

# **HELPING CHANGE OF CAREER INDIVIDUALS TO PREPARE TO BECOME SECONDARY MATHEMATICS TEACHERS**

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This article describes the development and content of a special introductory course developed and offered at New York University for change of career individuals entering the field of mathematics and science teaching at the graduate rather than the undergraduate level. With a critical shortage of qualified mathematics and science teachers at the secondary level being exacerbated in urban public schools, such as those in New York City, by high attrition rates during the first few years of teaching, it is important to find and encourage new populations of potential teachers. One such population is that of career changers, and the course described in this article is an attempt to help such individuals make their career change more smoothly and successfully. The focus of this course, and the illustrations provided in this article, are on the three major themes: "What Does It Mean To Be An Effective Mathematics Teacher"; "Technology and the Internet"; and, "A Model of Effective Mathematics Teaching."

## **Introduction**

A growing body of research attests to the fact that there is a critical and continuing crisis in the lack of qualified teachers in the public schools. For example, the study *What Matters Most: Teaching for America's Future* (National Commission on Teaching and America's Future, 1996) states that over 50,000 inadequately prepared teachers enter the teaching profession each year. In particular, reports have shown that in grades 7-12 approximately 33% of mathematics teachers and 20% of science teachers do not have either a major or a minor in their field.

These shortages are even more acute in urban areas such as New York City. According to an article in the January 5, 2000 *New York Times*, the New York City Board of Education expects to have to replace 10,000 additional teachers over the next five years because of the large number of teachers who will either be retiring or moving to other, higher paying locations. This expectation exacerbates an already serious shortage of certified teachers in the New York City public schools. Further aggravating this shortage is the high rate of attrition of teachers in urban areas. According to a recent statistical

report of the United Federation of Teachers, 18.5% of new teachers in the New York City public schools do not return for their second year of teaching, 31% leave the New York City public schools by the end of their third year, and 41% leave by the end of their fifth year.

One of the consequences of this continuing shortage of qualified secondary science and mathematics teachers is that new populations of prospective teachers must be sought out and encouraged to enter the teaching profession. One such population is that of career changers, individuals who have an undergraduate degree in a field other than education and thus begin their teacher preparation at the graduate instead of the undergraduate level.

These new teachers have a very short time in which to take the appropriate education courses and be placed into a student teaching internship. Because they often have a preconceived but erroneous image of what teaching is all about and what makes an effective teacher, it is important that they be given an early overview of the field into which they are moving. This enables them to make sense of the courses in which they enroll and take the utmost advantage of the student teaching experience.

At the urging of several graduates of the Masters Degree Program in Mathematics Education at New York University who were themselves career changers, Dr. Kenneth Goldberg developed a new course in spring 1998 that would provide this important overview of and introduction to teaching during the first semester of masters degree study for change of career individuals. The course, *E12.2089: Preparing to Teach Secondary Mathematics*, is a one-point course that meets once a week in the evening for two hours, for a total of six weeks.

### **Focus of the Course**

The course *E12.2089: Preparing to Teach Secondary Mathematics* introduces change of career individuals to: an overview of current issues in mathematics education; the local, regional, and national professional mathematics education associations, and the resources and support these associations provide to new and continuing teachers; and, use of the internet in order to access useful information, resources, and communicate on a regular basis with other mathematics educators to share experiences, concerns, questions, and stories of success.

E12.2089 uses the “Starter Kit” from the National Council of Teachers of Mathematics (NCTM) as its main resource. This kit contains copies of the NCTM journal *The Mathematics Teacher*, copies of NCTM position papers and statements, and a summary of the NCTM *Standards* and its history and purpose. A secondary resource is the book entitled, *Teaching: Making Sense of An Uncertain Craft* by Joseph McDonald. In addition, articles from newspapers, journals, and the internet, as well as video tape clips, are used to generate points of discussion.

Each semester, the students in the class select a focus topic from what they have read in the newspapers, seen on television, or heard through membership in internet discussion groups. In one semester, for example, the class focused on the so-called “Mathematics Wars” taking place in California. In this debate, some parents and educators contended that current mathematics teaching and curricula was “soft” and did not focus enough on the development of important mathematical skills; while others argued that mathematics involved more than just the development of algorithmic skills and that equal, if not greater, importance needs to be put on reasoning, estimation, and problem solving. Students in the class had to read newspaper and journal articles, as well as follow the internet discussions taking place on the NCTM list serve and in internet sites, such as the Math Forum at Swarthmore College.

### **Student Involvement in Setting the Agenda for the Course**

The objectives of the course are intended to meet the needs of the students. Furthermore, since the students are all change of career individuals who have made conscious and explicit decisions to become teachers, these students usually have a sense of what they want and need to know about the new career into which they are moving. Consequently, the first class session usually consists of a group discussion culminating in a listing of the objectives of the course for that particular semester. Following, for example, is the list of objectives developed by the students who took the course in fall 1998.

Objectives: At the conclusion of this course students will understand and be familiar with:

1. New York State Certification and New York City licensing requirements

- for teachers.
2. Use of e-mail, listservs, and the internet for communication and information.
  3. Recent national history of mathematics education from the New Math, to the Back to Basics Movement, to the NCTM Standards and beyond to today's controversies.
  4. The current New York State mathematics curricula and exams, where they came from and why, and proposed future changes.
  5. Professional associations and what they provide for teachers, including the National Council of Teachers of Mathematics, the New York State Mathematics Teachers Association, and the Association for Supervision and Curriculum Development.
  6. Discussion and use of videotapes to show different teaching styles and approaches.
  7. Instructional and educational materials available to teachers.
  8. Discussions of current issues and concerns, including the NCTM *Standards*, and the latest TIMSS (Third International Math and Science Study) and NAEP (National Assessment of Educational Progress) reports.

Three of the major themes of the course are: (1) what it means to be an effective mathematics teacher; (2) the use of technology, in particular the internet, to support and enhance the teaching and learning of mathematics; and, (3) how to use a model of instruction integrating content, questioning, and assessment as the organizational framework for classroom practice.

### **What Does It Mean To Be An Effective Mathematics Teacher?**

Change of career individuals often come to teaching with a preconceived idea of what a teacher is supposed to be and what a "good" classroom should look like. It is important for them to understand that teaching is a craft that is as individual as the people who become teachers, and that a person needs to find the teaching style and persona that is appropriate and right for them. It is also important for them to realize that whether learning and understanding is taking place in a classroom is more important than how the classroom looks to an outsider. To make this point, we ask the students, as their first homework assignment, to think about their own former mathematics teachers and to imagine the kind of teacher they themselves would like to be in five or ten years. They are

then asked to write down a brief description of their future selves that they can share with their classmates as the basis of a group discussion at the next session.

These presentations lead to a spirited discussion of the characteristics of an “effective” teacher, and what a “good” classroom should look like. Some students feel that, to be an effective teacher, you must create an atmosphere of informality in which the students work together on group projects and the teacher serves as a facilitator. Other students then argue that an effective teacher is one who manages a class well and keeps the students attentive and quiet, responding only when addressed directly by the teacher.

After this discussion has gone on for a while, we watch video clips illustrating a wide variety of teaching styles which, though different in many ways, all present models of effective teaching. Through these discussions and illustrations, the students come to understand that teaching is a very individual craft; they will need to find the model and the style that will be comfortable and right for them; moreover, this is an ongoing process as they mature and develop as teachers.

### **Technology and the Internet**

One of the aspects of current teacher preparation that has the greatest potential for providing support and a wealth of invaluable resources is the internet. At the same time, the internet is a part of life that change of career individuals have not grown up with as a regular part of their lives. Consequently, an objective given high priority in this course is an introduction to the internet and its use for educators.

At the second session, all students are asked to complete materials that will be used to give them computer accounts at New York University and free, unlimited access to the University’s computer labs. A list is then passed out containing 20-25 world wide web addresses of sites related to mathematics teaching in some way. Some of these are government sites (the New York State Education Department, the New York City Board of Education, the U.S. Department of Education and the National Science Foundation); some are professional organization sites (NCTM, ASCD, the National Board for Professional Teacher Certification); some are sites where lesson plans, discussion boards, and articles on educational topics are available (The Math Forum at Swarthmore College

and the Eisenhower National Clearinghouse at Ohio State University); and, some are sites where information on various mathematical topics can be found (ERIC).

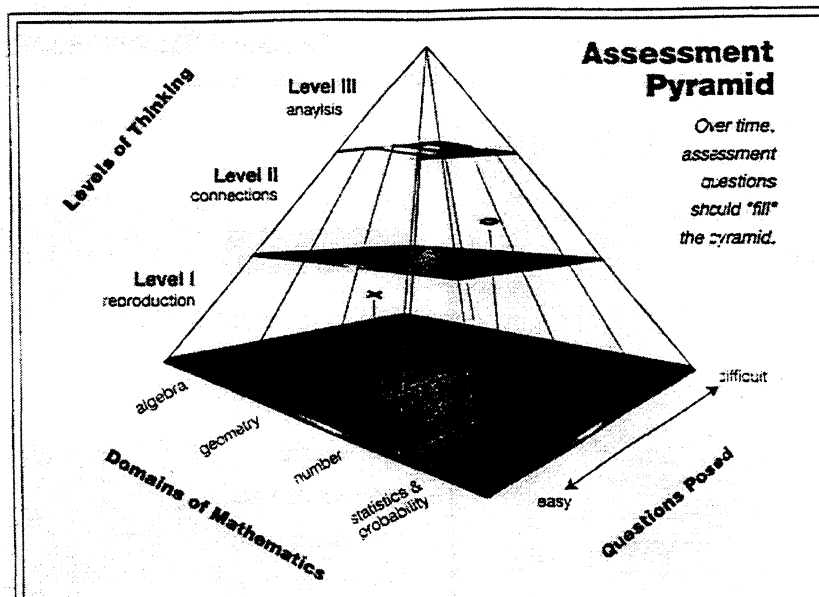
Each student in the class is randomly assigned two sites from the list. Their assignment for the next class is to visit that site by computer link and report on who hosts the site; what useful information, resources, or links the site provides; and in general, why a secondary mathematics teacher would want to be aware of this site and what educational use they can make of it. For the next class, we have a live internet hookup available in the classroom so that, as the students present their findings, they can actually show the site and its contents, illustrating how its resources may be accessed and how its links to other useful sites actually work.

By providing this introduction to the internet and its accessibility in this class, instructors in all the other courses the students take can assume internet familiarity and integrate the use of the internet into the course lessons, homework assignments, and group projects. The students also learn that the internet is an unfiltered mass of information, some of it useful and some of it not, and that they, as professional educators, need to learn to be careful and questioning consumers of what the internet has to offer.

### **A Model of Effective Mathematics Teaching**

One of the beliefs of new teachers, especially those who enter the teaching profession after a career in some other field, is that teachers just walk into a classroom and present information to the students from a textbook or a curriculum guide. They are unaware that teaching has the best chance of being successful if it is based on a model that helps the teacher plan for both short and long term learning goals in a structured fashion. And, while we want new teachers to understand that there are many different models of effective teaching available to choose from, this course provides a wonderful opportunity to expose them to one such model so that the use of such a model can be discussed, analyzed, and understood.

The model we employ in this course is one adapted from Verhage and de Lange called the “Assessment Pyramid” [1] and is shown in Figure 1 below.



The three dimensions of the pyramid model represent the content to be presented over the course of the semester, the level of difficulty of the questions the teacher poses to the students, and the level of thinking these questions require of the students. Each point within the pyramid represents a unique combination of these three components and the idea is that, over the course of the semester, the activities, assignments, and questioning should cover all levels of the three dimensions of the pyramid and thus fill in the pyramid with points.

Once this model has been introduced, discussed, and understood, we illustrate the components of the pyramid, the levels of difficulty for questions, and levels of thinking of the students by using articles from *THE MATHEMATICS TEACHER*, other journals, and video clips, depicting a variety of classroom activities. As the students take other courses in their masters degree program, they will be exposed to many other models of teaching, and will be better able to understand and evaluate these alternative models given this early introduction.

### Summary and Conclusions

The purpose of this new graduate level course was to help change of career individuals make a smoother and easier transition from their former careers into teaching. The success of this course will be measured by the percentage of students who take the course, complete their degree and certification requirements, begin their teaching careers, and continue as teachers in the New York City public schools. Since the first offering of this course was only in 1998, it is too early to tell whether or not this success will be achieved. However, since the change of career masters degree program takes two years to complete, the first cohort of students taking this new course will be graduating at the end of spring 2000, and data of the sort needed to evaluate the effectiveness of this course can begin to be collected at that time. ■

### Bio

Dr. Kenneth Goldberg is Professor of Mathematics Education and Director of the Mathematics Education Program in the Department of Teaching & Learning of the School of Education at New York University. He is a Co-Coordinator of the New York Collaborative for Excellence in Teacher Preparation (NYCETP), and the Co-Director of the Mathematics and Science Teacher Enhancement Program (MSTEP) at New York University funded by a Dwight D. Eisenhower Grant from the New York State Education Department. Dr. Goldberg is a former president of the New York State Mathematics Teachers Association. His areas of specialization are statistics and the implementation of technology as an effective method for teaching mathematics.

### REFERENCES

- [1] Verhage and de Lange, "Assessment Pyramid," *Principled Practice In Mathematics & Science Education* (Fall 1997).