

Project Description

This three-year NSF/ATE Teacher Preparation Partnership project will provide a seamless pathway for potential and declared pre-service teachers through a seamless link between regional high schools, Pellissippi State Technical Community College (PSTCC), and Tennessee Technological University (TTU) (See support letters in Supplementary Documentation). Through this collaboration, a four year teacher licensure program will be offered on the community college campus which will immerse pre-service teachers in colorful and intriguing math, science and technology experiences, professional development and leadership opportunities, and unique mentoring teams. Through the proposed Math and Science Teacher Education Resource Hubs (MASTER Hubs), this program will have an emphasis on conceptual understanding of math, science, and technology, integrated with field experience, mentoring opportunities and connections with local science resources.

The need for quality K-12 teachers who are literate in math and science is a major challenge facing our nation. The United States is expecting a tremendous teacher shortage and it is estimated that two million new teachers will be needed by the year 2007 (National Science Foundation, 1998). Therefore recruitment of highly motivated teachers and the quality of their training is very important. Community colleges have the potential to truly help alleviate this teacher shortage, since about 5.5% of community college freshman say they want to be elementary teachers, and about 3.5% want to be secondary teachers. Over the next decade this could result in more than 500,000 new teachers coming through community college programs (Evelyn, 2002). The shortage of quality K-12 teachers has become particularly acute in the state of Tennessee where teacher salaries are among the lowest in the nation. Many of Tennessee's current and prospective teachers are lured away to neighboring states such as

Georgia where signing bonuses and higher salaries tempt them. The State of Tennessee expects to have to replace 40-50% of its current teaching population in the next seven years. The potential for recruiting minority teachers and improving pre-service teacher education at the community college level is substantial. Pellissippi State is well positioned to help in the recruitment and retention of future teachers across these spectra because of our campus locations. Our main campus, with a student body of about 5000, is located in west Knoxville and it is currently estimated that the number of PSTCC students who are thinking about majoring in education is about 250. The Magnolia branch campus of Pellissippi State which will be involved in this proposed project is located in an Empowerment Zone community near inner city Knoxville. The community surrounding the Magnolia campus is approximately 80% African American, which certainly increases the opportunities to serve, recruit, and educate this underrepresented population. Also, because the community college has an open door admissions policy, so PSTCC welcomes , supports and encourages students with diverse backgrounds and needs.

Of course, it is not enough to train and graduate more teachers, because quality is more important than quantity. There is evidence that good teaching greatly impacts student success, and that content knowledge must be the central focus in the preparation of teachers (National Research Council, 2001). Research literature supports the idea that “in the absence of conceptual understanding of content, effective teaching is highly improbable” (NRC, 2001). The ability of students to truly understand the scientific method of inquiry, as well as the number of students who say that they “like” math and science, increases in a positive correlation to the number and quality of science and math courses that the teacher took in college (NRC, 2001). Many teachers are uncomfortable teaching math and science, have low-self confidence in their own

mathematical abilities, and do not have a strong conceptual understanding that would enable them to help their own students to gain this type of understanding. Therefore, it is imperative that colleges strive to improve the math and science preparation of future teachers. Community colleges are well qualified to provide this improved training because of their emphasis on excellence in teaching. Community college professors focus on providing an excellent academic experience for future teachers and serve as a model of innovative and high quality instruction (Wood, 2001).

Studies show that approximately 40% of in-service teachers take at least some, if not all, of their science and math courses at community colleges (NSF, 1998). Thus, community colleges represent a critical component in the educational continuum for many areas of education and career training, and are positioned to serve as a bridge between high school students and four-year universities. This project seeks to magnify the role of PSTCC in the area of teacher preparation by recruiting and training pre-service teachers to prepare them for transfer to a four year university. The initial foci of the Pellissippi State efforts are collaboration with Tennessee Technological University and excellence in math and science teaching. TTU offers an outstanding four-year education program with a particular emphasis on math, science, and technology. PSTCC will collaborate with TTU faculty to implement and improve math and science courses designed specifically for teachers. This collaboration will be accompanied by integration of technology and alignment to the Tennessee and National Standards in mathematics and science.

The primary goal of this proposal is to establish and maintain two “Math and Science Teacher Education Resource” (MASTER) Hubs at PSTCC which will be dedicated to pre-service teacher training. This facility will allow Pellissippi State to create a positive learning

environment so that these future teachers will gain or enhance a positive attitude and appreciation for math, science and technology. The MASTER Hub will be the central location for all teacher education activities, and will immerse these students in a strong technology infused math and science focused educational environment. High school students will be actively recruited to participate in mentor-teams, classroom activities, workshops, student conferences and other activities that will occur throughout the year. In the first year of the project, the MASTER Hub will be located in an approximately 1,800 square feet 100% dedicated facility on the main campus of PSTCC. In the second year of the project, an additional 1,100 square feet 50% dedicated MASTER Hub will be established on the Magnolia Avenue campus of PSTCC, which primarily serves minority populations. Imagine walking into a specially designated room surrounded by the sights and activities related to math, science and technology. Descriptive math and science posters are hanging on the walls, and shelves are filled with intriguing math manipulatives and scientific tools. There is a science lab area with benches and hoods, tables with chairs forming a small group discussion area, and a twenty seat computer area. A place will be created that student teachers want to be, a positive and innovative learning environment. This area will accommodate 24-30 students and has already been dedicated to this project by the PSTCC administration.

Specific Objectives

Recruitment

While recruiting from the main PSTCC campus MASTER Hub will target all area high schools, creation of an additional Master Hub at PSTCC's Magnolia Avenue Campus will enable us to place special emphasis on recruitment of minority students into PSTCC, and particularly the teaching profession. The Magnolia Avenue Campus of PSTCC was opened in Fall 2001.

This facility was purchased independently by Pellissippi State (no state monies) and then renovated with additional donated funds. Located in an inner-city high minority area, this new campus has expanded PSTCC's opportunity to meet the educational needs of an under-served population. While the minority population of all area high schools from which PSTCC primarily draws students is 12%, the African American population of the two high schools close to the Magnolia Campus is 40 - 60%. Forty-three percent of Knox County's minority population lives in the Empowerment Zone, which surrounds the Magnolia Campus. Pellissippi State President, Dr. Allen Edwards, observed, "Our main campus is about 16 miles from the center of Knoxville and even further from the eastern reaches of the county. We found East Knox residents in general were underserved by higher education. Research showed almost twice as many West Knox residents held college degrees as did people living in East Knoxville. Likewise, statistics showed 11 percent of West Knox residents participated in higher education, while only six percent of people in East Knox County did. Clearly, we needed to make a commitment to eastern Knox County. We found the ideal location with our new Magnolia Avenue campus."

It is in this environment that focus on recruitment of a specific clientele of students will occur, once again placing an emphasis on the teacher preparation program through the MASTER Hub. Activities include education of the high school counselors about these new opportunities, visits with high school students, and MASTER Hub open houses to inform present and potential students about the opportunities to become teachers, and the benefits of the profession.

Pellissippi State has considerable experience in the area of program recruitment and supplying prospective students with current information. Over the past two years, Dr. Kelley (Co-PI for this project) has engineered a complete overhaul of the nursing and allied health recruitment and advising system at Pellissippi State. This included identifying potential enrollees, sending

recruitment letters, reducing the total number of advisors for specific areas, and assigning students to advisors who met specific student needs. Working with Pellissippi State's Admissions Office, a concerted effort was initiated and has been maintained to assure area high school students of the most current information related to career pathways, articulation agreements, and job opportunities in those fields. A similar pattern will be followed for students interested in the field of education as this project develops.

Pre-service Teacher Training

PSTCC is in the beginning phases of developing a teacher preparation program with an emphasis on math and science. This effort has been initiated by math and science faculty members and administrators, which positions Pellissippi State to focus on the math and science preparation of future teachers. The PI and Co-PI's for this project, Meg Moss, Yolanda Sankey, and Dr. Jim Kelley, from PSTCC, working with the Co-PI, Dr. Margaret Phelps from TTU, are already involved with a number of projects and collaborations.

a) Last November, Ms. Moss received an internal college grant to accomplish three main goals. The first goal was the creation of two math content courses for future teachers. Second, improvement of the advising system for education majors was initiated. Third, dialogue with area universities began. This third goal enabled members of the team to travel twice to both TTU and the University of Tennessee-Knoxville (UT-K) during spring, 2002, for very profitable meetings. The meetings with TTU were the impetus for establishing a close working relationship. Contacts were established between the appropriate math and science teaching faculty. Through these discussions, Pellissippi State set plans in motion to mirror the first two years of TTU's education program. TTU then made a commitment to teach the upper division courses of the four year education program on Pellissippi State campuses. Although the primary

focus was on the PSTCC/TTU relationship, Ms. Moss has sought to keep communication with UT-K open to ensure articulation agreements and transferability of math and field experience courses.

b) Ms. Moss, PI, and Dr. Kelley (PSTCC) and Dr. Phelps,(TTU) CO-PI's, are participants in the Phi Theta Kappa (PTK)/National Science Foundation (NSF) project, "Preparing Tomorrow's Math and Science Teachers: The Community College's Response." This project has enabled us to learn from colleagues around the country about best practices in math and science preparation of teachers, as well as to continue to strengthen interactions between PSTCC and TTU. As part of this project, our mentor, Dr. Pat Cunniff from Prince George's Community College, visited the PSTCC campus in May of 2002 where she met with PSTCC and TTU faculty and administrators. In October, 2002, the team members from both PSTCC and TTU, along with a PSTCC chemistry faculty member (who will initiate our teacher education Concepts of Chemistry course), will meet with math, science, and education faculty at Prince George's Community College. Knowledge of experiences and successes of the Prince George's faculty in implementing their teacher education program will provide an excellent model for PSTCC.

c) During the summer of 2002, Pellissippi State signed articulation agreements in education with TTU, and also with Lincoln Memorial University (LMU). LMU is a private school with a main campus about 80 miles northeast of Knoxville which began offering a teacher education program on their new campus in West Knoxville in fall of 2002.

d) In June, 2002, TTU was mandated by the Tennessee Board of Regents to bring their four year teacher licensure program on-site at Pellissippi State.

e) In August of 2002, Ms. Moss was appointed as the Teacher Education Program Coordinator, with this developing program housed in the Natural and Behavioral Sciences Department, where

Dr. Kelley serves as chairperson.

f) Ms. Moss traveled to TTU in August, 2002, to meet with members of the TTU College of Education to plan the implementation of this program on the PSTCC campus.

g) In September 2002, TTU articulation coordinator, Jerri Winningham, TTU Assistant Dean of Education, Beth Mannle, and TTU math/science education specialist and Co-PI of this project, Dr. Phelps, met with Mississippi State staff to plan this grant project and the articulation agreement.

h) During October, 2002, TTU initiated the process of hiring education faculty members to teach on the PSTCC main campus. The first junior year cohort will begin at PSTCC during fall of 2003, with both a junior and senior year cohort to follow in fall of 2004. The first graduating class will be spring of 2005.

Specific Courses

Particular attention will be given to developing and improving math, science, and technology courses for future teachers. All courses will focus on the use of hands-on, discovery-based, active-learning approaches and will integrate the use of manipulatives and technology tools. Small group discussions will also be an integral part of this format. These approaches mirror the top teachers' strategies reported by the recipients of the presidential award for excellence in mathematics and science teaching (Hennessy, 2002). Since teachers tend to "teach the way that they were taught," these courses will be designed to model active learning strategies. By physically teaching all of these math, science, and technology courses in the MASTER Hub, the students will experience an immersion into the thoughts, sights, and feel of a unique math, science, and technology learning environment.

Special care will be given to align the curriculum of these courses with both state and

national standards. These courses will be created in collaboration with TTU as well as through examination of similar courses taught at other colleges. Because members of our team have been involved in a variety of relevant activities including the PTK/NSF teacher preparation project, Oregon Collaborative for Excellence in the Preparation of Teachers (OCEPT), Appalachia Educational Laboratory (AEL), Appalachian Rural Systemic Initiative (ARSI), the Institute for Inquiry at The Exploratorium, and Appalachian Collaborative Center for Learning, Assessment, and Instruction in Mathematics (ACCLAIM), a wealth of information along with many collegial contacts have been accumulated. These involvements will enable the teaching faculty to learn from and share ideas with other professionals involved in math, science and technology teacher education. Several members of this team, as well as other key faculty, will also be participating in the Super Computing 2002 Conference in Baltimore in November and the accompanying summer workshop in 2003. These workshops will assist us in integrating additional real world technology into PSTCC's teacher education content courses.

Pellissippi State specializes in the inclusion of technology in teaching and learning across the curriculum. U.S. News and World Report has recognized PSTCC as one of the top fifty community colleges in the nation for its technology opportunities. TTU is a technological university with a mission focused on science, math, engineering, and technology. TTU is committed to preparing all teachers for effective use of appropriate instructional and discipline-specific technology. For the past twenty years, the College of Education has included training in instructional technology as a core requirement of all teacher education programs. More recently, the TTU College of Education received a million dollar endowment for technology and was awarded a three-year Preparing Tomorrow's Teachers to Use Technology (PT3) Implementation grant. This ATE proposal asks for support to help PSTCC math, science, and technology faculty

to better utilize technology and best practices into these courses.

Mathematics

Ms. Moss, PI, (a participant in the PTK/NSF and Super Computing 2002 projects) is the lead teacher responsible for the development and instruction of these math content courses. Under her direction, two sections of the first course in the sequence (Math 1410) were taught during fall of 2002. These had a combined enrollment of 38 students. The second course in this sequence (Math 1420) will be offered during the spring of 2003 along with a repeat of Math 1410. Technology tools, such as computers and calculators, and manipulatives, such as base ten blocks, Algeblocks, and Geoboards, need to be an integral part of these courses. Ms. Moss has experience integrating geometry software, calculators, spreadsheets and the Internet into these math courses through her OCEPT project and her own experiences. In addition, Ms. Moss plans on utilizing other technology such as Fathom software in these courses. Additionally, an example of an activity in these courses that integrates workplace technology is using surveying instruments to bring life and applicability to right triangle trigonometry.

Chemistry

Mr. Garry Pennycuff, an Assistant Professor of Chemistry at Pellissippi State, is responsible for the development and instruction of the Concepts of Chemistry course. One section of the course will be offered beginning spring of 2003. Mr. Pennycuff has ten years experience of teaching chemistry at the high school level (Columbus, OH), which brings a different dimension and an added understanding to PSTCC's program. Within the context of this course, students will be introduced to the wealth of teaching information available through the Eisenhower National Clearinghouse for Mathematics and Science. This plan would include the selection and performance of some laboratory exercises with subsequent peer group

presentations. Additionally, other laboratory exercises spanning the range of do-it-yourself, kitchen chemistry, to the use of Calculator Based Laboratories (CBL's) (e.g. examination of household acids and bases), to the addition of CBL materials to Personal Digital Assistants (PDA's) (e.g. an examination of Boyle's Law) will be introduced. Students will utilize computer software packages, such as Microsoft Excel or other graphing software, to construct plots of data obtained in the laboratory. This process will enable students to use the predictive capabilities of the software to discover other ideas.

Another very exciting real-world application of chemistry is the development of new drugs. Chemical companies have, in the past ten years, become very involved in the use of computerized molecular modeling software in determining the activity- structure relationships for drug candidates and biological processes. In this chemistry course for teachers, students will employ a basic molecular software package (e.g. Rasmol, Spartan, Molekel) to visualize molecules in three-dimensional space. Study of the reactivity of sample molecules with other drug molecules can then reinforce concepts used everyday in the pharmaceutical industry for determining the best candidates for drugs in the treatment of diseases.

Biology

The Concepts of Biology course was developed by Ms. Yolanda Sankey (project Co-PI), who teaches sections of Pellissippi State's on-line biology courses for the Tennessee Regent's On-Line Degree program, Ms. Teresa Fulcher, Lead teacher for Pellissippi state's general biology program, and Mr. Ron Bridges, Lead teacher for Human Anatomy and Physiology I. (Mr. Bridges also supplements a middle school/high school home school science class.) Because of considerable interest in CBL experimentation in many of our local school systems, some laboratory exercises such as diffusion and enzyme action (testing for catalase) will be carried out

in this format, in addition to more traditional approaches. The use of PDA's in data gathering will also be incorporated as a more advanced portion of these experiments. Additionally, there is the opportunity to do remote work with the transmission electron microscope at the Oak Ridge National Laboratory. The biology course that PSTCC is creating is also unique in that several colleges and organizations which were contacted by PSTCC for information either were not satisfied with their syllabus for this type of course or did not have the course. They asked that PSTCC specifically send them a copy of Pellissippi State's syllabus when it was completed.

Earth Science

The earth science course will be developed and taught by Dr. Mike Naney. Dr. Naney has worked with Pellissippi State's geology course sequence for the last six years, bringing to it a wealth of information and contacts from 20 years at Oak Ridge National Laboratory. While continuing to pursue some CBL and PDA work in this course, examining such phenomena as the greenhouse effect, mapping the ocean floor and water field studies, use will also be made of another Pellissippi State resource. Since Pellissippi State is a designated Eisenhower National Clearinghouse (ENC) Access Center, all participants will be introduced to the math and science resources available through ENC. Using information garnered from ENC, students in earth science will examine the Water on the Web project and some of NASA's most up-to-date projects.

Physics

The Concepts in Physics course will be developed and taught by Dr. Allen Farvin, who began his teaching career at Pellissippi State when it opened in 1988. Dr. Farvin's approach to Pellissippi State's course will represent a blend of information, focusing primarily on the course already in place at TTU. Dr. Steve Robinson, the instructor of the TTU course, has a long

standing relationship with the NSF Program, Constructing Physics Understanding, operated by San Diego State University and continues to modify and upgrade the TTU course depending upon the findings of this program. Examples of areas covered in this course would be magnetic, electric circuit and electromagnetic interactions and thermal interactions and conservation of energy.

Introduction to Teaching & Technology

Tennessee Technological University is in the process of combining three courses: Instructional Technology I, Early Field Experience, and Introduction to the Profession, into an integrated unit. This course will be innovative in that it will combine the development of an electronic portfolio, with early field experience, and learning more about the profession and its requirements. TTU will begin offering this course Spring 2003. PSTCC will offer it beginning Fall 2003. Working with TTU, three people at Pellissippi will create and implement this course. Those involved will be Ms. Moss, PI, a new education faculty member to be hired by Pellissippi State by December 1, 2002, and Ms. Audrey Williams. Ms. Williams (a TTU alumnus) is the Instructional Technology Specialist for Pellissippi State. Additionally, Ms. Williams is one of the Pellissippi State participants in the Super Computing 2002 team.

Instructional Technology

Ms. Williams will also create and implement a junior level instructional technology course for TTU. The purpose of this course will be to provide theoretical, practical, and hands-on experiences with the instructional technologies found in a 21st century classroom as well as common technologies employed in today's workplace. This will be accomplished through demonstrations, tutorials, and project based learning. Assignments for the course will include, but are not limited to, creation of HTML files and a web site, developing basic photo image

editing skills, and using office productivity software such as word processors, databases, spreadsheets, presentation packages, and electronic mail. A sample activity to be incorporated is using the digital camera and an HTML editor to storyboard and create a web site about a hands-on activity in science and/or math. The activity will consist of four components. A storyboard

modern thought about the teaching of math and science within a school system, they will be able to point the appropriate individuals in the direction of these professional development activities.

Because there are approximately 250 education majors currently enrolled at Pellissippi State at various stages of their programs, it is anticipated that the introductory science and math courses for education majors for Fall Semester 2003 will show maximum enrollments. For biology, chemistry, physics, and earth science this number would be 24 students per section with multiple sections being available. Based on Fall 2002 enrollments in the mathematics courses (38), Fall 2003 courses will also fill. The introductory course in the series typically has 30 students with multiple sections offered. The same situation will exist with the course, Education 1000, Exploring the Profession. It is projected that as many as 4 sections of this 30 student per section course will be needed.

Articulation

An integral part of this MASTER program is the creation of direct transfer pathways to regional colleges and universities where students can complete their baccalaureate degrees. Currently, the University of Tennessee at Knoxville (UTK) only offers a five-year education program in which education majors take methods courses and have teaching field experience in their fifth year, after earning a bachelor's degree in an arts and sciences field. There are several reasons that this graduate level teacher licensure program does not appeal to PSTCC students. First, it requires an additional year (a five-year program as opposed to a four-year) to earn teacher licensure. Second, students who begin in a community college often do not want to get lost in the crowd of a huge university setting. They greatly prefer a small campus setting, where the professors know their names and they can find a parking place. Third, the fifth year has a low acceptance rate (only about 60% of applicants are accepted into the fifth year program), so

even after getting the bachelors degree in an arts and sciences subject, there is a fairly high probability that they will not be accepted into the licensure program. Fourth, students enrolled in the program must wait until their fifth year for the opportunity to formally explore their future profession. An earlier exposure to the K-12 classroom would be extremely beneficial and could serve to help curb the attrition rate among K-12 teachers. UTK's fifth year program creates a challenge in creating a seamless pathway between the community college and the University teacher education program, since UTK does not have a junior or senior year in teacher education. However, communication and collaboration between UTK and PSTCC is very important and will be pursued in areas such as upper division content courses, and graduate programs for future graduates. Because TTU will be offering their baccalaureate program on-site at Pellissippi State, their articulation agreement will be a primary focus. However, as indicated by the aforementioned LMU relationship, articulation will be explored with several other area colleges and universities. Maryville College (15 miles away), for example, has already expressed an interest in opening pathways for PSTCC students to their teacher education programs. This approach will create for Pellissippi State students a multitude of pathways and opportunities. There are four public universities and fourteen private colleges/universities in the middle and east Tennessee area. As part of this goal of extension, an Education Professions Day will be held each fall. The area colleges and universities with teacher education programs will be invited to come to the PSTCC campus for an information session with prospective teachers. Information from the PTK/NSF National Teacher Preparation conference indicates that the development of similar transfer programs at other community colleges across the country has a dramatic affect on student enrollment. The work proposed here would open up multiple pathways for students pursuing a career in teaching.

Student Support

To enhance recruitment of potential pre-service teachers, to increase persistence to graduation and to promote retention of education majors in the field of teaching once they have completed their training, the following student support activities will be developed and implemented to support students involved in the MASTER program:

MASTER Future Teachers Organization

This will be a student-run organization for pre-service teachers (PSTCC education students, TTU education students, and high school students) that will provide the opportunity for pre-service teachers to network with each other and to collaboratively plan and organize activities. This organization will also serve as an excellent mechanism for conveying information to students about events in the program as well as advising information. Field trips to various state and local community science and math education outreach establishments (American Museum of Science and Energy in nearby Oak Ridge, the IJAMS Nature Center, Knoxville) as well as to more distant science education centers (Tennessee Aquarium, Discovery Museum and the Challenger Center in Chattanooga, TN) will be conducted under the auspices of this student organization. The future teachers will also participate in local professional development meetings and symposiums such as the meetings of the Smokey Mountain Math Educator's Association, the Collegiate division of the Tennessee Academy of Science (Eastern Division) and the East Tennessee Education Association. Due to legal concerns, this club will be connected to the Student Tennessee Education Association in order to provide liability insurance for students as they participate in field experiences.

MASTER Teacher Conference

This annual MASTER Teacher Conference will be planned, organized, and hosted by

students in the MASTER Future Teachers Organization. Faculty advisors will facilitate planning and implementation. The conference will be a mechanism for pre-service teachers to network with each other and area education professionals, to participate in learning workshops, to hear speakers and discussion panels from the field of education, and to develop their organizational skills as future professionals. A focus of the annual conference will be on math, science, and technology instruction. Through the PTK/NSF activities, it was learned that other colleges have held this type of conference with much success. As an example, presenters from the Los Angeles Collaborative for Excellence in Teacher Preparation reported that not only did the pre-service teachers learn by participating in the workshops, but the leadership skills gained and the experience of feeling like a professional were also benefits to the pre-service teachers.

MASTER Mentor Teams

Operating from the MASTER Hub, 4 - 5 member mentoring teams (comprised of one in-service teacher, two freshman/sophomore level pre-service teachers from PSTCC, one junior/senior-level TTU pre-service teacher, and possibly one high school pre-education major) will be developed. Research indicates that mentoring provides a very effective means of teacher development. Just as pre-service students need support from fellow learners (Atwell, 1998), teachers need to have a culture of collegial network of support to get a view of multiple perspectives and not feel isolated in the classroom. Boreen & Niday view mentoring as exchanges of ideas and inquiry and argue that it should begin during the pre-service years (2000). Dr. Kelley, Co-PI, will be responsible for identifying in-service teachers who will participate. Dr. Kelley's eight years of experience with AEL provides many contacts with local school systems. Additionally, contacts have been established through Pellissippi State's early field experience placements. Ms. Sankey, Co-PI, will be responsible for coordinating and

facilitating the MASTER Teams, as well as organizing the activities placed on the program website. Experience gained through both of these will facilitate the selection of mentor team members who exhibit best practices in math and science teaching in both practice and theory.

The plan for the MASTER Mentor Teams is as follows:

TTU student MASTER Mentor Team members will:

- i. advise and mentor PSTCC students through early program activities, and later admission into the TTU program;
- ii. advise and mentor high school students planning to go into the teacher education program;
- iii. assist the in-service teacher to research, develop, implement and assess math, science, and technology activities;
- iv. communicate regularly with their mentor team members via a web bulletin board and in person;

PSTCC student MASTER Mentor Team members will:

- i. advise and mentor high school students planning to go into the teacher education program;
- ii. help the inservice teacher to research, develop, implement, and assess math, science and technology activities in the K-12 classroom;
- iii. communicate regularly with their mentor team members via web bulletin board and in person;

High school MASTER Mentor Team members will:

- i. help the in-service teacher to research, develop, implement, and assess math, science and technology activities in the K-12 classroom;
- ii. communicate regularly with their MASTER Team members via web bulletin board and in person;

In-service teacher MASTER Mentor Team members will:

- i. advise and mentor pre-service team members;
- ii. guide students in the research, development, implementation, and assessment of math, science and technology activities in the K-12 classroom;
- iii. receive a stipend as compensation for their time and efforts;

As team members work through the teaching certification program, and move into their teaching careers, they will be asked to remain a part of their MASTER teams. This support mechanism should serve them well in their crucial early years of teaching. At a recent Tennessee Board of Regents education summit it was noted that 42 percent of teachers in Tennessee leave the profession in the first five years of teaching. In Mississippi, as many as 50 percent of beginning teachers leave the profession within three years, and isolation contributes to their sense of frustration (Buckley, 2002). By experiencing collegial teamwork in their pre-service years, these teachers should understand the importance of these professional discussions and interactions so that they seek and initiate professional dialogues throughout their teaching careers (Boreen & Niday, 2000).

The MASTER Mentor Team members will communicate regularly face to face and via web discussion groups. Web-CT, a common tool at Pellissippi State, will be utilized to implement these Internet based activities and will provide pertinent interactions with colleagues through technology. Every semester, each MASTER Team will collectively develop at least one theme-based K-12 hands-on math, science, and/or technology classroom activity to be shared with other pre-service teachers (through the website, MASTER Future Teachers meetings and conferences). This activity will ultimately be used in K-12 classrooms. Integration of technology into these activities will be encouraged. These activities will become part of the

required assignments for the math, science, and methods courses. Teams will also conduct assessments in order to gauge K-12 student learning in the classroom where the activity was conducted. The results of these assessments will be used in making modifications to the activities. Teams will be encouraged to use materials from the MASTER Hub in these activities.

One model that will be presented to these teams will be that developed by Oregon State University and the University of Idaho. In this plan, pre-service teachers work with in-service teachers to research and integrate the use of computer software into the K-12 classroom (Kelly and Coggins, 2002). Another model incorporated will be that of Boreen & Niday who held purely email mentor relationships among pre-service teachers and between pre-service teachers and veteran teachers (Boreen & Niday, 2000). Lessons can be learned from both of these mentoring models. The Boreen and Niday model found that face-to-face interactions were needed in addition to electronic interactions, which the PSTCC program will incorporate.

K-12 Classroom Experiences

TTU's teacher education program is designed to provide students with extensive field experiences. The junior and senior level methods courses are structured such that during the first half of the semester the students and professor meet in the college setting, and the second half of the semester the students directly apply their knowledge gained in the K-12 classroom through field experiences. PSTCC began offering early field experience opportunities to freshmen pre-service teachers during fall, 2002. In addition, the pre-service teachers involved in this teacher education program will interact with K-12 students and teachers by conducting science, math and technology MASTER Mentor Team activities in area classrooms.

Area K-12 schools have been very receptive to having pre-service teachers in their classrooms. In fact, PSTCC has been receiving many calls from area K-12 schools who are

requesting students to come work with their students. This semester there are not enough pre-service teachers to meet the demand. The sites for all pre-service field experiences will be diversified to include suburban, rural, and urban schools and will provide a variety of learning experiences for pre-service teachers.

Praxis Success Workshop

Since all students have to pass the Praxis I test in order to be accepted into teacher education programs, Ms. Moss will create and team teach a workshop to help students prepare for the Praxis I test with the help of an English teacher. Ms. Moss will teach general test taking skills and review mathematical concepts with the students. The English teacher will prepare the students for the reading and writing portions of this test.

There are also plans to have students tutor fellow students who do not pass the Praxis on the first attempt. Mississippi State maintains a strong tutorial program at designated centers on all campuses, so the mentor tutoring could be linked with the college's existing tutoring programs in the TRIO project, PSTCC Learning Center, or Services for Students with disabilities.

Web-based Resource

A web-based resource for pre-service teachers and their MASTER Mentor Teams will be developed and maintained. The purpose of this resource will be to provide many forms of communication and information. This resource will provide information to pre-service teachers about articulation and transfer programs with regional colleges and universities and about MASTER program opportunities such as activities of the MASTER Future Teacher Organization (trips to local museums, guest speakers, membership). This resource will provide a mechanism to share activities and lessons learned from K-12 math, science and technology teaching experiences through the MASTER Teams and other field experiences. There will be a "resource

review” where pre-service teachers can discuss the pros and cons of the manipulatives and technologies used in the classrooms. The project website will also be a means of sharing syllabi and activities, both with pre-service teachers and worldwide, used in the math, science, and technology courses that PSTCC faculty will be developing in collaboration with TTU. Although some students, particularly from lower socio-economic backgrounds, may not have access to the web based resources from their homes, all of them have access to these resources on campus. Through the technology access fee, Pellissippi has developed excellent student access to computer resources. Because this is a community college setting and many students typically maintain close ties to some part of their local school system, another source of computer access will also be available. Tennessee is one of the states that has established a network based on the “Building A Presence (BAP) in Science” project. (Dr. Kelley played a significant role in the development of this network with Pellissippi State hosting the local organizational meeting.) Students will be provided with the contacts at each school participating in this project. The BAP teachers will be advised of the project, thus establishing a potential local computer use link should the students need one.

Evaluation

The Math and Science Teacher Education Resource (MASTER) Program evaluation plan serves two basic purposes: summative – documenting project outcomes and impacts for reporting to NSF and other stakeholders; and formative – providing regular feedback into planning and decision making to keep the project on course toward its goals. This evaluation plan allows project personnel to look backward and forward, reflecting on lessons learned and capitalizing on emerging opportunities. Design of the MASTER Program evaluation is based on collecting and analyzing information to determine the quality of activities and processes,

significance of outcomes, and degree of impact. The evaluation plan is built around a set of evaluation questions that address both the long-term goal and the project goals outlined in this proposal, and looks at both processes and products.

<i>Goal</i>	<i>Evaluation Questions</i>
<p>Long-Term Goal: Increased content knowledge and pedagogy in elementary science and mathematics pre-service teachers.</p>	<ul style="list-style-type: none"> • To what extent do pre-service teachers demonstrate improved understanding and application of science and mathematics content? • To what extent do pre-service teachers enroll in and successfully complete challenging courses in science and mathematics? • To what extent do pre-service teachers demonstrate positive attitudes toward science and mathematics, both as fields of study and careers? • To what extent are observed changes in content knowledge and pedagogy associated with the pre-service teacher's participation in project activities?
<p>Project Goal 1: Provide teacher education activities that are content rich, model best practice pedagogy, diverse field experience opportunities, and include a strong integration of instructional and content-specific technologies.</p>	<ul style="list-style-type: none"> • To what extent are teacher activities perceived as content rich and modeling best practice pedagogy? • To what extent are field experience opportunities provided? • To what extent are instructional and content-specific technologies integrated into the teacher activities?
<p>Project Goal 2: Provide an on-going supply of high-quality mathematics and science teachers, including recruitment, pre-service preparation, induction, and retention.</p>	<ul style="list-style-type: none"> • To what extent are mathematics and science pre-service teachers well-prepared for their assigned responsibilities? • To what extent are new mathematics and science teachers appropriately supported for successful induction? • To what extent do project initiatives increase the pool of qualified mathematics and science teachers?

Quantitative and qualitative data will be collected and analyzed to answer these questions.

Quantitative methods collect numerical data for comparison and statistical testing. Quantitative data will be collected using the following mechanisms:

- End of course assessment scores reflect the pre-service teachers' understanding of concepts and content identified as important;
- Pre-service teacher questionnaires reflect the participants' perceptions of the project, as well as attitudes, perceptions, and practices relative to teaching mathematics, science, and technology;
- Tracking data provide information on pre-service teacher characteristics, course enrollments, and transfers into four-year teacher preparation program.

Qualitative methods produce narrative information that provides a detailed picture of activities and outcomes, to deepen the information provided through quantitative means. Using a sampled approach, resources are focused on the following mechanisms:

- Project documents, including course materials, will be reviewed to analyze for evidence of enhanced capacity to plan, support, and sustain program improvements and implementation.
- Focus group and individual interviews gather feedback from a subset of participants and project personnel regarding project activities and impact.

The combination of these data will provide a rich set of triangulated information with which to address the evaluation questions. The project's evaluation plan includes a design matrix that will connect the evaluation questions to data sources and collection methods.

Additionally, because of the approximately 250 education majors currently enrolled at PSTCC, comparisons will be made between the initial cohort of 24-30 students who enter the TTU

program on the Pellissippi State Main Campus Fall Semester 2003 and the students who are involved in the PSTCC MASTER Hub experience.

The evaluation process for this Math and Science Teacher Education Resource Program was designed by Dr. Kimberly Hambrick of Appalachia Educational Laboratory and will be administered by Dr. Linda Cain, Independent Contract Evaluator. Both of these evaluators have extensive experience and insights that will add to the intellectual merit of this program.

Dissemination

- 1) Presentations at Tennessee Science Teachers Association, Tennessee Math Teachers Association, and other regional and state meetings
- 2) Presentations at national conferences such as the National Association of Community College Teacher Education Programs, Association of Math Teacher Educators, and the National Science Teachers Association
- 3) Sharing of syllabi and teaching materials for the math, science, and technology courses for teachers through the Internet and through networks such as the PTK/NSF Teacher Education project, the Super Computing 2000 project, etc
- 4) Sharing of articulation information and the thematic math/science lessons created by the MASTER Teams will occur via the web
- 5) Holding MASTER Hub Open House and Workshop to share our experiences and products with other colleges and universities
- 6) Sharing documentation including the accomplishments and activities of the MASTER Future Teachers Organization
- 7) Because PTK is seeking a continuation of its "Preparing Tomorrow's Math and Science Teachers: The Community College Response", it will also be possible to share

information about this project through the PTK/NSF network.

Interestingly, some members of the Pellissippi State team have already been contacted by other community colleges which are interested in the proposed approach to teacher education being developed here. Consequently, an education resource web site will be developed to share information about the teacher education efforts as well as specific materials being created and piloted in the math, science and technology courses.

Roles, Responsibilities and Management Plan

Meg Moss, PI, from Pellissippi State:

As PI, 1) Oversee all efforts of the project along with the budget, 2) Serve as math education specialist 3) Serve as lead faculty advisor to MASTER Future Teachers Organization and lead the facilitation of the MASTER Teacher Conferences, 4) Obtain and organize math manipulatives, 5) Serve as lead teacher for math content sequence and guide other math faculty in the appropriate pedagogical techniques necessary to effectively teach the math courses, 6) Organize and team teach Praxis preparedness workshop, 7) Coordinate evaluation process, prepare and submit annual and final reports to NSF.

Yolanda Sankey Co-PI, from Pellissippi State:

1) Serve as biology education specialist, 2) Coordinate and facilitate MASTER Teams, 3) Implement high school recruitment efforts, 4) Obtain and organize science manipulatives. 5) Coordinate web based resources (with the help of Instructional Technology Specialist, Audrey Williams) 6) Serve as lead teacher for biology content course and guide other science faculty in the appropriate pedagogical techniques necessary to effectively teach the science courses.

Dr. Maggie Phelps, Co-PI, from Tennessee Technological University:

- 1) Serve as liaison between PSTCC and TTU education programs, 2) Serve as coordinative link between PSTCC and TTU math, science, and technology courses
- 3) Coordinate activities between PSTCC and TTU student organizations 4) Participate in the formation and guidance of MASTER Teams.

Dr. Jim Kelley, Co-PI, from Pellissippi State:

- 1) Coordinate technology, materials, and physical space for the MASTER Hubs, 2) Coordinate development and implementation of all courses other than math, 3) Coordinate high school recruitment efforts 4) Coordinate articulation efforts between PSTCC and four year colleges, 5) Coordinate and recruit the in-service teacher MASTER Team participants, 6) Track students through the whole four year education program and into jobs in school systems. This last item will be part of the Natural and Behavioral Sciences Department's database for future program reviews (mandated by the Tennessee Board of Regents each five years).

Dr. Linda Cain, Independent Contract Evaluator

- 1) Coordinate formative and summative assessment of the project
- 2) Analyze data
- 3) Generate evaluative reports
- 4) Adjust approach as necessary

In order to learn from professionals in technological and scientific fields both in and out of the field of education, and to learn from attending conferences, PSTCC requests professional development for Pellissippi State faculty to include:

- a) travel for faculty to learn from other schools and programs.
- b) travel for faculty to professional conferences and workshops to gain ideas
- c) bring consultants onto the Pellissippi campus to aid in aspects of the project such as:

- i: work with all participants in learning and integrating workplace technologies into teaching
- ii. advise on issues of math and science education in K-12 schools
- iii. advise math and science faculty on the use of instructional technology tools

Project Sustainability:

This project involves a large number of quite diverse stakeholders, from high school students to K-12 teachers, from community college students and faculty to those in four year universities, from the majority to the minority populations. However, the common theme throughout is the development of exceptionally qualified teachers who can move into challenging careers and know they have the training and support to succeed. As indicated in the letters of support from the PSTCC and TTU administrations, long term commitment to continuance of this project will occur. PSTCC has designated specific space for the MASTER Hubs and will be hiring a new full-time faculty member in early childhood education, and will be seeking a mathematics teacher with knowledge in math teacher education. TTU has projected space needs at PSTCC and accommodations are available. Additionally, TTU will be hiring faculty who will be based in Knoxville to teach TTU courses at PSTCC. Once the connections between PSTCC, TTU and high schools have been established, the activities of the MASTER Hub have been institutionalized, and the roles of the participating team have been refined, the sustainability of this project will be secure because of the commitment of the participating institutions.

Time Table

	Summer	Fall	Spring
Year 1 2003–2004	1) Formalize plans for the formation of the MASTER Hub; 2) Research and purchase manipulatives, technology tools, and other resources; 3) Initiate MASTER Hub operation on main campus. 4) Participate in the Super Computing 2002 summer workshop	1) Biology, physics, math, and field experiences courses for the education program will be physically taught in the MASTER Hub with enhanced educational and technological surroundings; 2) Create MASTER Future Teachers Organization; 3) Begin creation of web presence; 4) Offer Praxis Preparation workshop; 5) Hold an Education Professions Day in which representatives from area universities provide information to students on their teacher education programs	1) Chemistry, earth science, instructional technology, math, and field experience courses for the education program will be physically taught in the MASTER Hub; 2) Begin formulating the MASTER Teams; 3) Begin direct interaction between TTU students and PSTCC education students; 4) Visit area high schools, and hold Master Hub Open House; 5) Host and organize a MASTER Teacher Conference.
Year 2 2004 – 2005	1) Evaluate previous year's experiences; 2) Research and purchase additional resources ; 3) Form MASTER Teams for following year; 4) Improve and add to web presence; 5) Create more activities to integrate technology and hands on inquiry into the math and science courses.	1) Add additional MASTER Hub at Magnolia Avenue Campus; 2) Biology, physics and math courses for the education program will be physically taught in the MASTER Hub on the main campus, and biology and math will be physically taught in the new MASTER Hub on the Magnolia campus, with enhanced educational and technological surroundings; 3) Create a branch of the MASTER Future Teachers Organization at Magnolia Campus; 4) Offer Praxis Preparation workshop; 5) Hold an Education Professions Day in which representatives from area universities provide information to students on their teacher education programs 6) Initiate MASTER Teams	1) Chemistry, earth science, instructional technology and math courses for the education program will be physically taught in the MASTER Hub of the main campus, and chemistry, math, and instructional technology courses will be taught in the Magnolia MASTER Hub; 2) Begin formulating the MASTER Teams centered at the Magnolia campus; 3) Visit area high schools, hold MASTER Hub Open Houses at each of the hubs; 4) Host and organize a MASTER Teacher Conference
Year 3 2005 – 2006	1) Evaluate previous year's experiences; 2) Research and purchase additional resources; 3) Form MASTER Teams for following year; 4) Improve and add to web presence; 5) Create activities to integrate technology and hands on inquiry into the curriculum.	1) Biology, physics and math courses for the education program will be physically taught in each of the MASTER Hubs with enhanced educational and technological surroundings; 2) MASTER Teams will be enhanced and refined; 3) Offer Praxis Preparation workshop; 4) Hold an Education Professions Day in which representatives from area universities provide information to students on their teacher education programs	1) Chemistry, earth science, instructional technology and math courses for the education program will be physically taught in the MASTER Hub; 2) Visit area high schools, hold MASTER Hub Open Houses at each of the hubs; 3) Host and organize a MASTER Teacher Conference.

