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How Do Undergraduate Mathematics Faculty Learn To Teach Online?

Margaret McDonough Pankowski

HOW DO UNDERGRADUATE MATHEMATICS FACULTY LEARN TO TEACH ONLINE?

by

Margaret McDonough Pankowski

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Abstract

This study investigated the training that faculty receive to teach undergraduate mathematics courses online and the effectiveness of that training. A survey was distributed to 64 faculty who taught undergraduate mathematics courses online. In responding to the survey, faculty supplied information about the duration, topics, and types of training they received both before and after beginning to teach online, about their use of best practices for online education, and about their attitudes toward online education. Subsequent to completion of the survey, four focus group interviews were conducted with a total of 14 of the survey respondents. During focus group interviews faculty described both the technical and pedagogical training they received to teach online, identified components critical to the success of online courses, and delineated the training that should be required before faculty begin to teach online. Results of the study demonstrate that most faculty do not receive adequate training to teach online. 23% of participants received no training before beginning online teaching. Participants received more technical training, particularly training to use course management systems, than pedagogical training.

Only 20% of participants received training in active learning or fostering student collaborations online before they began to teach online and 29% of survey respondents received no pedagogical training of any type before beginning to teach online. Results of the study demonstrate that faculty should receive both technical and pedagogical training before beginning to teach online. Some portion of training to teach online should be delivered online so that faculty experience online learning from the student point of view. Training programs should also include a mentoring component so that faculty new to online teaching can benefit from the experience of their colleagues.

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CHAPTER 1

INTRODUCTION

The Problem

The purpose of this study is to identify the training that faculty who teach online undergraduate mathematics courses receive and to assess the effectiveness of that training. Online education has grown to the point where there are now several hundred two-year college mathematics faculty teaching online courses in the United States (Statistical Abstract of Undergraduate Programs in the Mathematical Sciences in the United States, pp.61, 130) yet information on how to manage faculty members' transition from face to face classrooms to online instruction is scarce (Couvillon, Hendrix, and Donlon, 2002).

Educators expressed a need for research to build the knowledge base for the new field of online education as early as 1990 when the first book on theory building for online education, "*Online Education: Perspectives on a New Environment*," by Harasim, was published. In this book the need for faculty retraining from teaching in traditional face-to-face settings to teaching online was recognized as the most serious problem in introducing Internet education (Harasim, 1990).

Both computer usage and online courses have increased dramatically in recent years. Current data for Internet courses are not available on a national level, however, the 2001 Campus Computing Report found that the percentage of college and university students who own personal computers rose from 58.5% in 2000 to 71.5% in 2001. This survey, now in its twelfth year, is based on data from 590 two- and four-year public and private colleges and universities across the United States. The Campus Computing Report also found that about 75% of community colleges use course management systems, up from 57.8% in 2000. The percentage of all college courses using course management systems also rose from 14.7% in 2000 to 20.6% in 2001. Almost one-third of the reporting institutions identified assisting faculty with the integration of technology into instruction as the key instructional technology issue for the coming years (The Campus Computing Project, 2001).

According to an article in the Chronicle of Higher Education, The National Center for Education Statistics, in its report titled *Distance Education at Postsecondary Education Institutions: 1997-98,* found “that 1,680 institutions offered a total of about 54,000 online-education courses in 1998 with 1.6 million students

enrolled” and that, in the 1997-98 academic year, “the proportion of those offering asynchronous courses on the Internet increased to 60%, from 22% in 1995. The proportion providing synchronous courses on the Internet increased to 19% from 14% during the same period”(Carnevale, 2000).

These statistics illustrate the increasing use of technology in postsecondary education. The demographic profile of the average college student is also changing from the majority in their late teens and early twenties. Increasing numbers of adults seeking enhancement of their skills in order to maintain or improve their current employment status are enrolling in community colleges. Their schedules are often such that Internet courses are attractive alternatives to traditional campus classes (Thiede, 2002).

The typical student in an undergraduate online class is an adult with a full-time job and family responsibilities. The majority of these students are women who may work odd hours in contrast to typical course schedules (Pozo-Olano, 2002). The flexibility to learn at their own pace is important to these students, as is their need to improve their skills (Instructional Technology Council, 2002).

In order to transition from traditional classrooms to online education, faculty must master both the technical and pedagogical requirements of this medium (Fink, 2002, White and Weight, 2000). They must transition their classroom methodologies to the online environment.

> [This] involves much more than simply taking old, 'tried and true' models of pedagogy and transferring them to a different medium. Unlike in the face-to-face classroom, in online distance education attention needs to be paid to developing a sense of community in the group of participants in order for the learning process to be successful. (Palloff and Pratt, 2001, p.20)

Community in online classrooms is developed through the use of electronic bulletin boards, streaming video, asynchronous environments, and real-time chats (Ko and Rossen, 2001).

Although there has been a steady increase in the number of courses offered and an increase in both pedagogical and technical training opportunities for faculty (Patton, 1999), no published study has examined the relationships between training to teach online, best practices in online education, and faculty perception of

training to teach online. Further, there is no published research that specifically deals with the online teaching of mathematics as a content area. In order to identify and assess the effectiveness of training to teach online, this study will:

- Identify the training received by faculty who teach online undergraduate mathematics courses
- Examine whether best practices for online education are included in training for faculty to teach online
- Examine whether faculty who teach online undergraduate mathematics courses incorporate recognized best practices in their online courses
- Identify the training that faculty teaching online undergraduate mathematics courses cite as beneficial

The results of this study will provide information for future training decisions and the design of training for faculty to teach undergraduate mathematics courses online.

Definition of Terms

Asynchronous learning is characteristic of online courses and, according to the Learning Resources Network

(LERN), indicates that “participants can ask questions and make comments anytime, day or night” (LERN, 2002). Students and instructors need not be in the same place at the same time in order to interact asynchronously (White and Weight, 2000).

Course Management Systems are software programs that integrate a number of instructional functions such as lectures, moderated discussions, and chat sessions. “Typical examples are those produced by WebCT, Blackboard CourseInfo, [and] eCollege” (Ko and Rossen, 2001).

Distance education is defined in many ways. For the purposes of this study, the term distance education shall refer to the delivery of instruction to locations away from a classroom, building or site, “by using video, audio, computer, multimedia communications, or some combination of these with other traditional delivery methods” (Instructional Technology Council, 2002).

Hybrid courses “Hybrid is the name commonly used nationwide to describe courses that combine face-to-face classroom instruction with computer-based learning. Hybrid courses move a significant part of course learning online and, as a result, reduce the amount of classroom seat time” (University of Wisconsin – Madison website, 2002).

Online education as used in this study refers to those courses that are taught wholly over the Internet and do not involve any face-to-face sessions. An early definition of online education characterized it as “distinguished by the social nature of the learning environment that it offers. Like face-to-face education, online education supports interactive group communication” (Harasim, 1990, p42).

Synchronous learning, as defined by the Distance Learning Resource Network (DLRN), “requires the simultaneous participation of all students and instructors. The advantage of synchronous instruction is that interaction is done in ‘real time’” (DLRN, 2002), as in traditional face-to-face classes.

Training to Teach Online

Training opportunities for prospective online faculty are varied but few are designed specifically for mathematics faculty. Colleges, universities, and even commercial vendors all offer training to teach online. The website for the Instructional Technology Council (ITC), an affiliated council of the American Association of Community Colleges, lists 43 publications devoted to learning to teach online in its distance learning resource section (ITC, 2002). The Learning Resources Network (LERN), a

nonprofit educational organization founded in 1974 that offers professional development for educators at all levels, has enrolled over 5,000 faculty in their courses in online learning (LERN, 2002). In 2002, LERN instituted a Certified Online Instructor (COI) designation created by LERN's Faculty Advisory Committee for TeachingOntheNet to "serve faculty in higher education and others teaching who want to gain recognition for their knowledge skills in the area of online teaching" (LERN, 2002). The Simon Fraser University and TELEStraining began offering an online advanced certificate in Web-Based Instruction in January 2003.

> The program is aimed at teachers, instructors, and trainers who would like to transfer their classroom teaching experience to the Web and design and produce successful online courses. It combines the teaching of both conceptual and technical skills during a period of twelve weeks. (Wong, 2002)

Learning to Teach On-Line (LeTTOL), was developed in the United Kingdom and as of January 2002 had trained nearly 1,000 people worldwide (LeTTOL, 2002). Training offered by these and other groups deals with both the pedagogical and technical aspects of online learning but

does not focus on specific content areas such as mathematics.

The only source of training to teach online geared to mathematics as a specific content area has been sessions at professional conferences such as those offered by the American Mathematical Association of Two-Year Colleges (AMATYC), the International Conference on Technology in Collegiate Mathematics (ICTCM), and the Mathematical Association of America (MAA).

During the summer of 2002, two distinct training opportunities were available for mathematics faculty seeking to learn to teach online. The MAA offered an online course for mathematics faculty, “Authoring Online Materials.” The emphasis was on teams of faculty learning to create Hypertext markup language (HTML) pages. Faculty were supplied with *Dreamweaver* and *Maple* software and each team worked to complete a project appropriate for an hour-long class. This four-day online workshop focused on the hardware and software aspects of online education and was not concerneded with the pedagogical aspects. (MAA Workshop Schedule, 2002)

Addison-Wesley, through the ICTCM, offered two short courses on using the web in mathematics during the summer

of 2002 (ICTCM, 2002). An advisory committee from ICTCM developed both courses and advocated the use of JAVA programming for creating online materials (S. Sledge, personal communication, April 3, 2002). Hence these courses, like the MAA's "Authoring Online Materials", focused on the hardware and software aspects rather than pedagogical issues related to course design and implementation.

Training evaluations have been conducted immediately following training and have found significant changes in faculty attitudes toward online education (Gold, 1999) but have not followed faculty to determine whether those attitudinal changes remain over time or whether such changes cause faculty to change their teaching methods and/or course design.

> Ironically, teacher learning may be the most difficult thing to measure in professional development. End-of-workshop evaluations are commonplace, but they represent measures of teacher attitudes, not knowledge. … the systematic exploration of the design of professional development linking standards to student achievement is a necessary element of

future progress in systemic school reform (Fishman, Best, and Marx, 2001).

The quality of training programs can be assessed by the extent to which the training program incorporates best practices in online education as identified by the Institute for Higher Education Policy (IHEP), the American Federation of Teachers (AFT), the Pennsylvania State University's World Campus, and individuals such as Cagiltay, Chickering, Craner, Duffy, Gamson, Graham, and Lim.

Best Practices in Online Education

A number of organizations have attempted to define what constitutes best practice for online courses. The American Federation of Teachers (AFT, 2000) and the Institute for Higher Education Policy (IHEP, 2000) both provide lists of such standards. Graham, Cagiltay, Lim, Craner, and Duffy (2001) identified best practices for online courses based on Chickering and Gamson's "Seven Principles for Good Practice in Undergraduate Education" (Chickering & Gamson, 1991). Their research confirmed the standards listed by both the AFT and the IHEP. They used Chickering and Gamson's principles to evaluate four online courses at a large university and concluded that

instructors should provide clear guidelines for interaction, well-designed discussion assignments, both information and acknowledgement feedback, deadlines, and challenging tasks. Additionally, they stated that instructors should also encourage active learning and accommodate diversity among students by allowing students some choice of projects. (Graham et al., 2001)

Pennsylvania State University is one of the leaders in online education at the postsecondary level through its World Campus. The faculty and staff of the university's World Campus advocate similar activities with their five-faceted approach to online instructor-student interactions that includes monitoring student progress, motivating students, intervention, critiquing written exercises, and responding to questions (Hons, 2002). The university offers training for faculty to teach online through its online Faculty Development Program. This program addresses pedagogical, administrative, and technical issues (Pennsylvania State University World Campus, 2003).

Best practices in undergraduate classroom mathematics education are benchmarked in "Crossroads in Mathematics: Standards for Introductory College Mathematics Before Calculus" and are based on the principles that mathematics

for undergraduates should be meaningful and relevant, taught as a laboratory discipline, incorporate technology, and balance content and instructional strategies (AMATYC, 1995). Recently, AMATYC published the position paper *Recommendations on Distance Education in College Mathematics Courses In The First Two Years.* This position paper states, “Training and support for mathematics distance education providers must be part of any distance education program. Colleges should provide continuous and relevant training and support for mathematics faculty” (AMATYC, 2002).

Research Questions

This study seeks to determine how faculty learn to teach undergraduate mathematics courses online by seeking answers to the following five questions:

1. Do mathematics faculty take advantage of formal courses such as those offered by MAA or are they self-taught?
2. When do faculty who teach online undergraduate mathematics courses receive training to teach online?
    a. Do they receive training to teach online before they begin teaching online?

   b. Do they receive training to teach online after they have begun to teach online?
   c. Is there a difference between the types, topics, or duration of training received before and after beginning to teach online?

3. What types, topics, and duration of training to teach online do faculty who teach online undergraduate mathematics courses perceive as beneficial?
4. To what extent do online undergraduate mathematics faculty incorporate best practices in online education in their online courses?
5. Is there a relationship between the degree to which faculty incorporate best practices in their online courses and the topics and/or duration of training to teach online that faculty receive?

The data and resulting analysis from this study could be used by administrators to design training programs that are cost-effective and enable faculty to maximize their time by accessing effective training techniques.

Delimitations of the Study

For the purposes of this study, online education shall refer to classes that take place entirely via the Internet

and do not involve any face-to-face meetings. Hybrid classes, that is, those that combine traditional face-to-face classes with Internet instruction, are not considered in this research.

Additionally, this research is limited to a nonrandom sample of faculty who teach undergraduate mathematics courses online. Participants in the study were identified through their membership in professional organizations and through listings on state virtual community college websites.

Limitations of the Study

No published instrument exists to identify and evaluate faculty training to teach online. Accordingly, the researcher constructed the survey that is reproduced in Appendix C.

This research also consists of results obtained from self-selected samples. Initially, an online survey was distributed to 64 faculty, 35 of whom responded. Only 18 of the 35 respondents volunteered to participate in a focus group interview.

CHAPTER 2

REVIEW OF THE LITERATURE

Introduction

This study reviews the literature related to the training that faculty receive to teach online courses. There is little research documenting the process by which faculty make the transition from traditional classroom teaching to teaching online (Couvillon, Hendrix, & Donlon, 2002). Techniques that work well in classrooms often do not translate readily to online learning. Faculty have learned to facilitate interaction between and among students and faculty in classrooms, now they must learn to facilitate these types of interaction online (White & Weight, 2000). Further, there is no published research addressing the transition from classroom to online mathematics education.

This review begins with an overview of the literature regarding training for faculty to teach online and proceeds to an examination of training programs for different types of postsecondary institutions. Because this study is concerned with faculty perception of recognized best practices in online education and with how they incorporate those practices into their courses, the literature regarding best practices for online education is reviewed.

The chapter concludes with a review of studies that have evaluated online courses.

Training for Faculty to Teach Online

Gibbons and Wentworth, in the 2001 Conference Proceedings of the Distance Learning Association, reported that training for faculty to teach online is necessary to the success of course design and delivery. They also reported that training to teach online should include activities that allow faculty to experience online learning from the student point of view (Gibbons & Wentworth, 2001).

Training for faculty to teach online is sometimes provided by commercial enterprises that contract with institutions of higher education. Collegis, Incorporated, founded in 1986, is one of the leading providers of technology, business, and curriculum services to institutions of higher education (Eduprise, 2003). Edrie Greer, the Director of the Instructional Services division of Collegis, a division of Eduprise, summarized their findings:

> During the course of faculty development, we have discovered the value of:
>
> - Developing a training plan to inform the appropriate parties…

- Faculty learning from each other…
- Showing many good examples in the discipline…
- Working with early adopters to train or positively influence other faculty members
- Training students to make faculty workloads lighter (Greer, 2002).

Collegis also states that faculty should not have to learn HTML and that faculty need just-in-time assistance to function most effectively (Eduprise, 2003).

Cravener advocates a psychosocial model for faculty development. She demonstrates that, whereas technology experts design programs to train faculty to learn to use media effectively, faculty focus on the need to meet institutional requirements for tenure. She developed the Paradoxical Disjunction Model for faculty development programs based on this divergence. The model advocates “just-in-time” training for faculty to teach online by providing technology consultation to faculty in the privacy of their offices. In a case study of this model, applied in a university setting, her findings indicate that 32% of eligible faculty participated and that an important outcome of the individual consultations was improved faculty

satisfaction with their use of Internet resources (Cravener, 1999).

Training for faculty to teach online takes place in different ways at different levels. Accordingly, this review separates statewide, university, and community college faculty training programs.

Statewide Faculty Training Programs

In Maryland, the Faculty Online Technology Training Consortium (FOTTC) Project began in December 1999. A report on the project detailed a highly successful statewide effort to train faculty to teach online. A nine-day training program was developed and used to train 40 faculty from 20 institutions of higher education in the state of Maryland. These 40 “Faculty Fellows” provided 78 training events, serving 1140 of their colleagues by October 2000. The authors reported that the data suggest that the FOTTC project was highly successful in decreasing faculty levels of concern and in facilitating collaboration among both faculty and institutions. Paired t-tests of pre-tests and posttest measures of faculty skills and knowledge also showed significant improvement (significance levels below .05) on eleven of twenty-one measures. These included selecting resources, mentoring colleagues throughout the

development of an online course, facilitating development and use of online teaching, assisting peers with transition from traditional to online teaching, and assisting colleagues to incorporate best practices in online courses (Maina & Keeton, 2001).

The Tennessee Board of Regents, through the Regents Online Degree Program (RODP), developed extensive online training for prospective faculty. Faculty wishing to develop a course for this program can go online to the Faculty Lounge to review the standards and guidelines, register for training, peruse syllabus templates, and download procedures for submitting an online course. RODP faculty trainers provide training in course management systems and other software packages through sessions open to all faculty and staff (TBR Online Degree Programs, 2002).

The RODP Peer Review Committee is composed of representatives from all campuses and coordinates curriculum for the program. As faculty progress through the training and develop their online course, there are two different formative reviews available from this group. The technical review examines course navigation, use of graphics, audio and visual, and course features designed to

meet the needs of individuals with disabilities. The content review is based on the “Seven Principles of Effective Teaching: A Practical Lens for Evaluating Online Courses” by Graham, Cagiltay, Lim, Craner and Duffy. Both reviews are designed to assist the course developer by providing feedback on areas of strengths and weaknesses and to guide further course development efforts (TBR-RODP Reviewer’s, 2002).

The Distance Learning Design/Model (DLD/M) Project developed a planning/training design model and other materials in response to the needs of the North Carolina Community College System (NCCCS) between October 1998 and May 1999. The plan was the work of a collaboration between the NCCCS and the North Carolina Adult Education Association (NCAEA). As part of the project, a training survey was administered to faculty, staff, and administrators at eight NCCCS institutions. This survey showed that distance education training varied widely among institutions in North Carolina and that instructor training was most needed for Internet-based course development. Although the recommendations contained in the report included the creation of a Distance Education Faculty and Staff Development Center, the detailed training modules

developed included only technological competencies. Pedagogical competencies were not included in the training plan (Blue, Greer, Vetter, Irvine, & Cole, 1999).

University Faculty Training Programs

As the need for online courses continues to increase, so does the need for faculty training to teach online (Gold, 1999). Certainly, colleges and universities are offering a growing number of courses and programs designed to assist faculty to integrate technology with their teaching and to design and teach Internet courses, yet there is little research on the effectiveness of these efforts.

Pennsylvania State University delivers faculty training through the World Campus Faculty Development Program. This program addresses pedagogical, administrative, and technical issues by providing “online resources, ThinkTank forums, hands-on technical training, and conferences. ... In addition, one-on-one training is available to all faculty in the use of the learning management system used by the World Campus” (Pennsylvania State University World Campus, 2003). The online component of the program was developed in 1998 and includes a course entitled Faculty Development 101 wherein faculty lessons in

both designing and teaching online classes are offered in a self-paced environment. This fourteen-hour course enables faculty to experience online learning in an environment similar to the one they will use for their own course and includes both pedagogical and technical skills (World Campus, 2003).

The Bank Street College of Education in New York began Project EXPERT (Expanding Educational Repertoire through Technology) in 1998, in an effort to systematically integrate technology into its graduate teacher education program. This ongoing program supported faculty for several years. During the second year of the program, participating faculty experienced an

> eight-session 'hands on' look at selected technological tools. They were given the opportunity to discuss ways that these tools might be used to support teaching and learning. The goal was to provide the faculty with insight into *how* technology might interact with their work (Cohen & Brunner, 2000).

The following year the United States Department of Education awarded a three-year implementation grant. Entitled Project DEEP (Deepening and Expanding Project

EXPERT), this project will continue the work begun by Project EXPERT (Cohen & Brunner, 2000).

At the University of Toledo, the first faculty to teach online were trained in all aspects of course development. Later the university's division of distance learning realized that faculty could not continue to do it all and moved to a client services approach wherein a design team from the instructional technology department is assigned to work with each faculty member teaching an online course. The faculty member is the content expert, the director of the course. The instructional design team consists of an instructional systems designer and a visual/digital artist. They meet with the faculty member regularly as the course is being developed and improved. Another important feature of their client services approach is the student support. Both students and faculty have access to a web-based support area, email help, and a toll-free telephone number. "By providing technical support and prerequisite skills to students, faculty spend less time teaching non-content skills, and more time interacting with students" (Fink, 2002).

Sanford Gold examined a two-week faculty development course that "focused on teachers rethinking their existing

educational practices" (Gold, 1999) and claimed that such rethinking was necessary in order that faculty operate effectively within the online medium. The participants in this course were all college teachers, 53% of whom had over 13 years of classroom teaching experience. He found that course participants significantly changed their attitudes towards online instruction. In particular, after participating in the course and experiencing online learning from the perspective of a student, they saw it as more interactive than face-to-face instruction. His dissertation concluded with a warning to the teaching profession that the gap between faculty skills and the skills necessary for successful online teaching will continue to widen unless more training in online pedagogy is offered in faculty development courses (Gold, 1999).

At the University of Florida, researchers and practitioners in the College of Agricultural and Life Sciences (CALS) surveyed faculty and found that training content should include instructional design, technology use, and software use. While CALS faculty recognized the professional benefits of training, they identified lack of time and resources as critical obstacles. As a result of this study, a faculty training and development model was

constructed. This model places institutional support at the base of all training and acknowledges that “all four factors – institutional support, content, training, and faculty motivation – are essential to achieving program effectiveness” (Irani & Telg, 2001).

At West Texas A&M University, as faculty in the College of Education receive training to teach online, they are supported by a student-based Web Team that creates and maintains the online course, and provides both HTML expertise and web programming. The Instructional Innovation and Technology Lab handles technology related problems through a dial-up student-based help line. In describing their professional development model, McKinzie and McCallie note that once faculty become comfortable with the online teaching environment “intuitive teaching practices seem to emerge, and even drive the development of web-based courses” (McCallie & McKinzie, 1999).

University of Phoenix has been offering college degree programs via the Internet since 1989 (University of Phoenix, 2003). All University of Phoenix faculty must complete a basic 16 hour Faculty Certification Workshop Series prior to teaching a course for the university and may complete additional training modules in facilitation

skills, tutoring, grading and evaluation, and other topics in order to obtain certification to teach additional courses (W. Valalik, personal communication, December 12, 2002). In January 2003 University of Phoenix had over 141,300 online degree-seeking students, making it the largest institution of higher education in the United States (University of Phoenix, 2003).

The issue of distance education in nursing was addressed in an American Association of Colleges of Nursing (AACN) Bulletin in January 2000. Kathleen Potempa, Dean of the School of Nursing at Oregon Health Sciences University, chaired the AACN Task Force on Distance Technology and Nursing Education. The Bulletin quotes Potempa as saying that distance education “fundamentally changes the relationships between student and faculty, student and school. Once content is modularized and paced, activities determined, and the curriculum set, the teacher becomes the coach, rather than the ‘sage on stage’” (AACN, 2000). The Bulletin also stated that “what faculty have found, in fact, is when students learn in a virtual environment … they tend to participate in the process to a much larger degree” (AACN, 2000).

Community College Faculty Training Programs

The Learn Online Project at Grant MacEwan Community College assisted faculty in converting existing distance education courses to a web-based environment during the 1999/2000 school year. Three of the courses were evaluated over the course of the year in order to develop appropriate training for additional faculty to teach online. The instructors involved were truly “learning by doing” and, based on their experiences, a list of instructor competencies was developed. These competencies clarify areas for faculty development and include comfort and effectiveness with all technology used in the course, the ability to model useful technology and to track student activities in the course, willingness to be innovative in teaching methods and in use of technology, willingness to learn while doing, tolerance to change, ability to commit significant time to the course and to handle a high amount of interaction with students, being a good facilitator of communication, being able to write clear, focused messages, and providing clear expectations of student responsibilities in course (White, 2002).

The League for Innovation in the Community College paired with PLATO Learning Incorporated for a research

project titled “Adding Up the Distance: Critical Success Factors for Internet-Based Learning in Developmental Mathematics.” The project involved eight community colleges in Florida, Michigan, Iowa, Illinois, Ohio and Hawaii and explored the implementation of successful distance learning programs in developmental mathematics. The researchers stressed the importance of faculty development and found that the more successful programs were those at colleges offering more than five professional development opportunities and where faculty were active in attending workshops and conferences along with professional development opportunities offered by their college. (Perez & Foshay, 2002).

The North Carolina Community College System developed a planning/training design model between 1998 and 1999. This model was discussed earlier as a statewide program.

Best Practices

The Institute for Higher Education Policy (IHEP) conducted research published in April 2000. “*Quality on the Line: Benchmarks for Success In Internet-Based Distance Education*” details the three step process followed by the IHEP in conducting the research. First, a literature search was used to identify benchmarks developed by other

organizations. Then six regionally accredited institutions, chosen for their considerable experience in distance education, were studied to determine the benchmarks they deemed important. Twenty-four benchmarks “considered essential to ensuring excellence in Internet-based distance learning” (IHEP, p. vii) were identified. These benchmarks are divided into seven areas: Institutional Support, Course Development, Teaching/Learning, Course Structure, Student Support, Faculty Support, and Evaluation and Assessment (IHEP, 2000).

Only the Teaching/Learning, Course Structure, and Faculty Support benchmarks are relevant to this study. The Teaching/Learning benchmarks state that student interaction with faculty and other students should be facilitated through a variety of ways, and that constructive and timely feedback to student assignments and questions should be provided. The Course Structure benchmarks emphasize the need for faculty and students to agree upon expectations regarding times for both student assignment completion and instructor feedback. The Faculty Support benchmarks stress the need to assist faculty in the transition from classroom teaching to online teaching, to provide technical assistance in course development, instructor training, and

assistance that continues through the progression of the online course (IHEP, 2000).

The Higher Education Program and Policy Council of the American Federation of Teachers (AFT) published its "*Guidelines for Good Practice*" in distance education in May 2000. The report is based on a fall 1999 survey of 200 AFT members who teach distance education courses. While all types of distance education were included, the most common delivery mode was Internet courses (AFT, 2000). This document identified the standards for faculty, courses, and students. They found that faculty must retain academic control, and be prepared to meet the special requirements of teaching at a distance. They recommend that faculty should retain creative control over use and re-use of materials. Course design should be shaped to the potentials of the medium, and courses should cover all material. Students must fully understand course requirements and be prepared to succeed and student assessment should be comparable. Additionally, the recommendations state that close personal interaction must be maintained, class size should be set through normal faculty channels, experimentation with a broad variety of subjects should be encouraged, equivalent research opportunities should be

provided, and equivalent advisement opportunities must be offered (AFT, 2000).

All of the above models of best practices in online education are well summarized in Chickering and Gamson's "*Seven Principles for Good Practice in Undergraduate Education*". These principles state that good practice in undergraduate education encourages contacts between students and faculty, encourages cooperation among students, encourages active learning, gives prompt feedback, emphasizes time on task, communicates high expectations, and respects diverse talents and ways of learning (Chickering & Gamson, 1991).

Evaluating Online Courses

Graham, Cagiltay, Lim, Craner & Duffy used Chickering and Gamson's *Seven Principles for Good Practice in Undergraduate Education* to evaluate online courses from the perspective of students. They chose Chickering and Gamson's seven principles because of the depth of research available. The principles were used to evaluate four online courses at a large university in the Midwestern part of the country. Their evaluations analyzed course materials, discussion-forum postings, and faculty interviews. They identified seven lessons for online instruction:

1) instructors should provide clear guidelines for interaction with students,
2) well-designed discussion assignments facilitate meaningful cooperation among students,
3) students should present course projects,
4) instructors need to provide both information and acknowledgment feedback,
5) online courses need deadlines,
6) challenging tasks, sample cases, and praise for quality work communicate high expectations, and
7) allowing students to choose project topics incorporates diverse views into online courses. (Graham et al., 2001)

There are studies published dealing with online collaboration among faculty and students. Reinhart, Anderson, and Slowinski conducted an experiment involving collaboration among pre-service teachers and stressed the importance of careful attention to course design and willingness, on the part of the instructor, to adjust activities as needed (Reinhart, Anderson, and Slowinski, 2000).

Roblyer and Ekhaml questioned whether distance learning courses could offer enough interaction to enable students to learn. They created a detailed rubric to promote interaction in online courses. Their rubric measures the degree of intensity for four separate elements: (a) instructor created social rapport-building activities, (b) instructional designs for learning, (c) levels of interactivity of technology resources, (d) impact of interactive qualities as reflected in learner response (Roblyer & Ekhaml, 2000).

Recently, Nishikant Sonwalkar developed a learning cube that can be used to assess the pedagogical effectiveness of online courses (Sonwalkar, 2001). Information about the cube was originally published in the November 2001 issue of Syllabus and explained in more detail in the January 2002 issue. It utilizes a three-dimensional model with learning styles and media elements depicted on the x- and y-axes while the degree of student engagement is represented on the z-axis. The Pedagogical Effectiveness Index (PEI) can then be calculated to evaluate an online course. The PEI is the summation of the values along the x-, y-, and z-axes and indicates the pedagogical richness of a course. High PEI values indicate

courses that incorporate varied learning styles and media elements and are more student-centered. Low PEI scores indicate more teacher-centered courses that address only a limited number of learning styles and incorporate few different media elements (Sonwalker, 2002).

Conclusion

Ensminger and Surry conducted a study of conditions that influence the success of implementing technological innovations. They administered their survey to 56 members of an instructional technology listserv. Sixty-five percent of these respondents worked in higher education settings. Results of their survey indicate that the most important condition for implementing an online program is adequate resources followed by faculty who possess the necessary design, development, and instructional skills. They concluded that the RIPPLES model addresses all of the conditions that influence successful implementation of an online program (Ensminger & Surry, 2002).

The RIPPLES model was designed to integrate instructional technology in colleges of education. The main elements of the model are Resources, Infrastructure, People, Policies, Learning, Evaluation, and Support. It is not intended to be a step-by-step model. Instead the model

advises administrators planning for the integration of technology to consider all of the elements of the model throughout the integration process (Surry, Robinson, & Marcinkiewicz, 2001).

Summary

Published studies agree that training is necessary in order for faculty to make the transition from the traditional classroom to online courses (Blue et al., Fink, Gibbons, Gold, IHEP, Perez & Foshay, Wentworth).

Cravener and Gold conducted evaluations immediately following training and found that training improved faculty attitudes and the Maryland Faculty Online Technology Training Consortium Project found significant improvement in faculty skills and knowledge after training.

The Institute for Higher Education Policy and the Higher Education and Policy Council of the American Federation of Teachers published standards for best practices in online education. These best practices are similar to Chickering and Gamson's "Seven Principles for Good Practice in Undergraduate Education." Graham et al. based their evaluation of the effectiveness of online courses on these principles and identified lessons for online instruction. Roblyer and Ekhaml and Sonwalker have

developed rubrics to assess the pedagogical effectiveness of online courses.

CHAPTER 3

DESIGN OF THE STUDY

Introduction

In order to identify how faculty who teach online undergraduate mathematics courses learn to teach online, a group of faculty who have taught such courses were surveyed. Participants were identified through the AMATYC Distance Learning Committee, personal contacts, and several state virtual community college websites.

Initial data was collected by means of an online survey. After a preliminary analysis of the survey responses, focus group interviews were conducted with a subset of survey respondents in order to further explore faculty experiences and satisfaction with the training that they received to teach online. In order to maximize interaction, each focus group consisted of three or four faculty.

Research Methodology

This study was both exploratory and analytical. As Mauch and Birch indicate, exploratory investigations scrutinize new or relatively unknown territory in order to lead to better understanding whereas analytical studies are

conducted to discern principles that may guide future action (Mauch & Birch, 1998).

Faculty learning to teach online is relatively new territory and this study sought both to understand how faculty learn to teach undergraduate mathematics courses online and to identify components that could be used to develop future training for faculty preparing to teach online.

Data was collected using both an online survey and personal interviews. Early in the fall 2002 semester an email containing a link to the survey was sent to 64 faculty who had been identified as having taught undergraduate mathematics courses online. The text of the email can be found in Appendix A. The email distribution list consisted of all members of the AMATYC Distance Learning Committee supplemented by names and email addresses of faculty who teach undergraduate mathematics courses online obtained from personal contacts and state-wide virtual community college websites. The email also encouraged recipients to forward the message to other faculty who teach online undergraduate mathematics courses. Appendix B contains a copy of the consent form for the

online survey. The researcher expected to obtain between 30 and 50 survey responses.

The timing of the initial survey provided for preliminary analysis of the survey results to be done during October 2002 and follow-up personal interviews to be conducted in November 2002 at the AMATYC National Conference in Phoenix, Arizona.

Survey Instrument

An initial draft of the survey was examined by participants in a graduate seminar in program design and was rewritten based on the suggestions offered by this group. A copy of the online survey is included in Appendix C. The online survey was constructed by the researcher because no appropriate published instrument existed. The final draft of the survey was piloted with a group of faculty who teach online undergraduate mathematics courses. This group suggested no changes to the instrument.

The survey consists of three parts: teaching experience, training experience, and observations. The first two parts of the survey are composed of multiple-choice questions. Demographic items that identify the online mathematics courses that faculty teach, their classroom and online teaching experience, the size of

online classes at their institution, and compensation policies at their institution, comprised the first section of the survey.

The second part of the survey consists of multiple-choice items related to the duration, types, and topics of training that faculty receive to teach online. Items in this section distinguish between the training to teach online received before and training received after faculty began to teach online.

The third part of the survey identified faculty observations and beliefs. Accordingly, a Likert scale was chosen for this portion of the instrument. There were 25 items in this section and response choices were on a scale from one to five with one being strongly disagree, two disagree, three neutral, four agree, and five strongly agree. Items on this part of the survey related to training, beliefs, observations about online learning, and best practices in online education. The items reflecting established best practices in online education were designed to identify the degree to which faculty incorporate these practices in their online courses.

The final two items on the Likert scale portion of the survey concern faculty use of asynchronous and synchronous

sessions in their online courses. In order to identify the degree to which faculty use such sessions a different scale, where one represented never, two rarely, three sometimes, four regularly, and five frequently, was used for these questions.

Personal Interviews

Personal interviews were conducted with fourteen survey respondents in order to determine faculty opinions regarding the usefulness of the training they received to teach online. Interviewees were selected based on their response to the final question on the survey that asked about willingness to participate in a focus group interview. A copy of the interview questions is included in Appendix D.

Personal interviews were conducted by the researcher during the week of November 15, 2002 and an online interview was conducted early in December for individuals who could not be interviewed face-to-face. Face-to-face interviews were tape recorded and transcribed to facilitate data analysis. The software used for the online interview provided a transcript of the session. Appendix B contains a copy of the consent form for the personal interviews.

Data Analysis

The first research question seeks to determine whether faculty who teach undergraduate mathematics courses online take advantage of formal training or whether they are self taught. Data regarding this question was gathered from survey items numbered 11 through 14 and 21. Responses to focus group interview questions were analyzed to answer this question.

In order to determine when faculty receive training to teach online, responses to survey items numbered 11 through 18 were examined. When survey responses indicated that training to teach online continued after faculty began to teach online, the research investigated the relationship between training received before and after faculty began to teach online during the focus group interviews.

The third research question was included to determine the types, topics, and duration of training to teach online that faculty view as beneficial. Survey items 19 through 23 and 36 related to this question. Additional data to answer this research question was obtained from the focus group interviews. In particular, responses to interview questions numbered four and five were collected, collated, and analyzed.

The survey contains items designed to identify the degree to which participants incorporate best practices for online education in their online classes. Responses to those questions were used to answer the fourth research question, “To what extent do online undergraduate mathematics faculty incorporate best practices in online education in their online courses?” The items included in this portion of the survey solicited faculty opinions on the interactive nature of online courses.

A correlation coefficient was calculated to answer the final research question to determine whether a relationship exists between topic, type, or duration of training and faculty incorporation of best practices. Faculty responses to the survey items dealing with best practices were tabulated and an average best practice score was calculated for each participant. This average was then compared with the participant’s response to the items related to the duration of training that faculty received before and after beginning to teach online to determine the existence and strength of the relationship. The Spearman correlation was used because it measures the relationship between variables on an ordinal scale of measurement.

A Spearman correlation was also calculated to determine whether there is a relationship between length of traditional, face-to-face classroom teaching experience and online teaching experience by examining responses to the first two survey items.

CHAPTER 4

RESULTS

Introduction

To determine how faculty learn to teach online undergraduate mathematics courses, an online survey was sent to 64 faculty who teach online at postsecondary institutions throughout the United States. Thirty-five recipients responded to the survey for a response rate of 55%.

Among the 35 faculty completing the survey, 24 indicated a willingness to participate in an interview. The first 18 were contacted to participate in small focus group interviews. Four focus group interviews were conducted, each with three or four participants for a total of 14 interviews. The first three focus groups were conducted face-to-face. The final focus group was conducted online and involved four faculty in a synchronous chat.

Survey Results

The survey contained 12 demographic items, 14 items pertaining to training to teach online, 12 Likert scale items referenced accepted best practices for online education, and nine Likert scale items addressed faculty attitudes and beliefs on online education. Survey items can

be divided into four categories: demographic, training, best practices, and beliefs. For purposes of clarity, responses from each category are presented separately.

Demographics

Table 1 represents the set of survey items designed to gather demographic data. A significant majority, over 91% of the survey respondents, indicated having five or more years of traditional classroom teaching experience.

Table 1: Demographic Survey Items

1) How many years of traditional classroom teaching experience do you have?
2) How many years of online teaching experience do you have?
3) What mathematics courses have you taught online?
4) Which methods do you use to create materials for your online class(es)?
5) What is the maximum number of students in an online course at your institution?
6) Why did you begin to teach mathematics online?
7) Does your institution compensate faculty for developing online courses?
8) Does your institution provide additional compensation for faculty who teach online courses?
9) Are online courses at your institution considered faculty intellectual property?
10) How would you categorize your institution?
11) Have you ever taken an online course?

One participant indicated between three and four years of traditional classroom teaching experience, while another had less than one year. One respondent did not answer the question. In comparison, only six respondents, approximately 17% of the total, indicated five or more years of online teaching experience. A total of 11 respondents had four or more years of online teaching

experience, 16 respondents had between one and four years of online teaching experience, six respondents had less than one year of online teaching experience and two did not answer this question.

Because the responses to these questions consisted of ordinal data, a Spearman correlation was calculated to investigate the relationship between the amount of traditional, face-to-face classroom teaching experience and online teaching experience. Responses to each question were ranked and, when the ranks were compared, r_s =.366, a significant correlation between years of classroom teaching and years of online teaching experience at the .05 level.

Faculty participants in this research teach the full range of undergraduate mathematics courses online from developmental mathematics through calculus. Forty percent teach developmental mathematics online, 43% teach Intermediate Algebra online, and 26% teach College Algebra online. Other courses taught online include Statistics, Liberal Arts/Finite Mathematics, Precalculus, Trigonometry, Mathematics for Elementary Teachers, Number Bases, Beginning Algebra, and Integrating Science, Mathematics and Technology. Several of the participants teach more than one course online.

The majority of the survey participants, 29 faculty, use a course management system to create materials for their online classes. Thirteen faculty use WebCT and 16 faculty use Blackboard. Additionally, 14 faculty report using HTML to create materials, and four use Prentice Hall software. FrontPage, MathML, and Microsoft PowerPoint are each used by two of the survey participants. Other materials listed by faculty in response to this question included Adobe Acrobat, Carnegie Learning, Inc. materials, Embanet, Flash, IMME (developed at respondent's institution), Java, Microsoft Word, Respondus, Thinkwell, and Web Board. Again, several respondents indicated that they use more than one of the above so that the total is more than 35.

When asked to indicate the maximum number of students in an online course at their institution, no one reported less than 12 students per class, and only two respondents reported a maximum between 12 and 15. The remaining faculty surveyed indicated that the maximum number of students in an online class at their institution is 16 or more with the most common range, a maximum of 21 to 25 students per course as reported by 10 faculty. Eight of the respondents

teach at institutions where the maximum number of students in an online class is more than 30.

Responses to questions concerning compensation revealed that the majority of institutions, 68.57%, compensate faculty for developing online courses but only 14.29% provide additional compensation for faculty who teach online courses. Similarly, 88.57% of the respondents answered that they chose to teach mathematics online while the remaining 11.43% indicated that they began to teach mathematics online because no one else was willing to teach the courses and their college insisted on offering online mathematics courses.

Thirteen participants indicated that online courses are considered the intellectual property of faculty at their institutions. Online courses are not considered faculty intellectual property at 19 of the respondents' institutions, and three faculty did not answer this question.

The majority of the faculty, 32 respondents, indicated that they teach at a two-year institution. Of the remaining three respondents, two teach at four-year institutions and one indicated "other" in response to the question "How would you categorize your institution?"

When asked if they had ever taken an online course, respondents divided rather evenly. Nineteen indicated they had taken an online course and 16 had not.

Training for Faculty to Teach Online

Table 2 illustrates the set of survey items related to faculty training to teach online.

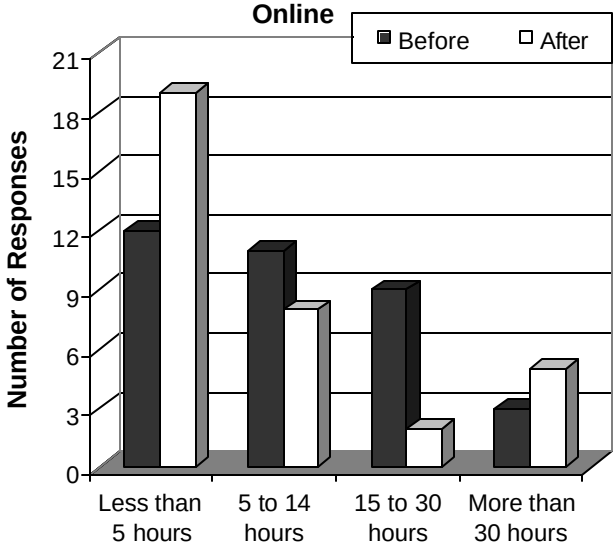
Table 2: Training Survey Items

BEFORE: Please answer the following questions based on training that you received PRIOR TO teaching any online courses:
How much training for online teaching did you receive before beginning to teach online?
What types of training for online teaching did you receive before teaching online?
What types of software were you trained to use before teaching online?
What are the different ways you received your training for online teaching before teaching online?
AFTER: Please answer the following questions based on training that you received AFTER beginning to teach online courses:
How much training for online teaching did you receive after beginning to teach online?
What types of training for online teaching did you receive after teaching online?
What types of software were you trained to use after beginning to teach online?
What are the different ways you received your training for online teaching after you began to teach online?
For each of the following questions, please select the number that most closely describes your opinion of the online courses you have taught (Likert scale questions):
The training I received before beginning to teach online adequately prepared me to teach online.
Training in using course management software would have been helpful.
Faculty do not need training to teach online.
I would have benefited from more training in facilitating online interaction among students BEFORE I began to teach online.
I would have benefited from more training in facilitating online interaction among students AFTER I began to teach online.
I spent too much time on training prior to teaching online.

The majority of the faculty responding to the survey received less than one credit equivalent (fifteen hours) of training for online teaching before beginning to teach online and only three faculty received more than 30 hours of training prior to teaching online. Approximately one-

third of the respondents reported receiving less than five hours of training to teach online prior to beginning to teach online. Figure 1 illustrates these responses and compares them to faculty responses to the question of how much training to teach online they received after beginning to teach online.

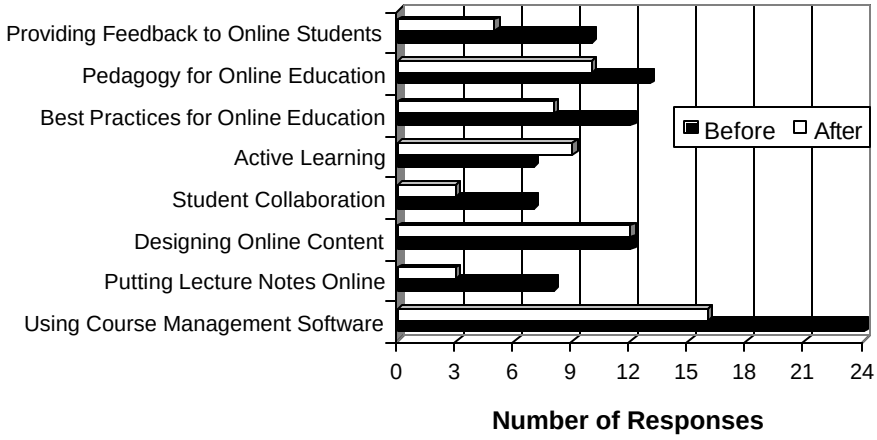
Figure 1 Duration of Training to Teach Online



Faculty were asked to indicate the topics included in training for online teaching that they received both before and after beginning to teach online. Twenty percent of faculty responding to this item indicated receiving training in active learning and student collaboration before beginning to teach online and almost 23% received training to put lecture notes online. Slightly over one-third reported receiving training in designing online

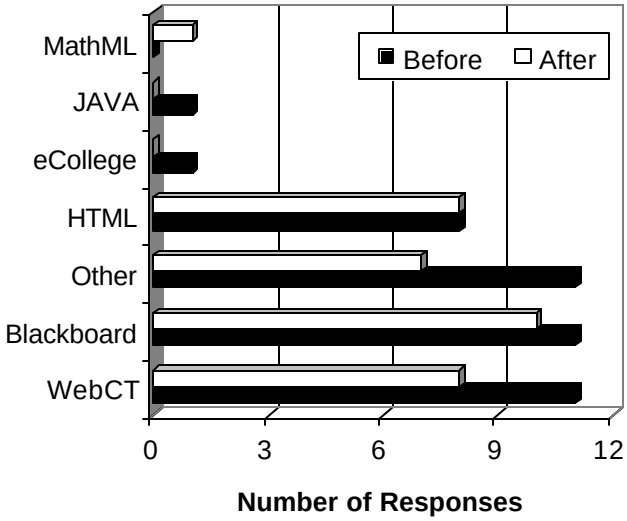
content, best practices for online education, and pedagogy for online education, whereas over two-thirds received training to use course management software and about 28% received training in providing feedback to online students. As indicated in Figure 2, fewer respondents reported receiving all types of training to teach online after they began teaching online when compared to before teaching online with the exception of active learning and designing online content. More faculty received training in facilitating active learning after they began to teach online and twelve faculty received training in designing online content both before and after beginning to teach online.

Figure 2 Training Topics



When queried as to the type of software they were trained to use before teaching online, faculty were evenly divided between Blackboard and WebCT, with 11 trained to use each system. One faculty member reported receiving training to use Java and another reported training to use eCollege. Eight respondents were trained to use HTML before they began to teach online and 11 respondents answered “other” in response to this item. In responding to the request to specify “other” types of software they had been trained to use, several faculty listed Prentice-Hall’s Interactive Math and Eduprise. Front Page, Embanet, SERF, and Outlook Express were each listed by individual respondents. Figure 3 shows the differences in software training received by faculty before and after they began to teach online.

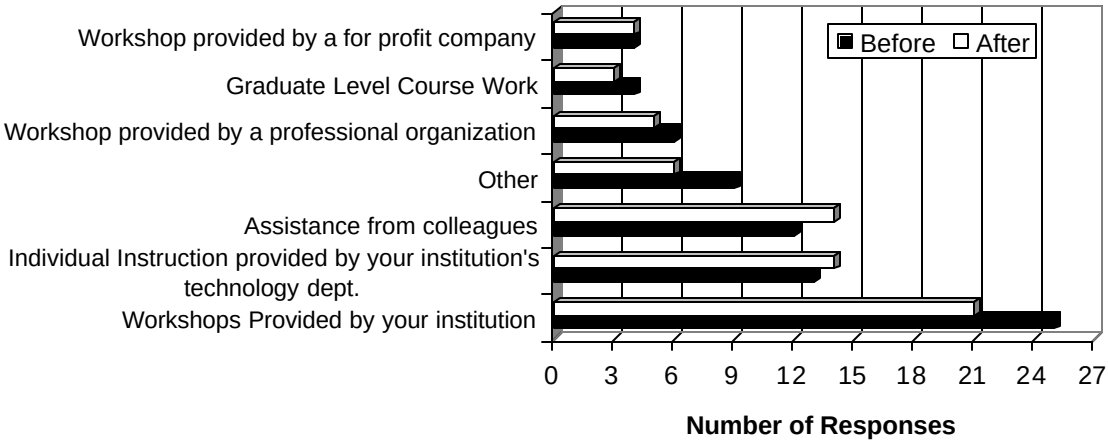
Figure 3 Software Training



The final survey item dealing with training received prior to teaching online asked respondents to discriminate with regard to the way in which training was delivered. Four respondents took graduate level course work and 25 attended workshops provided by their school before beginning to teach online. Additionally, 13 reported receiving individual assistance provided by their college's technology personnel and 12 received assistance from colleagues before beginning to teach online. A total of ten respondents attended workshops offered by professional organizations and for profit companies before they began to teach online. Figure 4 shows that fewer faculty attended graduate level courses or workshops provided by their

institution or a professional organization after beginning to teach online but more faculty reported receiving individual instruction from the school's technology personnel and assistance from colleagues after beginning to teach online.

Figure 4 Different Ways Training Is Received



The second part of the survey consisted of a Likert scale where faculty responded to items on a scale from one to five with one being "strongly disagree' and five "strongly agree." The complete results on this portion of the survey can be found in Appendix E.

Most faculty disagreed that the training they received prior to teaching online adequately prepared them to teach online. Seventeen faculty chose disagree or strongly

disagree in response to this item, six were neutral, 10 agreed, and two strongly agreed.

In responding to the statement “Faculty do not need training to teach online,” 25 respondents strongly disagreed, five disagreed, three were neutral, and only two strongly agreed. Another item read “I spent too much time on training prior to teaching online.” Twenty-eight of the 35 survey respondents disagreed or strongly disagreed with this statement, five were neutral, and only two agreed or strongly agreed.

The final items relating to training focused on training to use course management software and training in facilitating online interaction among students. Twenty-five respondents agreed or strongly agreed that training in course management software would have been helpful and 21 said they would have benefited from more training in facilitating online interaction among students before they began to teach online. When asked if they would have benefited from more training in facilitating online interaction among students after they began to teach online, 19 respondents agreed or strongly agreed.

Best Practices in Online Education

In order to assess the degree to which faculty teaching online undergraduate mathematics courses incorporate recognized best practices for online education into their courses, twelve items on the Likert scale section of the survey referenced best practices in online education. Table 3 lists the survey items related to best practices in online education and the percentage of participants who agreed or strongly agreed with each statement.

Table 3: Best Practice Survey Items

1) Standards for my online classes are comparable to those for my traditional classes.	94%
2) My online students receive prompt feedback from me.	97%
3) I am satisfied with the amount of student/faculty interaction in my online courses.	56%
4) I am satisfied with the quality of student/faculty interaction in my online courses.	59%
5) Online courses encourage active learning.	74%
6) Online courses work for student who use different learning styles.	76%
7) Online students cooperate and collaborate while learning mathematics.	35%
8) Online mathematics courses are an effective way for students to learn mathematics.	76%
9) Online students spend at least as much time on task as students in traditional classes.	82%
10) My online courses are more interactive now than when I first started teaching online.	65%

With regard to standards, 14 faculty agreed and 19 faculty strongly agreed that standards for their online classes are comparable to standards for their traditional

classes. No one strongly disagreed with that statement, one person disagreed, and one person was neutral.

When asked about prompt feedback, 33 faculty agreed or strongly agreed with a statement that online students receive prompt feedback, one disagreed, and one did not respond to that item.

Similarly, most faculty indicate satisfaction with both the amount and quality of student/faculty interaction in their online courses. Eleven faculty indicated they are not satisfied with the amount of student/faculty interaction in their online courses, four were neutral, and one did not respond. The remaining 19 faculty responded agree or strongly agree that they are satisfied with the amount of student/faculty interaction in their online courses.

Twenty faculty agreed or strongly agreed that they are satisfied with the quality of the student/faculty interaction in their online courses, four were neutral on this question, one did not respond, nine faculty disagreed, and one strongly disagreed with the statement.

While a number of faculty were neutral, 25 agreed or strongly agreed that online courses encourage active

learning and that online courses work for students who use different learning styles.

Faculty are more divided with regard to student collaboration in online courses. When responding to the statement “Online students cooperate and collaborate while learning mathematics,” 11 faculty disagreed, 11 were neutral, 12 agreed, and one did not respond. A similar division occurred on an item about interactivity. Responses to “My online courses are more interactive now than when I first started teaching online” indicate that five faculty disagreed with that statement, seven were neutral, ten agreed, and twelve strongly agreed. Here again, one participant did not respond to the item.

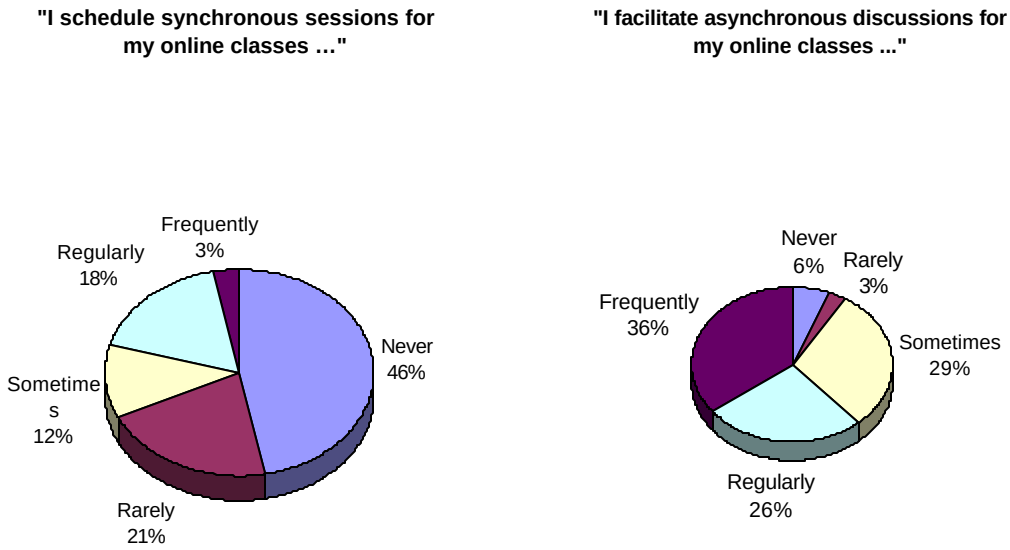
A composite best practice score for each respondent was calculated by averaging each person’s responses to the Likert scale items that dealt with best practices for online education. Using the 1 to 5 response scale, the composite scores ranged from a low of 2.5 to a high of 4.9 with a median of 4.

“Online mathematics courses are an effective way for students to learn mathematics” elicited primarily positive responses. Only two faculty disagreed with the statement, six were neutral, and 26 agreed or strongly agreed. Similar

results occurred with the statement “Online students spend at least as much time on task as students in traditional classes.” Only one respondent disagreed with that statement, five were neutral, and 28 agreed or strongly agreed.

Synchronous chats and asynchronous discussions elicited varying responses from faculty. Figure 5 shows that whereas synchronous sessions are never used by almost half of the respondents, asynchronous discussions are used frequently or regularly by over 60% of the faculty responding to the survey.

Figure 5 Synchronous/Asynchronous Discussions



Faculty Beliefs Regarding Online Education

Table 4 illustrates the percentages of faculty surveyed who agreed or strongly agreed with the items related to faculty beliefs about online education. Overwhelmingly, faculty agreed or strongly agreed that online classes take more time and are more difficult to teach. Twenty-four faculty agreed or strongly agreed that they spend more time teaching an online class than a traditional class and 26 faculty agreed or strongly agreed that teaching online is more difficult than teaching in a traditional classroom.

Table 4: Faculty Beliefs

Question	Percent
I spend more time teaching an online class than a traditional class	71%
Teaching online is more difficult than teaching in a traditional classroom	74%
Students find online courses more difficult than traditional classroom courses.	76%
Online students learn mathematics.	88%
Online mathematics courses are an effective way for students to learn mathematics.	76%
There are some undergraduate courses that should not be taught online.	69%
Developmental mathematics courses can be taught online.	77%
Online courses are as effective as on-campus classes in teaching mathematics.	68%
I enjoy teaching online.	88%
I hope to continue teaching online classes.	97%

Approximately the same number of respondents, 26, agreed or strongly agreed that students find online courses more difficult than traditional courses and none of the respondents strongly disagreed with that statement.

Faculty were almost unanimous that students enrolled in online mathematics courses are performing at a level commensurate with their peers in on campus mathematics courses. Four faculty were neutral on that statement but 30 agreed or strongly agreed, and one did not respond. A similar item, “Online mathematics courses are an effective way for students to learn mathematics,” elicited slightly less positive responses. Two faculty disagreed, six were neutral, one did not respond, and 26 agreed or strongly agreed.

Survey participants agree that there are some undergraduate mathematics courses that should not be taught online. Only eight faculty disagreed with that statement, three were neutral, one did not respond, and 24 agreed or strongly agreed. When asked if developmental mathematics courses can be taught online, four faculty disagreed, four were neutral, 19 agreed, and eight strongly agreed. Faculty indicated belief that online courses are effective. Only six faculty disagreed with the statement “Online courses are as effective as on campus courses in teaching mathematics,” five were neutral, one did not respond, and 23 agreed or strongly agreed.

Survey respondents enjoy teaching online. Two faculty did not respond to this item, four were neutral, and 29 responded that they agreed or strongly agreed with the statement “I enjoy teaching online.” Consistent with that response, 33 of the respondents agreed or strongly agreed that they intend to continue teaching online classes, one was neutral, and one did not respond.

Focus Group Interviews

Four focus groups were conducted with 14 faculty who completed the survey and indicated that they would be willing to participate in an interview. Three focus group interviews were conducted face-to-face, the fourth was conducted online, and each focus group contained three or four faculty members. In reporting the results of these interviews, approximately 50% of the participants are quoted. In order to preserve confidentiality, no names are used with these quotations.

Online courses taught by these faculty range from Beginning Algebra through Business Calculus and include several mathematics courses designed specifically for non-math majors such as Liberal Arts Mathematics and Mathematics for Teachers.

Demographics of Interview Participants

Two of the faculty interviewed indicated that they teach hybrid courses in addition to online courses and one person teaches only hybrid courses. Geographically, faculty interviewed teach online courses for colleges located in Arkansas, Delaware, Georgia, Illinois, Michigan, New Mexico, North Carolina, Ohio, Oklahoma, Pennsylvania, Texas, Utah, and Washington. As to gender, there were five males and nine females interviewed.

Technology Training Reported by Interviewed Faculty

In response to the question of what kind of training they had before beginning to teach online several replied "none." In every interview at least one faculty member stated that they began teaching online early and that, subsequently, their college instituted a formal training program. When one instructor asked, "How do I do this?" he/she was given the software package FrontPage along with the manual and told that was all he/she would need.
Five faculty who participated in the interviews stated that they did not receive any training to teach online prior to beginning to teach online. Fifty percent of those interviewed indicated that they received some training

prior to teaching online and only two reported receiving extensive training.

Those faculty whose schools use course management systems received training on how to use the system and several also received training in developing web pages. Several faculty reported going to conferences and attending mathematics workshops because their institution offers only generic workshops and “generic tends to be for the History and English people.” One of these participants, after attending a number of ICTCM and AMATYC conferences and workshops, organized a three-day summer workshop under the auspices of a state professional organization. That conference was specifically concerned with how to teach mathematics online.

Approximately half of the faculty interviewed reported receiving additional training to teach online after they began teaching online. Two stated that, after they began teaching online and made the administration aware of the need for training for faculty to teach online, their college instituted training. In separate interview sessions, two other participants reported taking graduate level course work in online education. One of these stated

their reason for taking a graduate course online was to experience online learning from the student perspective.

Pedagogical Training Reported by Interviewed Faculty

The next interview question asked faculty if they had received any pedagogical training to teach online. Ten of the faculty interviewed stated that they had not received any pedagogical training. Only two people reported that the training they received prior to beginning to teach online included both technical and pedagogical aspects of online education. One of these is the person identified earlier who organized a state conference. In setting up the conference, this particular faculty member was careful to include both technology and pedagogy. Two other faculty reported that they read texts containing general advice regarding teaching online.

Necessary Components of an Online Course

After faculty discussed the training they received to teach online, the researcher asked them to identify the components of an online course that are critical for successful online education. They identified good communication, screening students, community building activities, orientation to the course, and clear

expectations as essential components of a successful online course.

All four focus groups identified the need for good communication between faculty and students as a necessary component of a successful online course. During one of the focus groups, all participants emphasized that good communication implies prompt feedback from instructors. One of the participants in this group characterized it as a professional obligation and another stated “this is (an) ongoing, constant, everyday, all day long, check your email.”

The need to screen students was mentioned by faculty interviewed. Participants noted that online mathematics courses are not appropriate for every student and some described the difficulties encountered by students attempting to take online courses without a computer. Because of these problems, most faculty would like their college to institute a mandatory screening process whereby students would be permitted to register for online courses only if they passed the requisite criteria. Some criteria cited, in addition to course prerequisites, were the ability to use a computer, to work independently, and an email account.

A third critical component of a successful online course that was cited by all four groups was the development of a community of students. Two participants described this as active learning and all groups referred to the use of student-to-student communication through asynchronous discussions. These discussions take various forms, depending on the individual course and the use or lack of a course management system. Thirteen of the fourteen instructors interviewed use either discussion boards or web boards. The only instructor who disagreed with the need for community building activities was the instructor who taught only hybrid courses. This instructor stated that approximately one-third of the students in the hybrid courses taught at their institution are very individualistic and “resent having to work with somebody else.”

Although an orientation for online students was mentioned by faculty in every interview group, there was some disagreement on this point. In the first interview group only one faculty member described a mandatory college orientation without which students are not permitted to register for an online course. No one else in that interview group commented on this. In both the second and

third interview groups, faculty were unanimous that student orientations should be required, and in the fourth interview group there was disagreement about the need for student orientation. Three of the four faculty members in the last group mentioned the need for a student orientation. One of them planned to add an orientation component to his/her course, another stated that “the orientation saved me multiple headaches with basic questions on the setup of the course,” and the third stated that, when polled, my students “indicated that the orientation session was needed and most helpful to get them started.” However, the fourth faculty member in this group stated that she had discontinued an orientation and, although students in previous terms had said the orientation should be required, she found no significant difference between classes where the orientation was required and those where it was not required.

The need for clear expectations and structure in an online course was mentioned in three of the four interview groups. One group discussed this at great length, comparing their experiences. Several faculty in the group noted that they learned of the need for structure only through experience. In the words of one faculty member, “I thought,

I’m doing College Algebra, this is not developmental math, I don’t need to hold their hand, big mistake.” Whereupon another person in this group responded, “even in Complex Analysis, they need the structure too. They’re human too.”

Necessary Training for Faculty to Teach Online

Finally, after discussing the training they received and identifying the components of a successful online course, participants were asked to identify the training they believe should be required for faculty prior to teaching undergraduate mathematics courses online. Every group expressed the belief that some training should be required and participants were unanimous in the belief that this training should include both technology and pedagogy. Three of the four groups listed taking a class online and mentoring as additional required training.

Although all interviewees agreed that technology training should be required for all faculty before they begin teaching online, faculty disagree on what constitutes technological literacy. In particular, one group discussed the use of HTML, course management systems, and FrontPage. While they did not agree on the need for HTML, they did agree that the computer literacy obstacles are going to fade and they expressed the belief that the technology has

become easier to use and, over time, will continue to become more transparent. Other groups expressed the desire for follow-up technology training to be offered on an as needed basis. Several of the faculty interviewed stated that the technology training they received made more sense the second time. In the words of one faculty member, "…training I received the second time made more sense once I had taught a course using …."

Faculty interviewed were also unanimous that required training for faculty to teach online should include pedagogical as well as technical elements. The main thread for pedagogical training was the ability to engage students online. Participants stated that this should include training in learning styles, facilitating online discussions, psychology of the online student, and assessment and evaluation for online courses. One participant emphasized the need for online faculty to be conversant with AMATYC standards and the use of pedagogies that require inquiry. Another participant indicated the need for more time for faculty to experiment, and a third stated that faculty should be compensated for time spent in both training and course development.

As indicated at the beginning of this section, three out of four faculty focus groups also stated that taking a course online should be part of the training required before faculty begin to teach online. Everyone in these groups agreed that, since experience is often the best teacher, it is imperative to have the student experience. As one online instructor explained, “you realize a lot of things, like the number of emails and postings I had to look at and all the different things I had to go to … it would take me hours and hours.”

The same three faculty groups that identified the need for faculty to take an online course also suggested that training for faculty to teach online should include a mentoring component. Throughout the interviews, individual faculty in these groups referred to their early experiences with online teaching and named colleagues who had mentored them. Several said that they do not think they would have continued teaching online if it had not been for the encouragement and assistance they received from a colleague. One faculty member explained that his/her college is instituting a mentoring program whereby prospective online faculty will act as teaching assistants in online courses in order to “get their feet wet before

taking a class of their own.” The institution is increasing the number of students in these online sections as a way of financing the program. Some faculty, who did not specifically mention mentoring, referred instead to discussion groups. At one school the distance learning faculty meet regularly for a roundtable discussion about their experiences. Another participant stated that distance learning listservs had proven extremely helpful.

Statistical Analyses

A Spearman correlation was calculated to determine the strength of the relationship between duration of training for online instruction and faculty incorporation of best practices. In order to rank faculty’s incorporation of best practices, a composite best practice score was calculated for each respondent by averaging each individual’s responses to those items on the survey related to best practices in online education. Faculty were then ranked based on their composite scores. When the best practice ranks were compared with faculty rank based on duration of training received to teach online, the resulting Spearman correlation, $r_s = .104$, was not significant.

Since there was no significant correlation between faculty training to teach online and faculty incorporation

of best practices in their online courses as indicated by their composite best practice score, the researcher separated the respondents based on type of training reported and a Spearman correlation was calculated for training to teach online and best practices for only those faculty who reported receiving training in either best practices for online education or pedagogy for online education. There were 16 faculty in this group and the correlation was $r_s = .006$, again indicating no significant correlation.

Alternatively, the researcher isolated only those faculty who received training in both best practices for online education and pedagogy for online education. There were seven faculty in this group. When a Spearman correlation was calculated for duration of faculty training to teach online and faculty incorporation of best practices in online education for this group, the value of the coefficient was $r_s = -.06$, again indicating no significance.

Because the research did not demonstrate a significant correlation between faculty training to teach online and faculty use of best practices for online education, the researcher calculated another Spearman correlation comparing faculty experience in online teaching and their

use of best practices. This time r_s = .283683. The critical value for alpha = .05 is .283. Thus, the correlation between faculty experience in online teaching and faculty incorporation of best practices is significant. Table 5 summarizes the results of these statistical calculations.

Table 5: Spearman Coefficients

Correlation of Faculty Incorporation of Best Practices with:	r_s =	
1) Training Before	.104	
2) Pedagogical or Best Practice Training	.006	
3) Pedagogical and Best Practice Training	-.06	
4) Online Teaching Experience	.284	

CHAPTER 5

DISCUSSION

Introduction

The purpose of this study was to examine the training to teach online received by faculty who teach undergraduate mathematics courses online and to assess the effectiveness of that training. Accordingly, an online survey was distributed to 64 faculty who teach undergraduate mathematics courses online. Thirty-five faculty responded to the survey, a response rate of 55%. A subset of these faculty later participated in either a face-to-face or an online focus group interview.

Research Results

The study sought answers to five distinct research questions. Answers to each question are presented in a separate section for the sake of clarity.

Formal Training or Self-Taught?

The first research question asked whether faculty take advantage of formal courses or if they are self-taught. As indicated in chapter four, survey responses show that the majority of faculty surveyed received some formal training before beginning to teach online. Twelve of the 35 faculty reported receiving less than five hours of training to

teach online before beginning to teach online in response to survey item number 11. When asked to identify the different ways they received training before beginning to teach online (item number 14), five of those 12 faculty selected “other” and explained that they received no training to teach online.

Of the 14 faculty interviewed, five also stated that they received no training to teach online prior to beginning to teach online mathematics courses. However, a check of the survey results indicated that only two of the faculty who indicated receiving no training on the survey were interviewed. Hence it can be stated that a total of eight faculty out of 35 survey participants, about 23%, received no training before beginning to teach online.

As indicated in Figure 1, the most common response was “less than five hours” to both the before and after survey items numbered 11 and 15. Twelve faculty reported receiving less than five hours of training after beginning to teach online and, based on their responses to other questions, six of the 12 actually received no training after beginning to teach online. An additional cross-check of the data revealed that, of the six faculty who reported receiving no training to teach online after beginning to teach online,

four also reported receiving no training to teach online before beginning to teach online.

Therefore, in this group of 35 faculty members who teach undergraduate mathematics courses online, 11% have not received any training at all to teach online. It is important to note that these are experienced online faculty. Examination of their responses to survey item number two revealed that only one of the four reported less than one year of online teaching experience, one had between two and three years of online teaching experience, another reported between four and five years of online teaching experience, and the fourth had over five years of online teaching experience.

These findings indicate that the majority of faculty who teach online undergraduate mathematics courses are not self-taught. They do receive training and most of that training occurs before faculty begin to teach online courses. During focus group sessions, only 14% of the faculty interviewed noted reading books about teaching online and the same percentage spoke of the value of distance learning discussion groups and listservs. These low numbers indicate that most faculty who do not receive formal training are also not self-taught. That is, most

participants in this study who did not receive formal training to teach online did not seek information from books, discussion groups, or listservs.

Differences in Training Before and After

The second research question asked when faculty who teach undergraduate mathematics courses online receive training to teach online, whether their training occurs before and/or after they begin to teach online, and if there is a difference between the types and duration of training received before and after beginning to teach online. Figure 1 demonstrates that more faculty received between five and 30 hours of training before beginning to teach online than after but that, in the other categories, “less than 5 hours” and “more than 30 hours”, more participants received training after beginning to teach online. Thus, after beginning to teach online, slightly more than half of the participants received little or no additional training and approximately 14% of them received extensive additional training, most commonly in the form of graduate level courses.

Regarding training topics, the only topic that occurred more often in training after than before was active learning. The difference here (see Figure 2) is

slight and could be due to sampling error caused by the relatively small size of the sample. However, the increased frequency of training in active learning after faculty began to teach online could also be due to increased emphasis on this topic during recent years, especially within the mathematics community.

Of greater significance is the fact that participants clearly received more training in using course management software than any other training topic. Both before and after beginning to teach online, training to use course management software was reported significantly more often than any other topic. This is also illustrated in Figure 3, which details training to use various types of software. Training for Blackboard and WebCT, both popular course management systems, was reported more frequently both before and after faculty began to teach online than any other software training. Significant numbers of participants indicated that they use these course management systems and, based on faculty interviews, the number of responses indicating training after beginning to teach online is likely due to the fact that participants began teaching online before their institution made this particular software available.

Workshops provided by the faculty member's institution are by far the most common training delivery method. Over 70% of the participants received training at such workshops prior to teaching online and 60% attended workshops at their institution after they began to teach online. In contrast, only 11% of participants attended workshops by for profit companies or completed graduate level course work.

Based on discussions during the focus group interviews, it was concluded that this discrepancy is due to the fact that participants did not have the time and/or necessary funds to seek training from sources other than their own institutions. Survey responses to item number seven indicate that only 14% of the participants receive additional compensation for teaching online courses although, in response to survey items number 24 and 25, approximately three-fourths of respondents say that online courses require more time and are more difficult to teach. Thirty-three of the faculty who responded to the survey teach at two-year institutions where the typical full-time teaching load is 15 credit hours per term. That would make it very difficult to devote time to seeking training from outside sources such as graduate level courses, or

workshops offered by for profit or professional organizations.

Training Faculty Perceive As Beneficial

The third research question was designed to identify the training that faculty perceive as beneficial. Results of both the online survey and focus group interviews demonstrate the need for training for faculty to teach online. Examination of responses to survey item number 21 revealed that 85% of participants believe that faculty need training to teach online. Sixty percent responded that they would have benefited from more training in facilitating online interaction before they began to teach online, and, during focus group interviews, faculty expressed discomfort and resentment with regard to their lack of training. They repeatedly expressed frustration at having to “reinvent the wheel.”

When asked to identify the training that they believe should be required before faculty begin to teach undergraduate mathematics courses online, all participants in the focus group interviews agreed that both technical and pedagogical training should be required before faculty begin to teach online.

Faculty who participated in the focus group interviews did not agree, however, on the contents of required technical training. Some believe that faculty must have knowledge of HTML while others believe that the current state of available technologies has made this unnecessary.

In one focus group, several faculty members addressed the technical difficulty of communicating mathematics online. Whether in a synchronous chat room, an asynchronous discussion board, or on email, only language can be used on the Internet. One of the toughest problems faced by mathematics faculty is translating mathematical symbols into the English language in such a way that students relate the words to the symbols. MathML, a relatively new software on the market, purports to solve this problem by making mathematical symbols HTML compatible but only one participant in this research reported receiving training in MathML and, in the words of another participant, “no one has really done a good job with that.” In another focus group, one faculty member indicated that she circumvents the problem by having students fax homework to her rather than attempting to submit their assignments online. Other faculty spoke of students’ difficulties with verbalizing

mathematics and related that they use writing assignments to assist students to improve their abilities in this area.

Regarding technical training, focus group participants did agree that faculty must be trained to use course management systems if their institution uses such a system to provide online courses. Survey results indicate that training to use course management systems is currently being provided, although not always before faculty begin to teach online. All 29 participants in this research who teach online courses using course management systems did receive technical training to use those systems although 24% of them did not receive that training until after they began to teach online.

Faculty interviewed agreed that pedagogical training to teach online should include training in learning styles, facilitating online discussions, psychology of the online student, and assessment and evaluation for online courses. The concern expressed most often among faculty was the difficulty of engaging students in online learning. One faculty member interviewed emphasized the need for active learning with the concern that an online course that contains primarily lecture is nothing more than an electronic version of a correspondence course.

These faculty recommendations are consistent with published best practices for online education as reported in this study's review of the literature. In particular, Palloff and Pratt note the need to develop online communities of learners (Palloff & Pratt, 2001). Models of best practice emphasize the need for both interaction and active learning, although this is most evident in "Seven Principles of Effective Teaching: A Practical Lens for Evaluating Online Courses" (Graham, et. al., 2001).

This research demonstrates that postsecondary institutions do a relatively good job of providing technical training for their mathematics faculty to learn to teach online but they do not provide adequate pedagogical training. Twenty-four participants indicated receiving training to use course management systems before and 16 received training after they began to teach online yet, in response to survey items numbered 12 and 16, only 13 faculty received pedagogical training before and only 12 received pedagogical training after they began to teach online. Further, of the 35 participants, only three received both technical training to use course management systems and pedagogical training in best practices both

before and after they began to teach online. That is less than 9% of the population.

Course management systems contain tools such as chat rooms and discussion boards that can facilitate active learning and student collaboration but faculty who teach online undergraduate mathematics courses may not be skilled in facilitating student discussion and collaboration. Learning how to use the available tools does not necessarily enable faculty to effectively incorporate these tools into their online courses, hence the need for additional pedagogical training.

In addition to technical and pedagogical training, three of the four faculty focus groups indicated that training for faculty to teach online should include a mentoring component and several faculty in each of these groups provided anecdotal evidence in the form of personal experiences that attested to the effectiveness of mentoring for faculty who teach online courses. Several interviewees spoke of the assistance they received from colleagues who teach online but more referred to the problems they encountered because they were the first at their college to teach online and it was difficult to find colleagues with whom to collaborate. The need for mentoring is also evident

from the responses to items numbered 14 and 18 of the online survey where participants indicated that they received more personal instruction after they began to teach online. This is consistent with Cravener's recommendation of a mentoring component along with ongoing technology support in her psychosocial model of faculty development (Cravener, 1999), and with both Greer (Eduprise, 2003) and Fink's (Fink, 2002) emphasis on the need for ongoing support for faculty who teach online.

Inclusion of Best Practices for Online Courses

Faculty recommendations that required pedagogical training should include elements such as the ability to engage students online indicate that faculty do recognize the need to incorporate best practices in their online courses. When asked to identify components critical to the success of online courses, faculty listed good communication, community building activities, and clear expectations, all of which are accepted best practices in online education.

The fact that 65% of the participants in this study agreed that their online courses are more interactive now than they were at the beginning of their online teaching career illustrates faculty incorporation of best practices

in their online courses. As reported in chapter four, composite best practice scores were calculated for the 35 faculty who completed the survey and faculty composite scores ranged from a low of 2.5 to a high of 4.9 with a median of 4 and a mean of 3.867. These results indicate that some, but not all, faculty incorporate best practices in their online courses.

Further research could determine the reason for this discrepancy but it is consistent with responses to survey items related to training. The majority of faculty who participated in the study did not receive pedagogical training to teach online nor did they receive training in best practices for online education. Only 12 of the 35 participants reported receiving training in best practices for online education prior to beginning to teach online and only eight received such training afterward. That is a maximum of 57% of participating faculty who teach online undergraduate mathematics courses receiving training in best practices for online education. It is not surprising, then, that on average, faculty “agree” with best practices rather than “strongly agree.”

Two additional survey items related to best practices, items numbered 44 and 45 refer to the use of synchronous

and asynchronous course activities. Figure 5 illustrates faculty responses to these items. Survey results indicated a large difference between faculty use of synchronous and asynchronous activities. Among the faculty responding to this survey, 46% never schedule synchronous sessions for their online classes yet 62% frequently or regularly schedule asynchronous discussions. During focus group interviews, participants commented on the difficulty of scheduling synchronous sessions for online classes and indicated that they instead rely on asynchronous activities such as discussion boards and web boards. In contrast, experts such as Palloff and Pratt and White and Weight advocate the use of both synchronous and asynchronous sessions to build community among students enrolled in online courses. Because only slightly more than half of the faculty participants in this study are satisfied with the quality and/or amount of faculty/student interaction in their online courses, faculty should be exploring all possible avenues to increase and improve faculty/student interaction. The lack of training in active learning, student collaboration, and providing feedback to students, is a more logical explanation for the lack of synchronous sessions, but further research is warranted.

Relationship Between Best Practices and Training

In order to answer the final research question of whether a relationship exists between the degree to which faculty incorporate best practices in their online courses and the training that faculty receive to teach online, Spearman correlations were calculated. As reported in chapter four, there was no significant relationship between the duration of training to teach online that faculty receive before beginning to teach online and their incorporation of best practices in their online courses.

One possible explanation for the lack of significance is the fact that the Spearman correlation coefficients were based on a nonrandom, self-selected sample and, for each subsequent calculation, the sample was even more refined. The lack of significance is further illuminated by a more detailed examination of faculty responses to items dealing with training topics. At least one-third of the participants in this research received no pedagogical training before beginning to teach online.

Because only 10 participants received training in providing feedback to online students, only seven received training in active learning, and only seven received training in student collaboration, the training that

faculty did receive in both pedagogy and best practices must not incorporate published best practices in online education. The content of the best practices and pedagogical training reported by faculty participants is not clear from the available data, but the numbers clearly demonstrate that pedagogical and best practices training received by the participants in this study did not include accepted best practices in online education. The training that faculty identified as pedagogical and/or best practices concentrated on course structure benchmarks (IHEP, 2000) and AFT guidelines (AFT, 2000) rather than on the lessons learned from Graham et al. (Graham et al., 2001). This study did not explore these training topics in detail and further research is warranted.

The researcher anticipated that research would indicate that faculty training would incorporate accepted principles of best practices for online education but, because that is not the case for the participants in this research, a fourth Spearman coefficient was calculated to determine the relationship between faculty use of best practices for online education and faculty experience in online teaching. This time, r_s =.366, indicating significance at the .05 level.

The significance of this relationship supports the need for a mentoring program for faculty beginning to teach undergraduate mathematics courses online. Such a program would facilitate faculty incorporation of best practices in their online courses by acquainting faculty with techniques that the mentor uses to foster active learning, promote interaction, provide feedback, and facilitate collaboration.

Summary of Results

Survey and focus group interviews indicate that, for the 35 participants in this research:

- 23% received no training prior to teaching online
- Faculty are frustrated at their lack of training
- Few faculty receive adequate training
- 11% received no training either before or after beginning to teach online
- Technical training should be required and should include use of appropriate course management systems
- Pedagogical training should include facilitating online discussions, assessment and evaluation for online courses, learning styles, and psychology of online students
- Faculty do not receive training in pedagogical best

practices for online education

Limitations of the Study

Survey Instrument

Because of the lack of research in training for online faculty, the researcher was unable to find any published instrument that examines duration, topics and types of training received by faculty preparing to teach online. For that reason, the researcher constructed the survey used for this data collection. Every attempt was made to ensure the validity of the instrument. Initially the instrument was read and discussed during a graduate seminar on instrument design and changes were made based on suggestions from that group. Later, it was piloted with faculty who teach online undergraduate mathematics courses. This group did not suggest any additional changes to the instrument.

The content validity of the instrument can be judged by the consistency of responses on a number of the Likert scale items. Item number 43, “Online courses are as effective as on-campus classes in teaching mathematics,” item number 34, “Online mathematics courses are an effective way for students to learn mathematics,” and item number 37, “Online students learn mathematics” are different yet similar items and one would expect similar

patterns in the answers to those items if the instrument has content validity. It was reported in chapter four that, on the first of these items, 23 faculty agreed or strongly agreed. Similarly, 26 faculty agreed or strongly agreed with the second item and 30 agreed or strongly agreed with the third. Additionally, no participants strongly disagreed with any of these items.

Focus Group Interviews

Previously, it was noted that one of the interview questions did not elicit the type of response expected. When asked to identify the necessary components of a successful online course, participants gave examples of screening processes and course orientations but they did not propose any concrete suggestions for facilitating good communications. Nor did they offer any community-building activities. The interview questions were not piloted which may account for this discrepancy. Further, the researcher is not skilled at conducting focus groups. It is likely that, with a trained interviewer, the responses to this question might have concentrated more on activities specific to undergraduate mathematics courses.

Sampling Procedure

Another limitation of the research is the fact that the respondents were not randomly selected for this study. There is no published list of faculty who teach undergraduate mathematics courses online. Professional mathematics organizations such as AMATYC and MAA do not maintain lists of faculty who teach mathematics online. Accordingly, the researcher identified survey participants from several sources. Primarily, participants were members of the AMATYC Distance Learning Committee. Additional faculty who teach undergraduate mathematics courses online were identified using virtual community college websites.

The respondents also comprise a self-selected sample. The online survey was distributed to 64 faculty and 35 responded. That represents a response rate of only 55%.

Faculty Experience

During focus group interviews several participants indicated that they were the first at their school to teach online. This may, in part, account for both the low duration of training to teach online received before and the relatively high duration of training received after faculty began to teach online. Some participants in this study began to teach online before training was available,

hence they may have received more training after beginning to teach online than before.

Conclusions

This research indicates that most of the faculty who teach undergraduate mathematics courses online

- are experienced classroom teachers who enjoy teaching online
- receive formal training to teach online
- need both technical and pedagogical training to teach online
- are aware of the need to incorporate best practices in online education in their courses
- lack the skills to incorporate best practices for online education in their courses
- need improved pedagogical training
- need continuing, ongoing support and training
- need mentors
- should experience online learning from the student point of view

Thirty-two of the faculty who responded to the survey have at least five years of classroom teaching experience. Most of the faculty currently teaching online enjoy doing so and hope to continue despite the fact that they believe

that online courses require more time and are more difficult to teach than traditional face-to-face classes.

Most faculty teaching online undergraduate mathematics courses do receive training to teach online but over 20% of the participants in this research study received no training before beginning to teach online. Despite recommendations by the AFT, Cravener, Gibbons, Gold, IHEP, Palloff, Pratt, Weight, Wentworth, White and others, 11% of the online faculty surveyed for this study did not receive any training either before or after they began to teach online.

One indication of the need for additional technical training before faculty begin to teach online is the discrepancy between the number of users of course management systems and the number of faculty receiving training to use these systems before beginning to teach online. The fact that 13 faculty reported receiving individual instruction provided by their institution’s instructional technology department after they began teaching online, can be interpreted as further evidence of the need for additional technical training for faculty who teach online.

The need for pedagogical training for faculty to teach online is evident in several places in the results of this research. On survey item number 22, “I would have benefited from more training in facilitating online interaction among students BEFORE I began to teach online,” 21 faculty agreed or strongly agreed. All four faculty focus groups listed good communication between faculty and students as a necessary component of an online course, and the fact that 22 of the survey respondents agreed or strongly agreed with survey item number 38, that their online courses are more interactive now than when they first started teaching online, is further evidence of the need for pedagogical training before faculty begin to teach online. The need for pedagogical training is also stated in White’s writing,

> Although the online environment depends on computer-mediated communication, it involves people in ways that other examples of distance education may not. ... Online teaching depends on effective communication attitudes and behaviors. ... Effective online teaching is twofold: the ability to transmit messages clearly and accurately, and the ability to maintain positive interpersonal relationships (White & Weight, 2000, pp1, 10-11).

The lack of significant correlation between training and faculty use of best practices for online education also illustrates the need for more and better pedagogical training. Few participants in this research received pedagogical training, even fewer received training in best practices for online education, and still fewer received training in specific best practices such as active learning and providing feedback to students, yet during focus group interviews faculty listed community building activities and good communication as essential components of an online course. This is consistent with White's findings at Grant MacEwan Community College (White, 2000).

Faculty are aware of the need for best practices in online education in spite of their lack of pedagogical training as indicated by this research but many faculty who teach undergraduate mathematics courses are not skilled in facilitating active learning. The movement from traditional lecture to collaboration and active learning in undergraduate mathematics classes (AMATYC, 1995) occurred only a few years before colleges began offering courses online and many faculty teaching undergraduate mathematics courses in classrooms and online are still struggling to develop these new skills.

When participants in the focus groups were asked to identify the necessary components of an online course they included good communication and community building activities but their emphasis was on the need to screen students, orient students to the course, and set clear expectations. This is surprising because these latter components are not related to training for faculty. Rather, they emphasize external factors that are common problems to all types of education at the undergraduate level. Although this research did not probe these responses, it is likely that faculty emphasis on external factors is due to the technical emphasis of the training they have received. Recalling that they have not received pedagogical training and that only two of them mentioned reading about how to teach online, it is not surprising that this group did not emphasize best practices for online education when describing the necessary components of an online course. They have only learned the difficulty of actively engaging students online and facilitating interaction through several years of first hand experience. Those early years of experience with online teaching would have been easier for faculty and much better for students if the faculty had

received pedagogical training before they began to teach online.

This study supports the need for continuing, on-going training and support after faculty begin to teach online. This support is evident from several areas. First, in the words of one faculty member who was interviewed, "___ training I received the second time made more sense once I had taught a course using ___" Second, there were more faculty in the group receiving over 30 hours of training after beginning to teach online than before. Third, faculty surveyed report receiving more assistance from colleagues and more individual instruction from their institution's instructional technology department after beginning to teach online. Finally, three of the four focus groups listed a mentoring component as part of the training that they suggest should be required for faculty to teach undergraduate mathematics courses online.

The positive correlation between faculty online teaching experience and faculty incorporation of best practices in their online courses supports the concept of mentoring. Training, as it has been offered in the past, does not seem to positively affect faculty use of accepted best practices for online education, however the more

online teaching experience a faculty member has, the more he/she incorporates best practices in his/her online courses. An experienced faculty mentor should have a positive effect on the degree to which a faculty member who is new or relatively inexperienced with regard to online education, incorporates accepted best practices for online education.

A final conclusion is the need for faculty to receive at least a portion of their training to teach online through an online course. Gibbons and Wentworth also recommend that training be designed to allow prospective instructors to experience the type of online collaboration and dialogue that is necessary for student success in this medium (Gibbon & Wentworth, 2001). The need for faculty to experience online learning from the student point of view in order to fully understand online education was emphasized by three of the four faculty focus groups interviewed. Survey results showed that 19 of 35 faculty participants had taken an online course and, in the words of one respondent, “you realize a lot of things, ...it would take me hours and hours.”

Recommendations for Additional Research

Other than the difficulty of communicating mathematics online, as expressed during several focus group interviews, this research did not find any indication that teaching mathematics online is significantly different from teaching other disciplines online. To the extent that teaching undergraduate mathematics online is similar to teaching other undergraduate courses online, the results of this study may generalize to other disciplines. Future research could seek to replicate this study with undergraduate English faculty, undergraduate Liberal Arts faculty, and/or undergraduate Science faculty. Examining similarities and differences among the various discipline faculty could lead to better preparation for all faculty to teach online.

Future research should also be conducted to determine the extent to which pedagogical training for faculty to teach online incorporates accepted best practices for online education. Because this study found no significant correlation between training to teach online and faculty incorporation of best practices in their online courses, further research is warranted.

This research found a large difference between faculty use of synchronous and asynchronous sessions for online

courses. Most faculty who participated in this study use asynchronous discussions on a regular basis but do not schedule synchronous sessions. This is contrary to published best practices for online education, and, therefore, further research should be conducted to determine the feasibility and efficacy of synchronous sessions for undergraduate courses that are conducted online and to determine whether lack of training in facilitating online discussions is the true reason faculty do not schedule synchronous sessions.

Finally, the faculty interviewed for this study recommended mentoring as a necessary component of training to teach online although none had experienced a formal mentoring program. Further research in this area should be conducted to investigate the effectiveness of formal mentoring programs for faculty to teach online. The Maryland FOTTC project (Maina & Keeton, 2001) is an example of a formal mentoring program that should be investigated further.

Recommendations for Faculty Training To Teach Online

Training programs for faculty to teach online undergraduate mathematics courses should contain four major components:

- Technical training
- Pedagogical training
- Mentoring
- Online course work

At a minimum, technical training should include both the course management system that will be used to deliver the online course and the use of software that facilitates communicating mathematics via the Internet.

Pedagogical training must emphasize accepted best practices for online education such as those published by IHEP or Graham et al. or Chickering and Gamson's *Seven Principles for Good Practice in Undergraduate Education*. Specifically, faculty should receive training in facilitating interaction and discussion in online courses, in facilitating active learning and collaboration online, in assessment and evaluation for online courses, and in community-building activities for online courses.

Some portion of either the technical or pedagogical training for faculty to teach online should be delivered online so that faculty experience online education from the student point of view.

Finally, mentoring should be provided both as faculty begin to teach online and as they gain experience with this medium.

Ko & Rosen, Palloff and Pratt, White and Weight, among others, have written books designed to assist faculty in making the transition from the classroom to online education. The Learning Resources Network (LERN), Learning to Teach On-Line (LeTTOL), and others, offer online courses for faculty to learn to teach online but most faculty are not benefiting from them. As one interviewee said, she was handed a software manual and told it was all she would need. Now, that faculty member helps plan semi-annual faculty institutes at her college where faculty receive both technical and pedagogical training to teach online. Another interviewee described a new mentoring program that his/her institution is beginning for faculty to teach online. The literature illustrates that some colleges, universities, and even state systems such as in Maryland and Tennessee, offer training that incorporates both technical and pedagogical aspects as delineated in published best practices for online education. However, this study demonstrates that most two-year colleges are not

yet offering adequate training for faculty to learn to teach online.

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Appendix A:

Email to Participants

Dear Colleague:

I am writing to request your assistance with a research project. The purpose of the project is to identify the types of training provided to undergraduate mathematics faculty who teach online and to measure faculty satisfaction with that training. This is my doctoral dissertation project and I would greatly appreciate your input.

You are receiving this survey because you are listed as a member of AMATYC's Distance Learning Committee and/or have been identified as teaching an undergraduate mathematics course online.

I am very thankful to you for your assistance with this project. Please complete the online survey by clicking on the link: http://www-cgi.ccac.edu/survey/Pankowski.html

If you have never taught an online mathematics course please do not complete the survey. If you know of someone else who teaches online undergraduate mathematics courses please feel free to forward a copy of this email to them and/or contact me and I will email them personally.

Thank you,

Peg Pankowski

Mathematics Professor

CC of Allegheny County

AMATYC Secretary

(412)469-6228

mpankowski@ccac.edu

mpankows@aol.com http://www-cgi.ccac.edu/survey/Pankowski.html

Appendix B:

Participant Consent Forms

Consent to Participate in a Research Study

TITLE: How Do Undergraduate Mathematics Faculty Learn To Teach Online?

INVESTIGATOR: Margaret (Peg) Pankowski
Community College of Allegheny County
1750 Old Clairton Road, Route 885
West Mifflin, PA 15122
412-469-6228

ADVISOR: Dr. William P. Barone, Chair of the Department of Instruction and Leadership, School of Education, Duquesne University, 412-396-6111

SOURCE OF SUPPORT: This study is being performed as partial fulfillment of the requirements for the doctoral degree in Instruction and Leadership at Duquesne University.

PURPOSE: You are being asked to participate in a research project that seeks to investigate how undergraduate mathematics faculty learn to teach online. Your participation will consist of completing an online survey. Some participants will later be asked to participate in a taped interview.

CONFIDENTIALITY: Your name will never appear on any survey or research instruments. No identity will be made in the data analysis. All written materials and consent forms will

be stored in a locked file in the researcher's home. All online materials will be stored on a secure server. Your responses will only appear in statistical data summaries. All materials will be destroyed at the completion of the research.

RIGHT TO WITHDRAW: You are under no obligation to participate in this study. You are free to withdraw your consent to participate at any time.

SUMMARY OF RESULTS: A summary of the results of this research will be supplied to you, upon request, upon completion of the study.

VOLUNTARY CONSENT: I have read the above statements and understand what is being requested of me. I also understand that my participation is voluntary and that I am free to withdraw my consent at any time, for any reason. On these terms, I certify that I am willing to participate in this research project.

I understand that should I have any further questions about my participation in this study, I may call Dr. Paul Richer, Chair of the Duquesne University Institutional Review Board (412-396-6326).

_____ I agree to participate

_____ **I do not agree to participate**

Consent to Participate in a Personal Interview

TITLE: How Do Undergraduate Mathematics Faculty Learn To Teach Online?

INVESTIGATOR: Margaret (Peg) Pankowski
Community College of Allegheny County
1750 Old Clairton Road, Route 885
West Mifflin, PA 15122
412-469-6228

ADVISOR: Dr. William P. Barone, Chair of the Department of Instruction and Leadership, School of Education, Duquesne University, 412-396-6111

SOURCE OF SUPPORT: This study is being performed as partial fulfillment of the requirements for the doctoral degree in Instruction and Leadership at Duquesne University.

PURPOSE: You are being asked to continue your participation in the research project “How Do Undergraduate Mathematics Faculty Learn To Teach Online by now participating in a personal interview with the researcher. The interviews will be tape recorded to ensure accuracy.

CONFIDENTIALITY: Your name will never appear on any survey or research instruments. Your voice will never be used in the results of the study. No identity will be made in the data analysis. All recordings, written materials and

consent forms will be stored in a locked file in the researcher's home. All online materials will be stored on a secure server. Your responses will only appear in statistical data summaries. All materials will be destroyed at the completion of the research.

RIGHT TO WITHDRAW: You are under no obligation to participate in this study. You are free to withdraw your consent to participate at any time.

SUMMARY OF RESULTS: A summary of the results of this research will be supplied to you upon request at the completion of the study.

VOLUNTARY CONSENT: I have read the above statements and understand what is being requested of me. I also understand that my participation is voluntary and that I am free to withdraw my consent at any time, for any reason. On these terms, I certify that I am willing to participate in this research project. I understand that should I have any further questions about my participation in this study, I may call Dr. Paul Richer, Chair of the Duquesne University Institutional Review Board (412-396-6326).

_____ _____

Participant's Signature Date

Appendix C:

Survey: Learning to Teach Mathematics Online

Learning To Teach Mathematics Online

Directions: Answer the following questions only in relation to mathematics courses that you teach wholly online. That is, courses that do not meet in a scheduled on campus room.

I Teaching Experience: This first group of questions is demographic in nature. Answer each question by placing a check on the appropriate line.

1. How many years of traditional classroom teaching experience do you have?
__ Less than 1 year __ 2 years to less than 3 years __4 years to less than 5 years
__ 1 year to less than 2 years __ 3 years to less than 4 years __ 5 years or more

2. How many years of online teaching experience do you have?
__ Less than 1 year __ 2 years to less than 3 years __4 years to less than 5 years
__ 1 year to less than 2 years __ 3 years to less than 4 years __ 5 years or more

3. What mathematics courses have you taught online? Check all that apply.
_____ Developmental Mathematics _____ Trigonometry
_____ Intermediate Algebra _____ Calculus
_____ College Algebra _____ Statistics
_____ Liberal Arts/Finite Mathematics _____ Differential Equations
_____ Precalculus _____ Other (please specify) _____

4. Which of the following methods do you use to create materials for your online class(es)? Check all that apply:
_____WEBCT _____ECOLLEGE ____JAVA
_____BLACKBOARD _____ HTML ____MATHML
_____Other (Please specify) _____

5. What is the maximum number of students in an online course at your institution?
_____Less than 12 ____16 - 20 ____26 - 30
_____12 – 15 ____21 – 25 ____ More than 30

6. Does your school compensate faculty for developing online courses?
_____ Yes _____ No

7. Does your school provide additional compensation for faculty who teach online courses?
_____ Yes _____ No

8. Why did you begin to teach mathematics online?

_____ I chose to teach online
_____ My dean/administrator designated one of my courses to be offered online
_____ The college insisted that we offer online mathematics courses and no one else was willing to teach them

9. Are online courses at your institution considered as faculty intellectual property?
_____Yes _____No _____I don't know

10. How would you categorize your college?

____Two-Year ____Four-Year ____ Other

II Training Experience: Questions #11-18 ask for information about the types of training to teach online that you have received. The questions are divided into two sections: Before and After. Answer by placing checks on all appropriate lines.

BEFORE: Answer Questions #11-14 based on training that you received **prior to** teaching any online courses.

11. How much training for online teaching did you receive before beginning to teach online?
___ Less than 5 hours ___ 5 – 14 hours ___ 15 – 30 hours ___ More than 30 hours

12. Check all types of training to teach online that you received BEFORE teaching online.

_____Active Learning
_____Student Collaboration
_____Putting lecture notes online
_____Designing online content
_____ Other (Please specify) _____

_____ Providing feedback to online students
_____ Using Course Management Software
_____ Best Practices for online education
_____ Pedagogy for online education

13. Types of software that you were trained to use BEFORE teaching online:

_____WEBCT _____ECOLLEGE ____JAVA
_____BLACKBOARD _____ HTML ____MATHML
_____Other (Please specify)
_____

14. What are the different ways that you received your training for online teaching BEFORE
teaching online? Check all that apply.

____Graduate Level Course Work
____Workshop(s) provided by your school
____Individual instruction/help provided by your school's technology personnel
____Assistance from colleague(s)
____Workshop/Short Course provided by professional organization such as AMATYC.
____Workshop/Short Course provided by a for profit company such as LERN or Syllabus.
____Other (Please specify) _____

AFTER: Answer Questions #15-18 based on training that you received **after** beginning to teach online courses.

15. How much training for online teaching did you receive after beginning to teach online?

___ Less than 5 hours ___ 5 – 14 hours ___ 15 – 30 hours ___ More than 30 hours

16. Check all types of training to teach online that you received AFTER teaching online.

_____Active Learning _____ Providing feedback to online students
_____Student Collaboration _____ Using Course Management Software
_____Putting lecture notes online _____ Best Practices for online education
_____Designing online content _____ Pedagogy for online education
_____ Other (Please specify) _____

17. Types of software that you were trained to use AFTER beginning to teach online:

_____WEBCT _____ECOLLEGE ____JAVA
_____BLACKBOARD _____ HTML ____MATHML
_____Other (Please specify)
_____

18. What are the different ways that you received your training for online teaching AFTER you began to teach online? Check all that apply.

____Graduate Level Course Work
____Workshop(s) provided by your school
____Individual instruction/help provided by your school's technology personnel
____Assistance from colleague(s)
____Workshop/Short Course provided by professional organization such as AMATYC.
____Workshop/Short Course provided by a for profit company such as LERN or Syllabus.
____Other (Please specify) _____

III Observations: **For each of the following questions circle the number that most closely describes your opinion of the online courses that you have taught.**

1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

19. The training I received before beginning to teach online adequately prepared me to teach online. 1 2 3 4 5

20. Training in using course management software would have been helpful.
1 2 3 4 5

21. Faculty do not need training to teach online.
1 2 3 4 5

22. I would have benefited from more training in facilitating online interaction among students *before* I began to teach online.
1 2 3 4 5

23. I would have benefited from more training in facilitating online interaction among students *after* I began to teach online.
1 2 3 4 5

24. I spend more time teaching an online class than a traditional class.
1 2 3 4 5

25. Teaching online is more difficult than teaching in a traditional classroom.
1 2 3 4 5

26. Standards for my online classes are comparable to those for my traditional classes.
1 2 3 4 5

27. My online students receive prompt feedback from me.
1 2 3 4 5

28. I am satisfied with the amount of student/faculty interaction in my online courses.
1 2 3 4 5

29. I am satisfied with the quality of the student/faculty interaction in my online courses.
1 2 3 4 5

30. Online courses encourage active learning.
1 2 3 4 5

31. Online courses work for students who use different learning styles.
1 2 3 4 5

32. Online students cooperate and collaborate while learning mathematics.
1 2 3 4 5

33. Students find online courses more difficult than traditional classroom courses.
1 2 3 4 5

34. Online mathematics courses are an effective way for students to learn mathematics.
1 2 3 4 5

35. Online students spend at least as much time on task as students in traditional classes.
1 2 3 4 5

36. I spent too much time on training prior to teaching online.
1 2 3 4 5

37. Online students learn mathematics.
1 2 3 4 5

38. My online courses are more interactive now than when I first started teaching online.
1 2 3 4 5

39. There are some undergraduate mathematics courses that should not be taught online.
1 2 3 4 5

40. Developmental mathematics courses can be taught online.
1 2 3 4 5

41. I enjoy teaching online.
1 2 3 4 5

42. I hope to continue teaching online classes.
1 2 3 4 5

43. Online courses are as effective as on campus courses in teaching mathematics.
1 2 3 4 5

For the next two questions use the scale:
1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Regularly, 5 = Frequently

44. I schedule synchronous sessions for my online classes.
1 2 3 4 5

45. I facilitate asynchronous discussions for my online classes.
1 2 3 4 5

IV Additional Information

If you would be willing to participate in a personal interview concerning training for undergraduate mathematics faculty to teach online please supply the following contact information. (Note: If you do not wish to participate in a personal interview, ignore this question.)

NAME_____
EMAIL _____
TELEPHONE _____

Appendix D:

Interview Questions

INTERVIEW QUESTIONS

1. Tell us your name, where you currently teach, what subject(s) you teach online, and how long you've been teaching online.
2. Describe any technology training you have received to teach online.
3. Describe any pedagogical training you have received to teach online.
4. Identify the components that you think are most critical for successful online education.
5. Identify the training that you think is necessary before faculty begin to teach undergraduate mathematics courses online.
6. Identify any additional training that you think <u>should</u> have before beginning to teach undergraduate mathematics courses online.
7. Is there anything else you would like to tell me about training for faculty to teach online undergraduate mathematics courses?

Appendix E

Survey Responses to Likert Scale Questions

Likert Scale Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
1. The training I received before beginning to teach online adequately prepared me to teach online.	11	6	6	10	2	35
2. Training in using course management software would have been helpful.	1	1	7	21	4	34
3. Faculty do not need training to teach online.	25	5	3	0	2	35
4. I would have benefited from more training in facilitating online interaction among students BEFORE I began to teach online.	3	2	9	9	12	35
5. I would have benefited from more training in facilitating online interaction among students AFTER I began to teach online.	4	1	10	11	8	34
6. I spend more time teaching an online class than a traditional class.	1	3	6	10	14	34
7. Teaching online is more difficult than teaching in a traditional classroom.	1	3	5	14	12	35
8. Standards for my online classes are comparable to	0	1	1	14	19	35

Likert Scale Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
those for my traditional classes.						
9. My online students receive prompt feedback from me.	0	1	0	13	20	34
10. I am satisfied with the amount of student/faculty interaction in my online courses.	2	9	4	15	4	34
11. I am satisfied with the quality of student/faculty interaction in my online courses.	1	9	4	14	6	34
12. Online courses encourage active learning.	0	3	6	15	10	34
13. Online courses work for students who use different learning styles.	14.	0	15.	1	16.	7
14. Online students cooperate and collaborate while learning mathematics.	21.	4	22.	7	23.	11
15. Students find online courses more difficult than traditional classroom courses.	28.	0	29.	2	30.	6
16. Online mathematics courses are an effective way for students to learn mathematics.	0	2	6	22	4	34
17. Online students spend at least as much time on task as students in traditional classes.	0	1	5	12	16	34

Likert Scale Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
18. I spent too much time on training prior to teaching online.	16	12	5	1	1	35
19. Online students learn mathematics.	0	0	4	23	7	34
20. My online courses are more interactive now than when I first started teaching online.	0	5	7	10	12	34
21. There are some undergraduate mathematics courses that should not be taught online.	0	8	3	13	11	35
22. Developmental mathematics courses can be taught online.	0	4	4	19	8	35
23. I enjoy teaching online.	0	0	4	16	13	33
24. I hope to continue teaching online classes.	0	0	1	19	14	34
25. Online courses are as effective as on-campus classes in teaching mathematics	0	6	5	14	9	34