

AN UNDERGRADUATE INTERN MODEL FOR MATHEMATICS TEACHER PREPARATION

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Introduction

Efforts to improve mathematics and science education are an important issue for our nations' schools. There has been an increased awareness of the need to do this with the release of the Third International Mathematics and Science Study (TIMSS) [1]. An important component of this effort is the corresponding updating of science and mathematics teacher preparation programs. The National Science Foundation has invested significant resources to stimulate the progress of reform in science and mathematics teacher preparation through several programs including Course and Curriculum Development, Undergraduate Faculty Enhancement, the Collaboratives for Excellence in Teacher Preparation and others. California State University, Chico, with NSF support (DUE-9354776), has developed and institutionalized a promising new teacher preparation model for middle and high mathematics teachers. This article contains a full description of the Chico model together with some preliminary findings on its impacts.

The traditional model for obtaining a teaching credential in California normally consists of content coursework for the first four years culminating in a Bachelor's Degree, followed by a "fifth year" certification program that includes student teaching. Those who are planning to teach at the middle or high school level usually get an undergraduate degree in their specific discipline. Hence, future middle and high school teachers of mathematics in the State of California generally obtain an undergraduate degree in mathematics and then go on to earn a single subject credential. This credential allows them to teach mathematics at both middle and high school levels. At this time California does not have a statewide program that certifies teachers to teach only at the middle school level as some states do.

The Chico model we will describe is one that is embedded into the undergraduate mathematics degree within the mathematics education option (the one for prospective mathematics teachers). The model consists of three new mathematics education courses together with a teaching internship for the prospective mathematics teachers, two new courses in developmental entry level mathematics based on proven secondary reform curriculum for entering freshman with mathematics deficiencies, and a faculty development program designed to attract and educate traditional mathematics faculty in reform pedagogy and curriculum. Following the new undergraduate experience, the preparing teachers still must complete the usual "fifth year" program. Initial assessment of this model provided through exterior consultants supported through the grant and through DUE's own "External Evaluation of NSF Undergraduate Course and Curriculum Development Program" are quite positive and support the need for additional research into the effects of the program. The primary groups effected by this reform initiative include university undergraduates in need of mathematics remediation, preservice mathematics education majors, and regular mathematics faculty.

The new preservice courses provide understanding of the philosophies, beliefs, objectives, methods, and pedagogy underlying current mathematics education thinking. These courses provide specific experiences facilitating lessons using various new reformed mathematics curricula at the middle and high school levels. Subsequent to their coursework, the preservice teachers are provided a highly structured field experience based on these ideas as they actually teach (under the supervision of mathematics education faculty), two new developmental courses. Coupled with this internship is a seminar conducted by the supervising faculty member. The materials used in the developmental courses are college versions of the Interactive Mathematics Program (IMP), a reformed secondary curriculum developed through NSF support at the Lawrence Hall of Science, UC Berkeley and San Francisco State University. The developmental audience is college students with entry-level mathematics deficiencies. Participating mathematics education instructors go through a comprehensive faculty development program consisting of in-depth teaching experiences with the IMP materials, team teaching new preservice courses together with experienced mentor faculty, and participation in seminars associated with the field experience for the preservice undergraduates.

Other Existing Programs

The NCTM Curriculum and Evaluation Standards [2] represent the first time that virtually all professional mathematics organizations have endorsed a set of national standards; middle and secondary level curriculum designed to meet these standards is only now becoming available. Consequently there is no history of preservice programs based on the new curriculum. That is not to say that there have been no projects that have attempted to implement mathematics education reforms as called for by NCTM. Of those projects that have been funded, most deal with in-service training rather than preservice. "Integrated Pedagogy and Content in Preservice Mathematics Teacher Education" (University of Georgia), "Improving Teacher Preparation in the Natural Sciences and Mathematics at Allegheny College", "Bridging the Gap Between Theory and Practice in Teaching Elementary School Mathematics: Using Research and Teaching in Reform Teacher Education" (Vanderbilt) , and "Preparing Teachers to Teach Mathematics: A Problem Solving Focus" (Indiana University) are examples of recently funded NSF projects targeting training and curriculum development for reform mathematics. Perhaps the project that is most similar to the Chico model is the "Middle School Science and Mathematics Teacher Preparation Project" at Northern Arizona University. They have developed a five year model for the preparation of middle-school science and mathematics teachers. Academic abilities and teaching skills are developed followed by a "capstone" experience wherein students teach a summer camp under the direct supervision of master teachers and university professors.

We expect the number of teacher preparation projects integrating NCTM recommendations to grow as there is a general recognition within the mathematics community that teacher preparation and preservice programs are in need of improvement in light of the significant advancements in mathematics education methods and pedagogy. However, after thorough searching, the authors have found no ongoing projects like the Chico project that significantly integrate a year of undergraduate level content and methods instruction with extensive and well supervised field service experiences as recommended by NCTM, MAA and AMS. Further, none have attempted to look at reform ideas as they apply to remediation at the same time as they have developed programs for preservice teachers.

The Need for Reformed Teacher Preparation

There is a major component that is conspicuously absent in the implementation of

mathematics reform ideas into our schools; not so much a "knowledge gap" but more of a gap in the conceptual flow in the reform effort—the transition of effective strategies from the inservice to preservice levels. Teacher preparation programs have not themselves incorporated the advocated methods and content of the reform.

"Too few mathematics teachers are prepared to teach the mathematics their students need." [3]

The U.S. Department of Education recently funded researchers to observe and interview graduates of teacher preparation programs for a three year period. Known as the "Salish" study, researchers chose nine institutions that are members of the Salish consortium, a group of over 50 institutions interested in reform of preservice programs in science and mathematics education. One of the results of this study was that few new teachers were prepared to teach conceptual (constructivist) mathematics or make mathematics relevant to students' lives, as recommended in the NCTM Standards [3].

While all the "methods" courses in the Salish study emphasized conceptual mathematics and science, the preservice students' mathematics and science courses primarily relied upon traditional instruction. Because there were no opportunities for preservice teachers to practice the reform pedagogies they learned in their "method" courses, teachers ultimately tended to instruct mathematics in the more traditional ways they experienced in their college mathematics and science courses. A further deterrent to incorporating reform pedagogies in their practice was the generally conservative pedagogical environment found in most high school mathematics departments [4].

Thus, even for those leading universities that do have valuable experiences for preservice teachers using cooperative groups, embedded assessment ideas, higher level thinking skills, learning from a constructivist's viewpoint, etc., there is a serious problem in providing field experiences that continue to develop these ideas. If a student is exposed to excellent preservice coursework and becomes knowledgeable about these reform ideas, but then goes on to student teach or intern in a "traditional classroom" rather than a "reform classroom", then that student will likely interpret what took place at the university as "ivory tower ideals". Rather than confirming the claims of current methods and curriculum, any suspicions that

classroom theories learned at the university may not really work at the practical level of middle and secondary teaching will be supported by their observations in the traditional setting. A traditional master teacher, uninformed in reform ideas, will further reinforce these suspicions. Hence, the transition to new mathematical ideas is stalled—or at the very least severely impeded. We need to train future teachers effectively so that they can (and WILL) immediately teach consistently with the goals and expectations put forth in the NCTM Standards. The NCTM *Professional Standards for Teaching Mathematics* [5] recognizes this and identifies the need for preservice teachers to be actively involved in learning environments that use our current knowledge base of mathematical learning during their teacher preparation. In addition, the Mathematical Association of America's Committee on the Mathematics Education of Teachers wrote:

"To change the teaching and learning of mathematics in the nation's schools, the preparation of teachers must also include developing an understanding of students as learners of mathematics, obtaining appropriate background in mathematical pedagogy, and constructing suitable classroom environments to foster learning by all students." [6]

Model Description

Curriculum for Preservice Undergraduates

A series of three new mathematics education courses is now being field tested and refined at California State University, Chico. The targeted audience is mathematics majors who are interested in teaching as a career. These courses are available early in the college experience of these students, normally in their sophomore or junior year. The prerequisite is successful completion of the first full year of calculus. The first two courses carry three semester units and the third carries four units.

The primary objective of the first of these newly developed courses is to provide the undergraduate students with the overall background of current mathematics education ideas as expressed in such documents as the TIMSS [1] report, and the NCTM Standards [2]. An expected outcome of this course is that students will obtain the necessary theoretical constructs that form the foundation for reform curriculum. To deliver these ideas, similar methodologies as used by the already proven California Mathematics Projects at CSU, Chico

for *in-service* training of veteran teachers is applied. This course (as well as the second and third) is based on a constructivist theory of teaching and learning and incorporates extensive use of cooperative groups, active use of manipulatives, and real applications of technology (in particular, graphing calculators). The first course is a blend of both mathematics content and pedagogy and has the theme of learning to think mathematically. The current course outline includes: mathematical problem solving, nature of mathematics, and conceptual understanding of mathematical ideas through manipulative approaches.

The second course takes the preservice students carefully through many examples of reform curriculum including the College Preparatory Mathematics Program, Core Plus, Connected Mathematics, Mathematics in Context, University of Chicago School Mathematics Project, Shell Centre materials and the Interactive Mathematics Program. The materials chosen serve the triple purposes of reinforcing middle and high school mathematics topics, illustrating new activities and approaches to classroom instruction and providing students experience employing reform methods and pedagogy. It is these same kinds of materials that will be delivered by the preservice students during the field service component of the program. The current course outline breaks reform curriculum into several units: elements of reform, learning theory and constructivism, collaborative learning and orchestrating discourse, and alternative assessment. A typical experience includes a student or pair of students delivering a short lesson taken from one of the materials cited above. Following the mathematics lesson, the class engages in discussion and analysis of the lesson in terms of the specific elements of reform incorporated into the lesson.

At the same time as students are enrolled in their preservice coursework, they become eligible to serve as “tutors” helping the current interns (see below). Typically two students are assigned to each internship class and allocated three hours of tutor time per week. The tutors are paid around \$6.50 per hour. The tutors are expected to spend at least two hours per week in the interns’ developmental class simply observing and helping with group activities. The tutors also help with grading and usually are provided opportunities near the end of the semester to develop and lead a lesson. This tutoring element of the preservice coursework is not required, but has proven to be a major advantage for those who can fit it into their schedule. Since the program is growing at a slow but steady pace there has been enough tutor positions to accommodate over 80% of the preservice students.

The Internship

In order to develop future mathematics teachers who can teach effectively with new curriculum, they must be confident and adept at using the methodologies that these curricula employ. Curriculum developers are very much aware of this as all of them either require, or strongly encourage, substantial inservice programs for teachers wishing to adopt their materials. At Chico, we accomplish this goal by *employing* those preservice students to teach a college adaptation of the IMP materials to college students who have entry level deficiencies. This preservice *internship* is structured using a collaborative team approach and is supervised by mathematics faculty who have IMP training and experience.

In addition to this *paid* teaching, interns enroll concurrently in the third course of the new program, a "de-briefing" four unit seminar that meets for a week prior to the beginning of the semester and then twice a week throughout the term. The seminar is conducted by a faculty member who also supervises the interns. The supervising faculty visits each remediation class two hours per week and shares the observations at the twice-weekly seminars. There is time designed into the seminar sessions for peer coaching, curriculum modification, discussion and implementation of alternative assessment ideas, performance outcomes, and other topics held to be essential elements of a truly professional teacher preparation program.

Developmental Curriculum

The Interactive Mathematics Project curriculum, developed through Eisenhower and NSF funding, is a well-defined, exciting four-year high school math program. The University of California has endorsed this mathematics program as meeting their A-F requirements for admission. Chico State faculty together with the IMP authors have developed and field tested a "college version" of these materials for use by community colleges and universities to help students who do not yet meet the entry level requirements to begin normal college level coursework. The high school version of these materials is now available through Key Curriculum Press. The importance of these materials to the preservice program is that they represent a model of reform oriented curriculum for the preservice interns to implement. What makes the IMP materials more attractive for our program than other reform curriculum (which may be pedagogically similar) are the comprehensive lesson plans that guide the teacher step-by-step through the new reform oriented classroom discussions and activities. These comprehensive lesson plans have proven to be of tremendous importance to both the

novice interns and the supervising faculty.

Faculty Development and Program Load Allocations

The new model also calls for significant faculty development. Initially, two faculty members attended IMP inservice sessions held at the Lawrence Hall of Science in Berkeley where they received the same type of training in using the IMP materials as provided secondary instructors who adopt the program. These two faculty members then taught the college version of the IMP materials to developmental students and incorporated the IMP training into the preservice curriculum. Once the program was established, other faculty who expressed openness to the ideas of reform were invited to go to Berkeley to learn about the IMP materials. Currently additional faculty who express interest in becoming involved in the program attend 24 hours of IMP training held over three or four days the week before school. The sessions are lead by our own experienced faculty mentors. These sessions are held the week before each semester and have elements of the IMP training built in; they are also required for the interns scheduled to teach in that semester. The new faculty then teach a section of the same developmental course as taught by the interns. The new faculty also participate as do the interns in the debriefing seminars. Subsequent to this experience, the training faculty member team-teaches the preservice courses with a mentor instructor who has completed the full training. At this point the newly-trained faculty member is ready to supervise the interns, orchestrate the debriefing seminars concurrent with the internship, and facilitate the preservice coursework as the lead mentor faculty who may or may not have a team teacher "mentor-in-training".

The NSF grant provided initial support for the training of the first generation of faculty to deliver the new model. In the future these costs will need to be absorbed by the campus. These faculty training costs are largely offset by the positive economics of remediation by undergraduates. (See "Program Economics" below). Faculty load allocations for trained faculty have followed somewhat of a "trial and error" process through the first years of the project. Load allocation to faculty for the first two preservice courses is standard, with three units allocated to each. The supervising faculty is allocated three units of teaching load to run the seminar and approximately one unit of load for each developmental course taught by interns that is supervised. At Chico State, a team of four faculty members currently runs the program. The typical pattern is for faculty member A to teach the first preservice course in

the Fall, faculty member B teaches the second preservice course in the Spring. Faculty member C, having taught the Fall preservice course the year before supervises and runs the debriefing seminars in the Fall for those interns who completed the coursework the year before. Faculty member D, having taught the Spring course the year before, supervises and runs the seminars for those conducting their internships in the Spring. In this way, each faculty member follows a "class" of preservice undergraduates for two years, with preservice teaching or supervision responsibilities every other semester.

Program Economics

During the Fall semester of 1995 nine interns and one graduate student who interned the prior year taught five remediation courses using college versions of the IMP curriculum. Each intern was paid \$1,000 and the graduate student was paid \$2,400. The college version of the IMP materials involves two semesters of work meeting five days a week. The interns taught four first-semester courses in teams of two or three and the graduate student taught one second-semester course alone. A total of 162 remediation students were served five contact hours per week at a total instructional cost of \$11,400. The cost of the tutorial aides mentioned before amounted to about \$500 per class (\$2,500 total). These same five classes, if taught by part time faculty, would cost approximately \$25,000. In years 1996-97 and 1997-98, a total of 21 developmental classes were taught by interns and tutors at an instructional cost of approximately \$56,000. This compares to part time costs without tutors or graders of approximately \$105,000. Although these low internship costs are a tremendous savings to the University and lower than all but a few community colleges, more importantly, the interns and tutors received the educational benefit of a rich field service experience under the direct supervision of University mathematics faculty. As pointed out above, these savings can be used to help justify the cost of future faculty training and recruitment.

Preliminary Results

Effects on Preservice Undergraduates

The initial NSF support for development of the reformed model included a modest budget for project assessment. Several assessment instruments designed to measure the impacts of the program on the preservice teachers were developed locally. Some of the measures are provided in the appendix. The primary questions addressed included the following:

- *How does the preservice experience affect the knowledge and attitudes of preservice teachers toward teaching in a reform environment?*
- *What effect does this preservice undergraduate experience have on the overall quality of preservice teachers once they enter the student teaching program?*
- *What effect does this preservice undergraduate experience have on the career objectives of the participants?*

Dr. Lily Roberts developed instrumentation to provide data revealing the answers to the above questions. The initial funding was not sufficient to conduct a significant longitudinal study to definitively answer most of these questions. Despite this, initial results have been quite positive and provide a strong case for continuing and expanding the study. In addition, we have received anecdotal information from the interns themselves, university faculty who have supervisorial duties in the fifth year program, and master middle and secondary teachers in the field leading us to believe the program is having an extraordinary impact on some of the participants. Below is one of our favorite anecdotes:

One of our first interns to earn a credential recently accepted a teaching job at a high school in the Bay Area. For several days running, the Vice-Principal for Instruction would walk by and peer in at her class through a window in the door to her classroom. After several days of this, the Vice-Principal brought the Principal into her class and announced --"I wanted the Principal to see how mathematics should be taught!"

NSF provided another unexpected resource through their self-assessment process. The National Center for Improving Science Education (NCISE) had been contracted by NSF to assess the overall effectiveness of NSF-EHR-CCD funding. Chico was selected by NSF for exterior review by NCISE. At the annual Association of Mathematics Teacher Educators (AMTE) conference held in February 1997 in Washington, D.C., Dr. Ted Britton reported on the preliminary NCISE findings concerning the Chico project. Many of those findings affirmed that something new and successful was being developed.

"The mathematics students glowingly praised the experience for giving them an early opportunity to experience teaching. One of the most enthusiastic instructors

said: 'I can't imagine NOT doing this; I'd do it without pay.' While they found the learning difficulties and low motivation of some remedial students frustrating, it did not dissuade any of the fifteen undergraduate instructors we interviewed from wanting to become teachers." [7]

The preliminary anecdotal feedback and the findings of Dr. Roberts and NCISE indicate that such a reformed model may represent a major advancement in the preservice training of mathematics teachers.

Effects on Remediation Students:

Probably the single most important question related to the sustainability and replicability of the intern model like that at Chico is the effectiveness of the use of new reform curriculum by undergraduate preservice interns in terms of the success of the remediation students. In the initial NSF funding, the assessment component addressed the following questions:

- *What effect does having developmental mathematics curriculum based upon reform mathematics have on the overall success of the remedial student?*
- *How do the mathematical capabilities and attitudes of students remediated by preservice teachers compare to those taught by university faculty?*

To study these questions the principal investigators began tracking the mathematics histories of developmental students dating back to 1991. The earlier cohorts were taught by university faculty with traditional elementary and intermediate algebra materials. Developmental students are required to pass intermediate algebra or its equivalent prior to taking a university approved general education mathematics class. The number of students who had passed their general education mathematics class was tracked for each cohort. It was soon discovered that many developmental students deferred taking any math class for several semesters, despite passing the prerequisite developmental course. It was learned that six to eight semesters of history for each cohort must be studied before a true picture of the passing patterns emerges. The histories of the more recent cohorts of developmental students who have been remediated by the preservice interns are still in their early stages and will require several more semesters of study before comparisons can be made to earlier cohorts. A simple chart illustrating this information is provided in the appendix II. These initial findings indicate

no significant changes, positive or negative, from traditional remediation by regular faculty.

Impacts of Faculty Development on Teaching and Learning

The Chico preservice model incorporates an aggressive pursuit of faculty to get involved with mathematics teacher education. Five faculty members at Chico have completed this process in the past three years. One recently retired leaving the four who currently run the program. It appears that significant pressure for more faculty to become involved is building as the program grows. A new faculty member has just been hired and will begin their teaching assignment at Chico State by team-teaching the new courses described above with experienced faculty. Even though there is much anecdotal documentation about the strengths and effectiveness of the professional growth of the participating faculty, this does not come without some increased fears. The model has faculty working heavily in what may be considered non-traditional areas for mathematicians to be involved in, the teaching and learning of mathematics. Evaluators found concerns expressed:

"Some of the interviewed faculty and the department chair felt that these negative faculty members could put an assistant professor's tenure at risk if he/she placed any emphasis on education ahead of mathematics. One faculty member felt that one of these critics had 'placed fabricated damnations in the tenure file of a mathematics educator.' " [7]

It will be important for this model to continue to bridge the gap between traditional research oriented mathematicians and mathematics educators. Recommendations from the American Mathematics Society call for precisely this to happen. Having a program that has so many faculty and students directly effected may be the answer to make this tie become a reality.

Needed Additional Research

Longitudinal Assessment of Teacher Performance

If this preservice program represents a substantive improvement in teacher preparation, it must be well documented for policy makers and administrators to be persuaded to pilot such a program. In addition to the original research questions addressed through the NSF grant

the following questions should be addressed through a future longitudinal study of sufficient duration:

- *What effect does this reformed preservice undergraduate experience have on the overall quality of preservice teachers once they enter the workforce?*
- *To what extent are the preservice graduates ready to teach IMP or other reform curricula in the schools?*
- *Can the preservice graduates assume the leadership roles required to influence the adoption of reform in their schools?*

To get at these questions, it will be important to track graduates of the program in their early teaching years to answer questions such as:

- *How do mentor teachers supervising student teachers view/rank the level of preparation of those who experience the preservice program compared to those who don't?*
- *How do department chairs, principals, and other teacher supervisors view/rank the level of preparation of those who experience a reformed preservice program compared to those who don't?*
- *How do the mathematics students of new teachers view/rank the effectiveness of those who experience a reformed preservice program compared to those who don't?*
- *To what extent do those who experience the preservice program feel well-prepared to teach as they begin their careers?*
- *To what extent do those who experience the preservice program feel they are effective teachers early in their careers compared to other new teachers?*
- *To what extent do the preservice program graduates go on to become teachers who create student centered classrooms?*
- *To what extent do the preservice program graduates go on to become agents of mathematics education change in their schools?*

Can Remediation Drive Teacher Preparation Reform

The second critical need is the knowledge of the *effects of this teacher preparation program on college remediation efforts* when those efforts form the basis of the hands-on field experience. Knowledge that the preservice interns are obtaining major benefits from the reformed preparation program alone will not be enough to persuade policy and high level

decision makers to adopt the model if it comes at the expense of the remedial students. On the other hand, if additional research indicates equal or better learning taking place in the remedial classroom, strong incentives (educational AND financial) could begin to drive this reform effort on a systemic scale. The California State University System administers an Entry Level Mathematics exam to new students. The administrations in May [8], July [9], and October [10] of 1996 showed that 21,029 of 25,503 taking the exam (82.5%) statewide failed and therefore required some form of remediation. Nationwide, 60 percent of college mathematics enrollments are in courses ordinarily taught in high school. Perhaps this need will eventually be eliminated when national standards and higher expectations are in place in our nation's schools, but right now we have a severe problem. The California State University Trustees are searching desperately for cost-effective solutions to this remediation need. The Chico model provides remediation as a by-product of the internship component of the teacher preparation program at a fraction of the cost of remediation by regular faculty. In light of this tremendous need for remediation, the associated economic pressures represent a major force that could be harnessed to drive reform in teacher preparation if the reform in preservice teacher preparation can be shown to result in effective remediation.

The Link to Faculty Development

A third need for additional study relates to *faculty development in reform mathematics*. The following important questions have yet to be addressed.

- *When faculty receive special training and then deliver a reformed teacher preparation program, what impacts or changes are transmitted to their regular mathematics courses?*
- *What is the impact on the knowledge, attitudes, and beliefs regarding teaching and learning of faculty who experience the Chico faculty development program?*
- *To what extent do the ideas, methods, and pedagogy of reform transmit or diffuse from a reform teacher preparation program to the general mathematics faculty as a whole?*
- *How can other teacher preparation programs link with faculty development?*
- *How can incentives and rewards be structured within institutions to encourage growth in the number of faculty who participate actively in teacher education while developing an understanding and habit of practice of reform methodology and*

pedagogy?

Summary

In contrast to other modern teacher preparation programs, the Chico preservice model described above provides substantial opportunities for prospective teachers to not only learn about, but also practice employing reform pedagogies to teach mathematics. The new courses add a significant improvement to the overall education of future mathematics teachers, while the immediate transfer of those ideas to team-teaching intern experiences makes that knowledge concrete. The accompanying seminar that has all interns discussing their experiences and learning more about pedagogical ideas is the enhancement that is needed to create successful future mathematics teachers. One of the outcomes of this program is to create a teacher who views teaching as a professional endeavor and who discusses their teaching with other teachers and who views teaching as a lifelong learning experience.

At the same time we have created a more economical solution to mathematics remediation. Not only are the costs less than traditional approaches, the developmental students are given a different mathematical experience that is more useful to them in their future. Currently at Chico it is the case that developmental students who go through our developmental program are more successful than those students who test out of the program and can immediately take their General Education class. This fact may have nothing to do with our developmental program, but it may show that a modern approach to mathematics gives developmental students a better disposition to do mathematics.

Finally, the Chico model creates faculty who are much more concerned about the teaching and learning process. They have become more active professionally and report that their involvement in the teacher preparation program has positively influenced their mathematics instruction. ■

Appendix I**SAMPLE INSTRUMENTATION****Attitude Survey**

Every teacher has strengths and weaknesses, such as activities that s/he feels more confident about than others. For each instructional activity identified below, please check the box in the column that best indicates how confident you feel about your ability to carry out the activity successfully. If there is an activity listed that you do not use, please respond how confident you would feel in using that activity, but indicate that you don't use it currently by also checking the last column.

Instructional Activities	Very confident	Somewhat confident	Somewhat uncertain, but willing to try	Very uncertain, would like more preparation before trying	Don't use this activity currently, but indicated level of confidence
Lecture to students.					
Listen to students.					
Provide opportunities to do hands-on activities.					
Demonstrate hands-on activities with manipulatives.					
Have class discuss material related to math content with you and each other.					
Have students work in small groups.					
Facilitate group discussion or group processing.					
Encourage students to work with others regardless of ability level.					
Give students real-world problems to solve.					
Adopt new materials or otherwise revise curriculum as needed.					
Adopt new materials or otherwise revise curriculum based on student input.					
Encourage students to help others.					
Have students share responsibility for each other's learning.					
Use alternative forms of assessment (e.g., explorations, performance tasks, portfolio).					
Other, Please specify:					

Performance Tasks Inventory

Scenario 1: Pythagorean Theorem

You are going to teach the Pythagorean theorem. Describe how you will do this, including what you will consider before, during, and after you teach this class.

Scenario 2: Factoring Polynomials

You have several students in your class who complain that they just don't understand how to factor polynomials. Describe what you will do to address their complaints.

Scenario 3: Slope of Lines

You have to assess you students on their understanding of slope of lines. What are three possible assessment strategies that you might use and why would you use them?

Scenario 4: Teaching Philosophy

You are preparing your notes for Back-to-School Night. Describe the three most important points about your philosophy of teaching mathematics that you want to convey to parents.

Each task had its own 4 point scale and rubric. All intern papers were scored by the faculty in the program separately and differences in scores were mediated. The tasks were given as both pre and post measures. General characteristics of the rubrics included these ideas:

score	
4	describes at least one student activity in detail, including a description of why the activity works, or provides several such activities in less detail; an appropriate activity will clearly help students construct meaning
3	clearly a constructivist approach, but not exceptional
2	predominantly constructivist ideas, but a weak/minimal presentation or justification; possibly with a failure to address specifics of the scenario
1	may hint that learning is something done by students but doesn't go beyond that . . . or . . . totally teacher-centered . . . or . . . the respondent may lack necessary mathematical knowledge
0	doesn't address the scenario; little or no productive ideas

A typical response to a scenario can be characterized as either student-centered or teacher-centered. In broad terms, a student-centered approach provides opportunities for students to construct meaning while a teacher-centered approach focuses on feeding students information. A particular teacher-centered response might qualify as an excellent example of the use of non-constructive techniques of instruction, but it does not merit a high score in this rubric. One of the things this NSF grant was trying to measure was the increase in undergraduates understandings of teaching and learning from a student's perspective.

Open-ended Question Survey

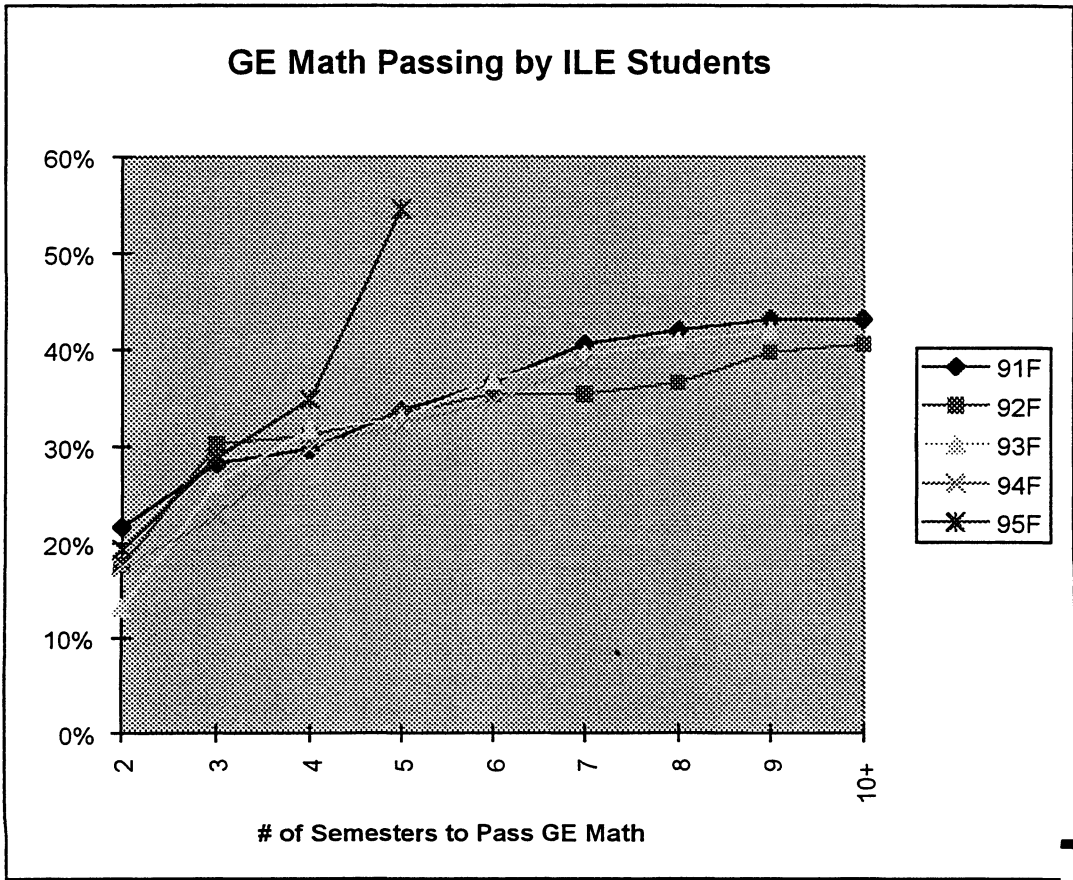
1. What do you do if you encounter a problem teaching this class? Who do you seek out for assistance (e.g., the professor or other students teaching Math 1)?
2. What has been your greatest challenge in teaching this course?
3. Ideally, what support is needed for undergraduate students teaching the Math 1 course?
4. Do you think the remedial students taking the course are receiving quality instruction? Do these students express any concerns about the quality of instruction?
5. Do you have any other comments or concerns about teaching this course?

Appendix II

Percent of Enrolled ILE Students who passed their GE math requirement

Year Enrolled	# Enrolled	+2 Sem	3 Sem	4 Sem	5 Sem	6 Sem	7 Sem	8 Sem	9 Sem	10+ Sem
91F	74	22	28%	30%	34%	36%	41%	42%	43%	43%
92F	96	18	30%	31%	33%	35%	35%	36%	40%	41%
93F	76	13	26%	32%	33%	37%	39%	41%	42%	
94F	127	17	23%	30%	32%	35%	39%			
95F	118	19	29%	35%	55%					

Note: 91F to 93F comprise the "PRE" group that were taught by regular faculty



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