contributed by various groups in different sessions.

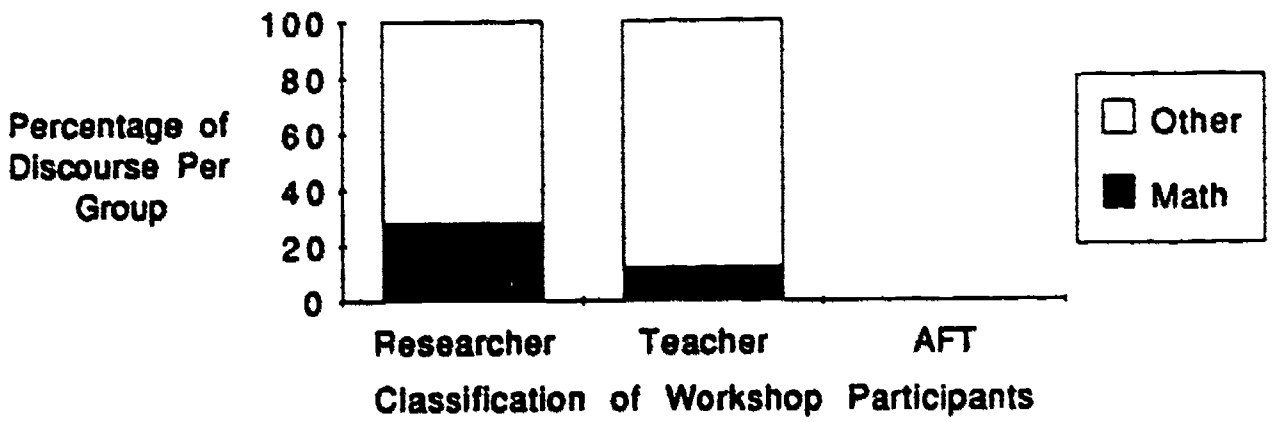

Figure 3. 1988 Summer Workshop: Comparison among Researchers, Teachers, and AFT representatives in terms of the amount of discourse related to Mathematics and the amount related to Other Topics.

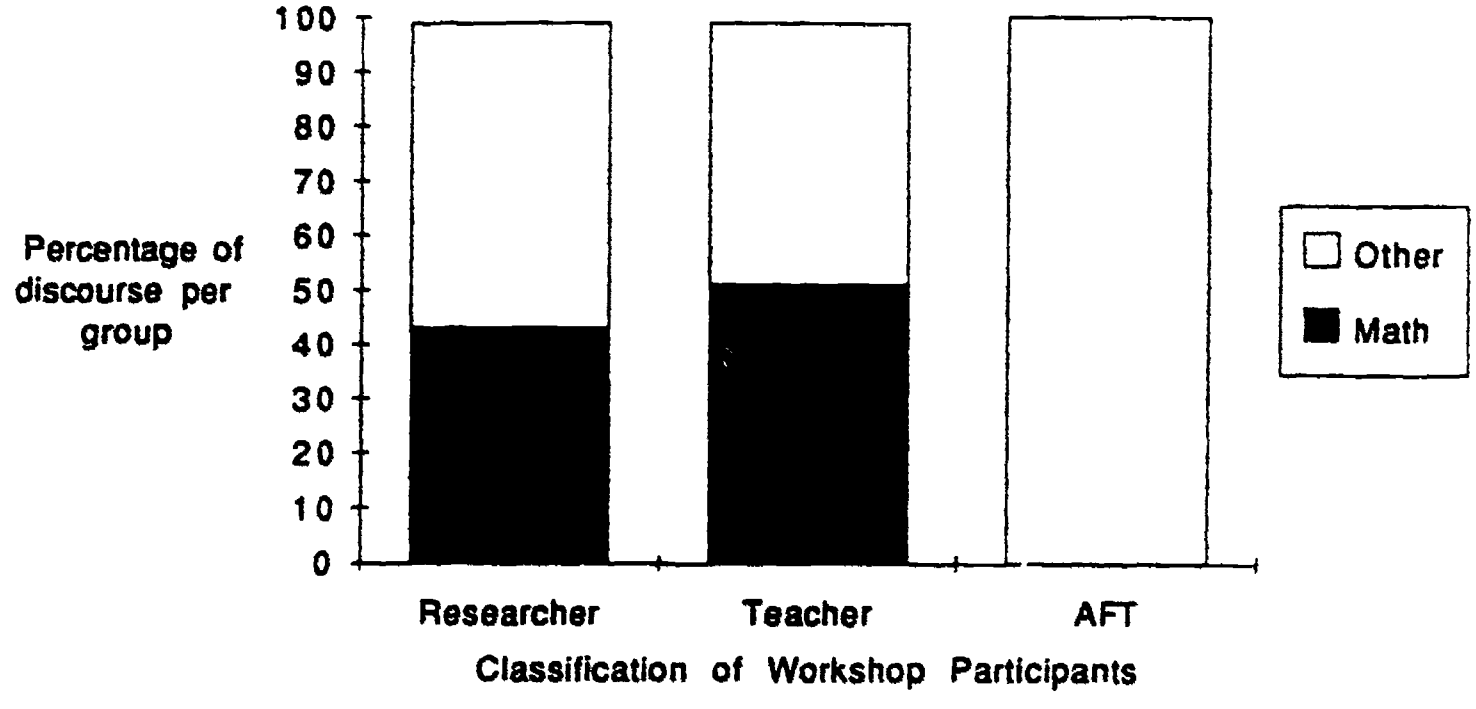

Figure 4. 1989 Summer Workshop: Comparison among Researchers, Teachers, and AFT representatives in terms of the amount of discourse related to Mathematics and the amount related to Other Topics.

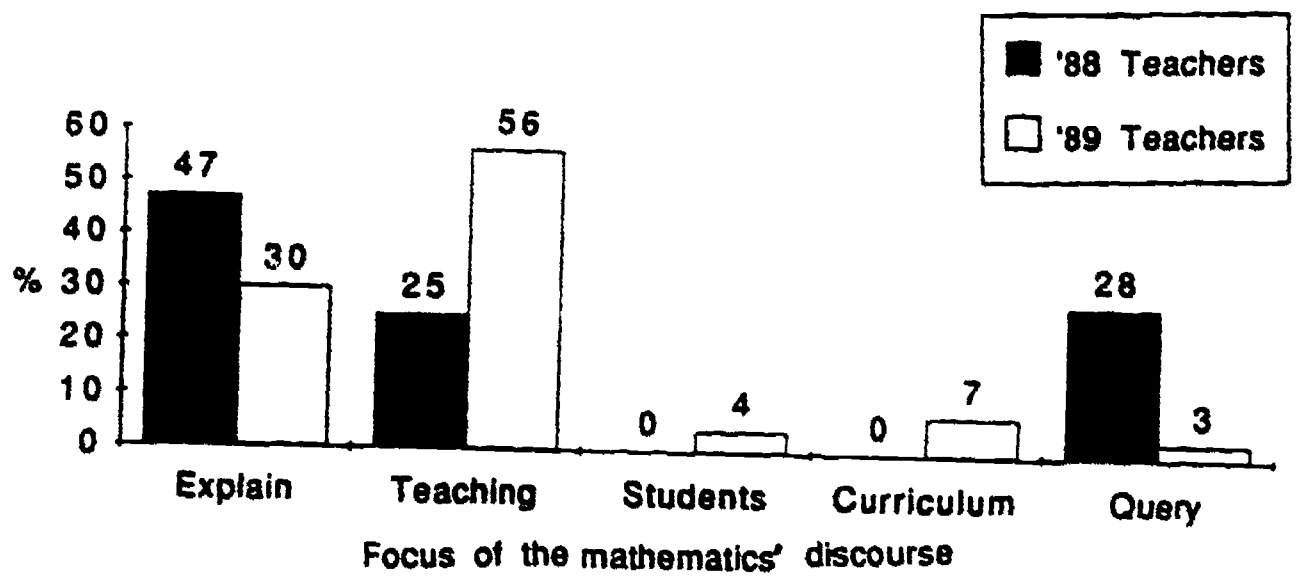

Figure 5. Comparison of 1988 and 1989 distribution of the focus of the discourse contributed by teachers which was related to mathematics.

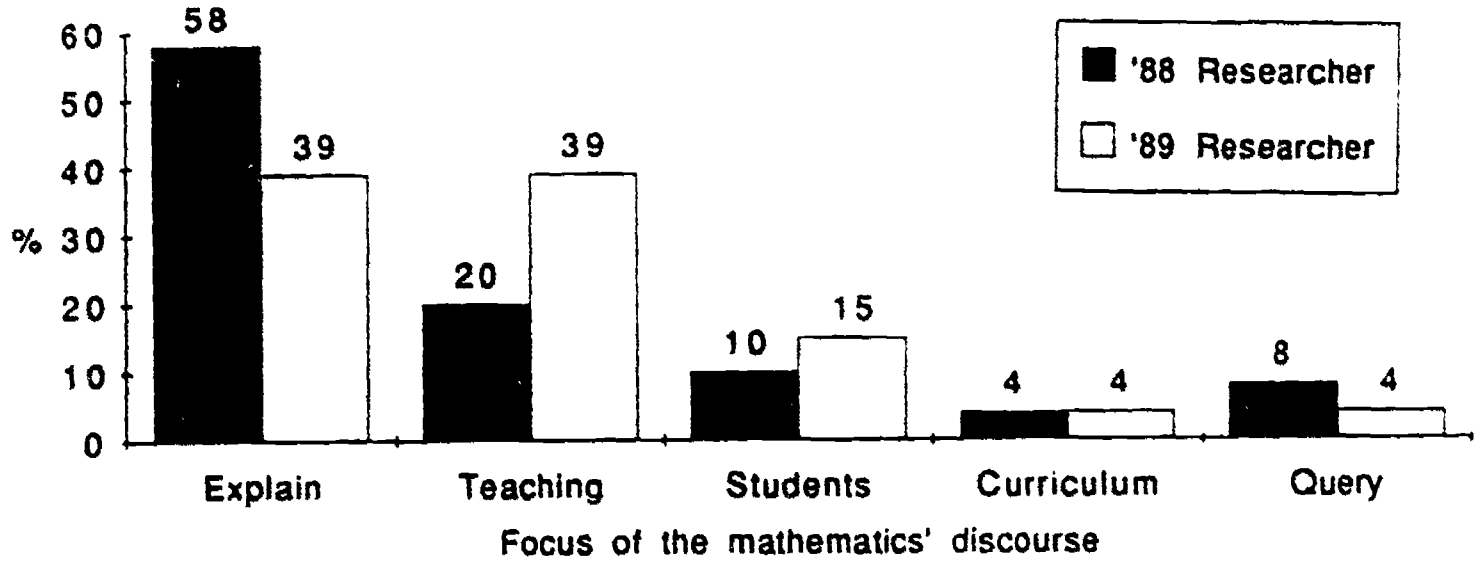

Figure 6. Comparison of 1988 and 1989 distribution of the focus of the discourse contributed by researchers which was related to mathematics

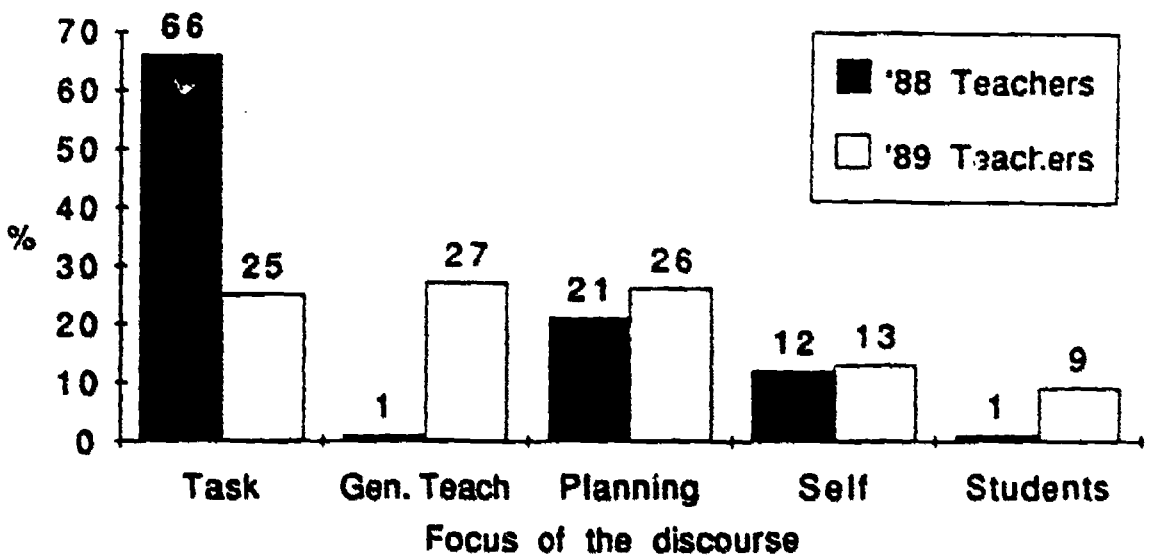

Figure 7. Comparison of 1988 and 1989 distribution of the focus of the discourse contributed by teachers which was related to topics other than mathematics.

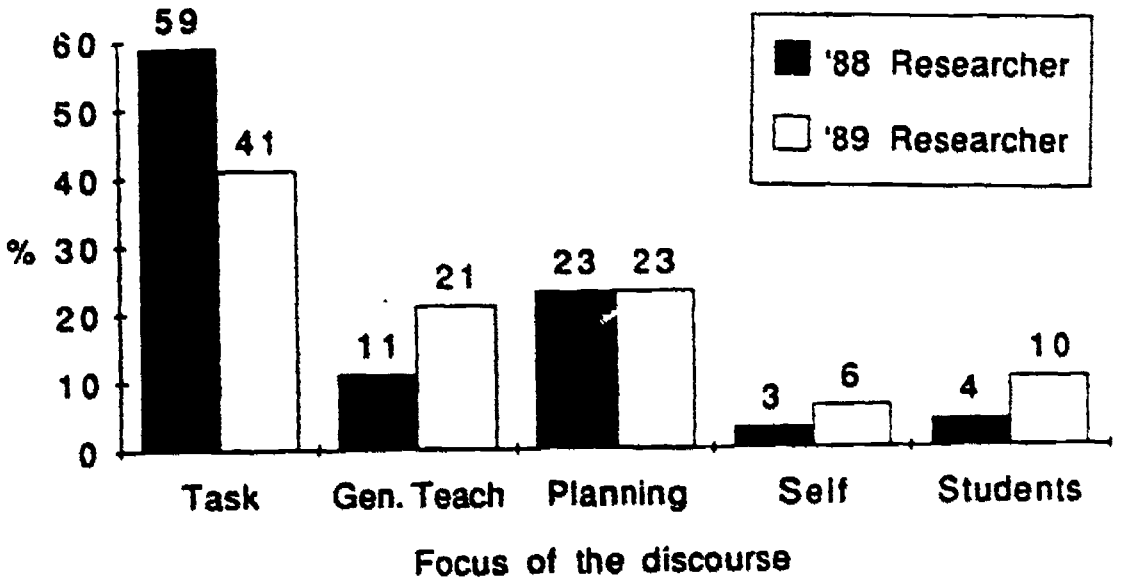

Figure 8. Comparison of 1988 and 1989 distribution of the focus of the discourse contributed by researchers which was related to topics other than mathematics.