THE USE OF RESEARCH TO INFORM THE EVALUATION OF THE MARYLAND COLLABORATIVE FOR TEACHER PREPARATION

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Introduction

This paper presents a reflection on how the research conducted by a Research Group in Maryland Collaborative for Teacher Preparation (MCTP) informs the evaluation of the project. The MCTP is the only funded project within NSF Collaboratives for Excellence in Teacher Preparation Program (CETP) program that includes in its organizational structure both an Evaluation Group and a Research Group. This reflection by the Co-Directors of MCTP Research is conducted as a way to generate grounded theory [1] that will contribute new insight into the role of research and evaluation in CETP projects, in particular, and in all funded education projects, in general.

Structurally, the paper is presented in three sections. An overview of the MCTP and the MCTP research program are presented in the first section. Next, a review of the literature on evaluation and research is conducted in section two. Two sources for this review are NSF documents and publications of evaluation theorists. Lastly, in section three, reflections-on-practice of the use of MCTP research to inform evaluation are presented by the MCTP Co-Directors of Research.

Section One: An Overview of the MCTP and the MCTP Research Group

The MCTP

The MCTP is a National Science Foundation (NSF) funded statewide undergraduate program for students who plan to become specialist mathematics and science upper elementary or middle level teachers. The MCTP was funded originally in 1993 for up to a five year period, and in 1998 was funded for an additional three years. It is a project in the NSF Collaboratives for Excellence in Teacher Preparation Program (CETP) program. The CETP program "supports large scale systemic projects designed to significantly change

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teacher preparation programs on a state or regional basis and to serve as comprehensive national models" [2]. Teacher candidates selected to participate in the MCTP program are, in general, representative of all teacher candidates in elementary teacher preparation programs in academic ability. MCTP teacher candidates are distinctive, however, by expressing an interest in teaching mathematics and science. Recruitment efforts have attracted many students traditionally underserved in the teaching force, most notably African Americans to the MCTP.

The goal of the MCTP is to promote the development of professional teachers who are competent to teach mathematics *and* science using technology, who can make connections between and among the disciplines, and who can provide an exciting and challenging learning environment for students of diverse backgrounds. This goal is in accord with the educational practice reforms advocated by the major professional mathematics and science education communities ([3] [4] [5]).

The MCTP was funded to create teacher education programs that contain (Figure 1, facing page):

- Specially designed courses in science and mathematics, taught by instructors committed to a hands-on, minds-on interdisciplinary approach.
- Internship experiences with research opportunities in business, industrial and scientific settings, and with teaching activities in science centers, zoos, and other institutions.
- Field experiences and student teaching situations with mentors devoted to the interdisciplinary approach to mathematics and science.
- Modern technologies as standard tools for planning and assessment, classroom and laboratory work, problem-solving and research.
- Placement assistance and sustained support during the induction year in the teaching profession.
- Financial support for qualified students.

Higher education institutions involved in this project include the majority of higher education institutions within the Maryland System responsible for teacher preparation. These include Bowie State University, Coppin State College, Frostburg State University, Morgan State University, Salisbury State University, Towson State University, University of Maryland Baltimore County, University of Maryland, College Park, and the University of

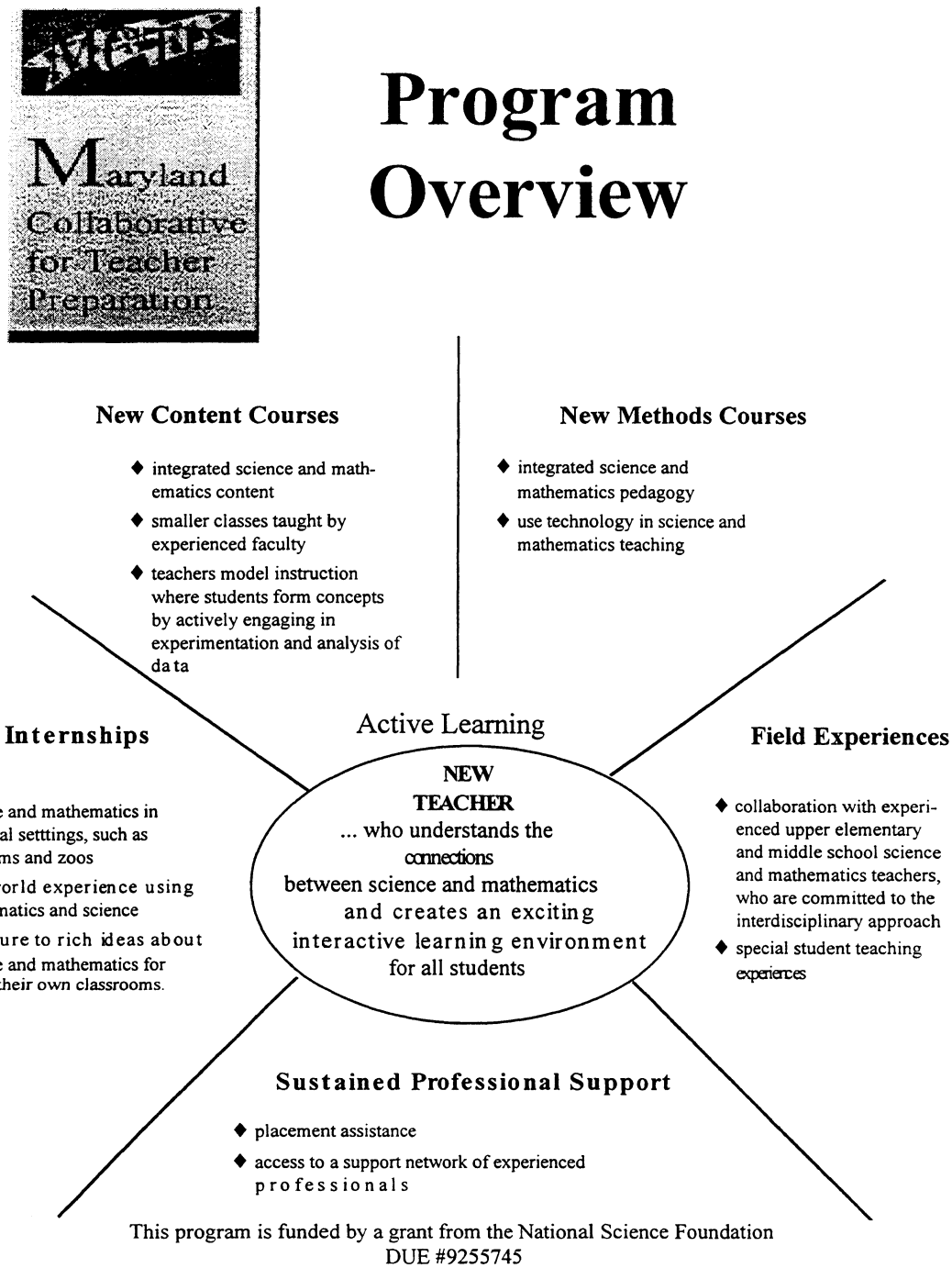

Figure 1. Program overview of the Maryland Collaborative for Teacher Preparation

Maryland Eastern Shore. Several community colleges also participate, including Baltimore Community College, Catonsville Community College, Prince George's Community College, and Anne Arundel Community College. In addition, large public school districts are active partners. These include these county public school districts: Prince George's, Montgomery, Baltimore, Baltimore City, and Allegany.

In practice, the MCTP undergraduate classes are typically taught by senior faculty in mathematics, science, and education who base primarily their course curriculum and instruction on two outcomes: 1) developing understanding of a few central concepts, and 2) making connections between the sciences and between mathematics and science. Faculty lecture is diminished and student-based problem-solving is emphasized which requires cross-disciplinary mathematical and scientific applications. These instructional strategies are thought within the context of the MCTP to be compatible with the constructivist perspective as recommended by the literature (e.g., student-centered, address conceptual change, promote reflection on changes in thinking, and stress logic and fundamental principles as opposed to memorization of unrelated facts) [6] [7]. In addition, faculty strive to infuse technology into their teaching practice.

The MCTP teacher candidates, selected by using criteria developed at each institution who provide evidence of an expressed commitment to specializing in the teaching of mathematics and science along with academic success in the learning of mathematics and science in precollege and college level courses, take the MCTP reformed undergraduate mathematics, science, and education courses offered at their campus. Furthermore, MCTP teacher candidates have the opportunity to apply for summer apprenticeships in Maryland mathematics and science rich environments under the guidance of a mentor at the site. A sampling of participating summer intern sites in 1998 included: Applied Physics Laboratory; Assateague Island National Seashore; Chesapeake Biological Laboratory; Horn Point Environmental Laboratory; Maryland Department of Natural Resources; NASA Goddard Space Flight; and the National Oceanic and Atmospheric Administration.

The MCTP Research Group

The proposal submitted to the NSF for the MCTP project included statements for both an Evaluation Group and a Research Group [8]. As typical, the proposal included a "Support

Group for Project Evaluation" section that stated that the project would conduct formative and summative evaluation. Innovatively, the proposal also included a "Support Group for Research on Teacher Education" section that stated the "project's innovative approaches to teacher preparation will be studied by a research group...." (p. 19). These two support groups were displayed in a diagram that delineated their roles in the project structure (see Figure 2).

In essence, the primary purpose of research in the MCTP was articulated as the documentation and interpretation of the MCTP undergraduate mathematics and science teacher education program. The unique elements of the MCTP (particularly the instruction of mathematical and scientific concepts and reasoning methods in undergraduate content *and* methods courses that model the practice of active, interdisciplinary teaching) were targeted for longitudinal study from two perspectives: the faculty and the teacher candidate.

The research questions which were included in the grant proposal were:

1. What is the nature of faculty and teacher candidates' beliefs and attitudes concerning: the nature of mathematics and science; the interdisciplinary teaching and learning of mathematics and science to diverse groups (both on the higher education and upper elementary and middle level); and the use of technology in teaching and learning mathematics and science?
2. How do the faculty and teacher candidates perceive the instruction in the MCTP as responsive to prior knowledge, addressing conceptual change, establishing connections among disciplines, incorporating technology, promoting reflection on changes in thinking, stressing logic and fundamental principles as opposed to memorization of unconnected facts, and modeling the kind of teaching/learning they would like to see on the upper elementary, middle level?

Answers to those questions were thought to inform the following research questions driving teacher education research in all subject domains:

1. How do teacher candidates construct the various facets of their knowledge bases?
2. What nature of teacher knowledge is requisite for effective teaching in a variety of contexts?
3. What specific analogies, metaphors, pitfalls, examples, demonstrations, and anecdotes should be taught content/method professors so that teacher candidates have

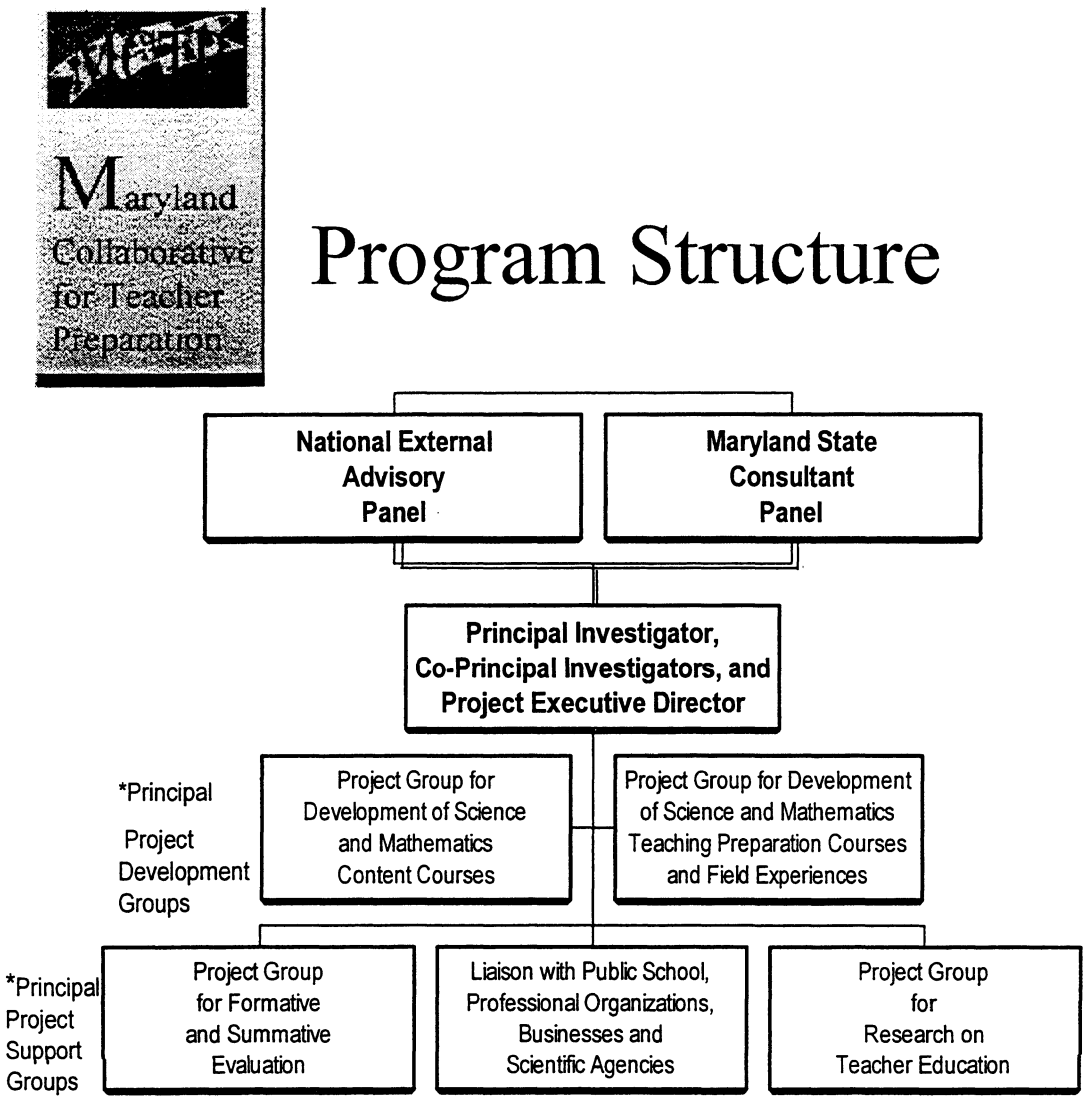

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Figure 2. Program structure of the Maryland Collaborative for Teacher Preparation

some knowledge to associate with specific content topics?

While the original research questions served to orient the Research Group to the larger questions that need answers, over time additional research questions have emerged in response to the interest of members of the Research Group and in response to specific inquiries made by the NSF about the project:

1. Is there a difference between the MCTP teacher candidates' and the non-MCTP teacher candidates' attitudes and beliefs about mathematics and science?
2. Do MCTP teacher candidates' attitudes toward and beliefs about mathematics and science change over time as they participate in the MCTP classes?
3. How do the MCTP faculty perceive their own discipline as well as the other discipline (mathematics/science) with which they seek to make connections?
4. How do college faculty "model" good instruction in mathematics and science methods courses for teacher candidates and how is that perceived by the teacher candidates?
5. How do new specialist teachers of mathematics and science who graduate from an inquiry-based, standards-guided innovative undergraduate teacher preparation:
   (a) view their subject disciplines;
   (b) enact their roles as teachers; and,
   (c) think about what they do when teaching science and mathematics with upper elementary/middle level students?

During the last five years, the MCTP Research Group has actively enacted a research program characterized by a multitude of diverse studies to answer these questions. Both hypothesis-testing and hypothesis-generation [9] research strategies have been used. Specific studies completed and ongoing as of this date include:

1. A Statistical Examination Of College Students' (Both MCTP Teacher Candidates And Other) Responses To A MCTP Attitude And Belief Survey On Mathematics And Science And The Teaching Of Those Subjects
2. A Discourse Analysis Of University Science And Mathematics Content Specialist And Pedagogy Professors' Perceptions About The Others' Discipline And Their Own
3. A Case Study Of Reform-Based Undergraduate Mathematics Teaching And Learning From The Professor And Teacher Candidate Perspectives
4. A Qualitative Analysis Of Faculty Perceptions On Modeling Making Connections

Between Mathematics And Science In An Innovative Undergraduate Teacher Education Program

5. A Qualitative Analysis Of Teacher Candidate Perceptions On Faculty Modeling Making Connections Between Mathematics And Science In An Innovative Undergraduate Teacher Education Program
6. An Action Research Analysis Of A Science Methods Professor Modeling Making Connections Between Mathematics And Science In An Innovative Undergraduate Teacher Education Program
7. A Case Study Of Six MCTP Teacher Candidates In Student Teaching
8. A Case Study of Five MCTP New Teachers in the Workplace (ongoing)

The MCTP supports an internet site (http://www.wam.umd.edu/~toh/MCTP.html) which provides information on the MCTP Research Group including full copies of the research reports.

Section Two: What Does the Literature State About the Role of Evaluation And Research?

To understand the intellectual contexts within the NSF and evaluation theorist communities that make it unusual for the MCTP to maintain both an Evaluation and a Research Group, it is helpful to conduct a selective literature review. This review first explicates how in its documents the NSF has defined evaluation and research. Second, this review summarizes how evaluation theorists have defined evaluation research, particularly the more contemporary view that argues for linkages between the two. Following this review, in Section Three, the researchers' reflections on how the research in the MCTP has informed the evaluation can then be assessed as to its contribution to the contemporary discussion on the relationship between evaluation and research.

National Science Foundation Documents

In 1981, The Joint Committee on Standards for Educational Evaluation defined evaluation as the "systematic investigation of the worth or merit of an object" [10]. The evaluation required by the MCTP to perform as a funded NSF project is described in the following manner:

Project evaluation...focuses on an individual project funded under the umbrella of the

> program. The evaluation provides information to improve the project as it develops and progresses. Information is collected to help determine whether it is proceeding as planned; whether it is meeting its stated program goals and project objectives according to the proposed timeline (p. 11).

Research in the same document is defined broadly as "the general field of disciplined investigation" (p. 95). The general tone of this NSF document is that evaluation is conducted in a three step process (planning, formative, and summative) with a focus on quantitative data.

In a more recent NSF document on evaluation, there is a broadening of acceptance for evaluation data to include qualitative information in a mixed-methodological design [11]. Interestingly, words by Cronbach are included in that document which acknowledge that,

> There is no single best plan for evaluation, not even for an inquiry into a particular program at a particular time, with a particular budget [12].

Publications of evaluation theorists

According to Worthen and Sanders, research and evaluation are nothing more than hypothetical constructs that provide us the conceptual space "to speak with consistency about certain approaches to the production of information or knowledge" (p.22) [13]. The difference between research and evaluation is apparent, "Research has many of the trappings of evaluation and shares with it many common activities, but it lacks evaluation's explicit judgments of quality" (p. 23).

Similarly, for Smith and Glass the difference between research and evaluation is unambiguous. They state that research is "the disciplined search for knowledge" (p. 6) while "evaluation is the process of establishing value judgments based on evidence about a program or a product" (p. 30) [14].

Guba and Lincoln [15] propose a dramatic "mature" reconceptualizaton of evaluation which they term "fourth generation evaluation" (p. 8). This evaluation is based on two elements: responsive focusing and constructivist methodology. Responsive focusing requires determining "what questions are to be asked and what information is to be collected on the basis of stakeholder inputs" (p. 11). Constructivist methodology means "carrying out the inquiry process within the ontological and epistemological presuppositions of the constructivist paradigm" (p. 11). The product of the evaluation is not a set of value

judgments, but "rather an agenda for negotiation" of those claims, concerns, and issues not previously resolved. (p. 13). Guba and Lincoln, while never mentioning research directly, do discuss various "inquiries" (p. 163) which have differing purposes. One inquiry is to add knowledge or understanding in some way. An other inquiry is intended to assess some state of affairs. Their version of evaluation seeks to "eliminate the distinction between basic and applied inquiry" (p. 264). Interestingly, they claim that new roles emerge for evaluators in this fourth generation evaluation. While the traditional roles of evaluators were technician, describer, and judge, the fourth generation evaluator would take on the roles of "human instrument and human data analyst," (p. 259) illuminator and historian, mediator of the judgment process, collaborator, learner and teacher, reality shaper, and change agent.

A recently well-received publication edited by Chelimsky and Shadish [16] provides thoughts on evaluation and research which promise to resolve the confusion of the roles of evaluation and research. Chelimsky [17], while continuing to acknowledge the traditional role of evaluation as determining the "efficiency of programs, projects, and their component processes," also appears to support Guba and Lincoln's reconceptualization of evaluation by recognizing evaluation as a process to "gain explanatory insights into social and other public problems and into past and present efforts to address them" (p. 9). The claim now is that "all of these purposes are legitimate" (p. 9). The different purposes are thought to fall into three general perspectives: evaluation for accountability (measurement of results or efficiency); evaluation for development (information collected to strengthen institutions); and evaluation for knowledge (acquisition of a more profound understanding in some specific area or field (p. 10). The role of the evaluator (distant to close) is dependent on which evaluation perspective is taken. Finally, key attributes of evaluation are for it to

> Keep its skepticism about the conventional wisdom, its meticulousness about measuring achievements, its willingness to be persistent about getting the information out, and its dedication to democratic reform on the basis of knowledge (p. 25).

Section Three: Reflections-On-Practice In The MCTP

In the context of the continuing debate over the appropriate role of evaluation and research in large scale teacher enhancement projects such as the MCTP, we offer insights constructed from our five years of lived-in-practice as Co-Directors of the MCTP Research Group. Our insights regarding the evaluation and research efforts within the MCTP are presented as three researcher assertions. We believe these thoughts, in particular, underscore

the extent in which the three purposes of evaluation as explicated by Chelimsky and Shadish help to give direction to project investigators as they seek to fulfill NSF requests for accountability while simultaneously generating new knowledge on mathematics and science teacher preparation programs.

Assertion One: *By necessity, a Research Group's work is a public activity within a project; Conversely, an Evaluation Group's work tends to be a private activity.*

Because the Research Group focused on understanding the innovative teacher education program developed by the MCTP project from the participants' perspectives, our main research activity was to listen to the various stakeholders of the project: MCTP university/college faculty, MCTP teacher candidates, and MCTP mentor teachers. Moreover, because our aim was to share our findings with a wider audience, we needed to make sure that our analyses of data collected from MCTP participants were accurate and trustworthy. To do this, we often shared our tentative findings with the participants. This sharing sometimes happened in a group setting, such as a separate research reporting session during the summer MCTP conferences. Other times, we simply talked with individuals after they had a chance to read the MCTP research reports we mailed to them. Also, since so many participants in the project contributed data to our various studies, we found it beneficial to share our research reports expeditiously over the project's internet site. This public sharing also enabled interested parties outside of our project to share in our research findings.

On the other hand, the activities of the Evaluation Group remained essentially private. Members of the MCTP Evaluation Group did observe a number of MCTP designed/influenced mathematics and science courses, with the instructors permission, but oftentimes the instructors were the only ones who knew that the evaluators were visiting these courses. The MCTP evaluators' reports were provided to the MCTP Project Director who used them to guide the project and to write yearly reports for the NSF.

Assertion Two: *The efforts of a Research Group can inform the evaluation within a project although tensions remain if the sole purpose of evaluation is perceived as for accountability.*

Although most (if not all) of the MCTP participants came to accept the major premises of the MCTP philosophy underlying the teaching and learning of mathematics and science, many of them still wanted to have a third party "objectively" assess their activities. Many of

these participants turned to the Research Group for such an assessment, in part because the MCTP Research Group was highly visible within the project, in contrast to the Evaluation Group members. In addition, the MCTP PIs began publicly to portray the Research Group activities as a *part* of the evaluation of the project. At the beginning of the project, the MCTP Research Group conceived the roles of such an assessment to be in the domain of the Evaluation group. However, as we became more familiar with the perspective put forward by Guba and Lincoln and by Chelimsky, we, as a group, became more willing to accept that perspective of the role of evaluators. More specifically, we felt that we have something to offer in terms of evaluation for development as well as knowledge. Unfortunately, the MCTP participants, as well as the project leadership, often came with the view of a more traditional view of evaluation, evaluation for accountability. Sometimes, they wanted evaluation to inform their instructional activities (evaluation for development); however, they often expected quantitative/statistical data, comparing what they do against control groups. On the other hand, although the Research Group members became more willing to accept their activities as a type of evaluation, the main focus of the group remained on evaluation for knowledge. This mismatch of foci created some tensions between the interests of the Research Group and the MCTP participants, including the project leadership. This tension most often emerged as minor differences of opinion concerning which type of studies were of most important to conduct: studies that measured project impact as compared to exploratory studies.

Assertion Three: *While the information that most shapes the PIs daily decisions about the project comes from the internal Evaluation Group, many of the PIs state that a lasting legacy of project is the Research Group products.*

Due to the demands placed on the MCTP project by the NSF to collect and report data for accountability purposes, from our perspective the Evaluation Group shaped more of the project leadership's daily decisions than did the Research Group. However, the project leadership expressed appreciation for the Research Group's products as leaving a lasting legacy of the project. In a project characterized by lasting and widespread impacts difficult to measure and touch (such as faculty transformation) as opposed to more tangible products (such as new curricula), the reports by the Research Group offer hope that over time a record will be available documenting the energies devoted to the MCTP. This type of appreciation of the Research Group's efforts was supportive since the time required to collect data, analyze them, and report back to the project limited the immediate impact of the Research Group's

finding on the project.

Conclusion

We began our experiences viewing evaluation and research as two distinct, often incompatible, activities. However, our view of evaluation has broadened. We are now in agreement with the view that there are multiple purposes and perspectives of evaluation. Evaluation for accountability, which is often thought to be the primary purpose of evaluation, is important and necessary. However, evaluation for development can be of extreme value to the participants in a CETP project, or any large scale teacher preparation project. Moreover, evaluation for knowledge will inform a much wider audience, resulting in long lasting benefits to the educators beyond the specific project. Thus, it appears reasonable that future programs address these multiple perspectives in their evaluation activities. Therefore, we believe that the traditional conception of a dichotomy of evaluation and research should be recast. We concur with Chelimsky (with acknowledgment to Guba and Lincoln for initially challenging our thinking) that a more fruitful conceptualization for future evaluation activities is one based on multiple purposes: accountability, development, and knowledge generation.

Finally, in consideration of the best of all worlds, our experience leads us to strongly advocate for two separate groups working on different purposes of evaluation, such as we have enjoyed in the MCTP. The reason we hold this belief for two separate inquiry groups termed "Evaluation" and "Research" is the concern we hold for the quality of data. We believe that if one team handled all three purposes of evaluation as presented by Chelimsky [17] it would be difficult to obtain the rich valid data we have obtained from our project participants. It was our experience as members of a separate Research Group that the participants were open and honest with us. This form of openness and honesty was a refreshing difference from the guarded responses participants oftentimes offer those whom they see as evaluating them solely for the purpose of accountability. ■

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