ARIZONA UNIVERSITY SYSTEM
CHIEF ACADEMIC OFFICERS GUIDELINES
FOR
REQUESTS FOR PLANNING AUTHORIZATION
FOR NEW ACADEMIC DEGREE PROGRAM
[UNIQUE PROGRAM]

I. PROGRAM NAME: Master of Arts in Middle School Mathematics Leadership
DESCRIPTION: The Mathematics Department proposes a new Master’s Degree concentrating on the mathematics taught in middle school and its pedagogy: The real number system, Algebra, Geometry, and Probability and Statistics.
CIP CODE*:

II. STUDENT LEARNING OUTCOMES AND ASSESSMENTS
A. What are the intended student outcomes, describing what students should know, understand, and/or be able to do at the conclusion of this program of study?
Students in this program will either be or will expect to become certified Highly-Qualified Mathematics teachers; however, this Master’s Degree would represent a greater degree of knowledge and understanding of Middle School Mathematics than necessary for this certification. Graduates would emerge with command of the mathematical intricacies hidden in: The Real Number System, Algebra, Geometry, and Probability and Statistics. Even though these are topics taught to children between the ages of 12 and 14, they often touch on some of the deepest abstract ideas of modern mathematics and science. At the same time, many middle school teachers are assigned to mathematics courses without formal training in these subjects. This degree program is intended to solve this structural problem in the State’s educational program by providing mathematical courses to middle school mathematics teachers. Students would complete the degree with an extensive knowledge of the mathematical ideas that serve as the basis of school mathematics and with experience developing effective pedagogical approaches based on a true appreciation of the underlying difficulties of the subject.
B. Provide a plan for assessing intended student outcomes.
The Mathematics Department, in partnership with the Tucson Unified School District, has a NSF grant (EHR-0634532) that will fund the development of the degree and a pilot program testing the curriculum. That grant requires a continuing, extensive and thorough evaluation. The NSF approved evaluation program is fully described an Appendix I. Further, the grant provides a advisory board and a curriculum review board comprised of national leaders in mathematics education. These include Cindy Bryant, Missouri, middle school teacher and state math consultant Skip Fennell, McDaniel College, mathematics educator and president of National Council of Teachers of Mathematics Glenda Lappan, Michigan State University, mathematics educator and developer of “Connected Mathematics” middle school curriculum Jim Lewis, University of Nebraska, mathematician and Principal Investigator on the Math and Science Partnership grant “Math in the Middle” (chair) Dan Lotesto, Milwaukee, high school mathematics department chair and participant in the Milwaukee Math and Science Partnership
Glenn Stevens, Boston University, mathematician and Principal Investigator on the Math and Science Partnership grant “Focus on Math.”

The Curriculum Review Board includes:
Wanda Bussey, high school teacher and chair of the Teacher Advisory Council to the National Academies
Roger Howe, mathematician and mathematics education consultant, Yale University
Jim Milgram, mathematician and consultant to the Department of Education, Stanford University
Barbara Reys, mathematics educator and co-director of the Center for Study of the Mathematics Curriculum, University of Missouri.

III. STATE’S NEED FOR THE PROGRAM

A. HOW DOES THIS PROGRAM FULFILL THE NEEDS OF THE STATE OF ARIZONA AND THE REGION?

By offering this degree, the University would be addressing a serious problem in education in the State and the Nation. The degree would give dedicated middle school mathematics teachers the opportunity to master the subjects they are asked to teach. It should improve mathematics education across the board. Better prepared middle school teachers will produce better prepared high school students. Better prepared high school students will experience more success in their mathematics courses in high school and beyond. Success in high school mathematics is critical in our increasingly technical modern economy.

The demand for qualified mathematics instructors at every level is well documented. The federal No Child Left Behind legislation and Arizona Instructional Measurement test have further increased the need for quality mathematics instruction in all our schools. The three state Universities have all made efforts to increase the number of highly qualified mathematics teachers in Arizona high schools. To some extent, middle school mathematics has been underserved in this process. Changes in state and federal laws have meant that school districts have placed a premium on recruiting and retaining high school teachers with undergraduate mathematics degrees. This has made it more difficult for them to find and keep equally qualified teachers for middle school and junior high classes.

The Department of Mathematics and the Tucson Unified School District (TUSD) joined together to address this problem. They proposed forming a partnership that would create a solution to this problem, and sought funding from the National Science Foundation (NSF). They hoped their joint effort would eventually have a major national impact.

TUSD middle school teachers have responded with enthusiasm to initial descriptions of a master’s degree program designed specifically for them. Other local school districts have also expressed interest in the proposed program. The
NSF agreed with the basic goals of the proposal and has agreed to fund a 5 year program that would allow as many as 45 TUSD Middle School teachers to pursue a graduate degree in mathematics part time, at night and over the summer.

We now propose a new Master’s Degree in Middle School Mathematics Leadership that would enhance this NSF grant and would help continue the program into future. In short time, the new degree should attract students from throughout the city and state. NSF has encouraged the Department to include a distance learning component as part of the project, and if that promise is fulfilled, the new degree could well become a truly national program. This new degree would concentrate on the mathematics that middle school and junior high teachers must understand and appreciate to do their job well. It would create a new level of professional mathematicians whose specialization would involve the basic notions of modern mathematics that appear in middle school curricula. Their training would include all the educational tools necessary to teach these basic ideas effectively.

B. IS THERE SUFFICIENT STUDENT DEMAND FOR THE PROGRAM? --

Explain:

The Master’s program, at least at first, will be targeted toward an audience of middle school teachers who have elementary certification. Most, if not all, of the candidates will be fulltime in-service teachers already teaching middle school mathematics who will pursue the degree part time. NSF has funded a pilot program that represents a partnership with TUSD. As part of their contribution, TUSD has pledged to recruit their teachers into the degree and provide incentives to the teachers who participate. This commitment was sufficient for NSF to provide funding for as many as 45 master’s candidates. The state’s largest school district employs more than enough middle school mathematics teachers to support the degree program indefinitely. Additionally, rumors about the NSF project have spread to other Tucson area school districts, and the Department has already received inquiries about other openings in the pilot program.

In order to support a statement to this effect, please answer the following questions.

1. What is the anticipated student enrollment for this program? (Please utilize the following tabular format).

<table>
<thead>
<tr>
<th>5-YEAR PROJECTED ANNUAL ENROLLMENT</th>
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</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>No. Student Majors</td>
</tr>
<tr>
<td>1st yr. 2nd yr. 3rd yr. 4th yr. 5th yr.</td>
</tr>
<tr>
<td>11  11  11  11  11</td>
</tr>
</tbody>
</table>
2. What are the sources for these projections of student enrollment? – Explain. This explanation may include numbers of requests from current students, requests from high schools, requests from potential students not currently enrolled, or other sources. This represents the number of candidates with NSF funding. However, we have already received inquiries in sufficient number to surpass these openings, and therefore the numbers provided distinctly underestimate the actual demand.

3. Beginning with the first year in which degrees will be awarded, what is the anticipated number of degrees that will be awarded each year for the first five years? (Please utilize the following tabular format.)

<table>
<thead>
<tr>
<th>Year: 1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
<th>4th Year</th>
<th>5th Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Degrees</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>11</td>
</tr>
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C. For a unique (non-duplicative) program, provide a statement to the effect that there are no existing programs at other Arizona public universities that duplicate the proposed program.

All three Arizona universities have Master’s Degrees available with an emphasis on school education. The University of Arizona Mathematics Department offers the Master’s of Arts with a Teaching Option, and it is this degree that students in the NSF pilot program will pursue. Both NAU and ASU offer degrees similar to Arizona’s. Except for this pilot program, all these degrees are designed primarily for high school teachers.

This proposed degree would be distinguished from these by concentrating of the problems in middle school mathematics. The mathematical emphasis and the educational emphasis of the proposed program would specifically be on the unique problems of pre-high school mathematics. A distinct degree would concentrate on the different needs of middle school teachers in admissions, mathematical content, and educational methods. Further, distinct degrees would allow those school teachers to gain expertise and formal training in both high school and junior high school mathematics. This would support those schools where teachers need to serve multiple roles.

IV. APPROPRIATENESS FOR THE UNIVERSITY – Explain how the proposed program is consistent with the University Mission and Strategic Direction statements of the university and why the university is the most appropriate location within the Arizona University System for the program.
The UA Department of Mathematics houses a Mathematics Education research group, including faculty with Ph.D.’s in both Mathematics and Mathematics Education, and has a long history of designing pre-service and in-service professional development programs for teachers, starting in the late 80s and continuing until the present day:

- Promoting Reasoning in School Mathematics (PRISM), a three-year NSF-funded teacher enhancement project for middle and high school teachers in the Tucson area
- Making Math Count, an NSF-funded project for middle school teachers throughout the state
- Promoting Reform in Mathematics Education (PRIME), an NSF-funded five-year program to increase the mathematical knowledge and leadership skills of teachers in grades 3-8
- Making Everybody Count, an NSF-funded sequel to Making Math Count
- The NSF-funded Math and Parents Partnerships (MAPPS)

Furthermore, there are three current programs that demonstrate the department’s ability to design vertically integrated, multi-institutional partnerships that include faculty, post-doctoral fellows, graduate students, and undergraduates in collaborative enterprises, including outreach to local schools:

- The Center for Mathematics Education of Latinos/as (CEMELA), an NSF CLT, a partnership with three other universities, which includes professional development for local elementary and middle school teachers;
- The NSF Vertical Integration of Research and Education (VIGRE) grant, which, although primarily focused on the graduate program, provides graduate students with outreach opportunities in local schools, and hosts a regional network of universities interested in providing students with undergraduate research experiences both in mathematics and in education;
- The Center for Recruitment and Retention (CRR), funded by local school districts and philanthropists, which has a teacher induction program to support new teachers in the field and a tutor program that recruits and places mathematics undergraduates as assistants in local classrooms.

The UA College of Science includes science and mathematics education in its research program through hiring and promotion. It has a similar master’s degree for biology teachers. Furthermore, the College of Science has developed innovative promotion and tenure procedures designed to reward faculty whose principal scholarly activity is in education, for which it received an NSF Recognition Award for Integration of Research and Education in 1997. The University has recognized and rewarded the efforts of mathematics faculty in college education with three University Distinguished Professorships.

The UA College of Education, under the leadership of recently appointed Dean Ron Marx, has started rebuilding a small but active group in mathematics.
education. The College will offer courses in education research as part of the project.

Currently Arizona State University Mathematics Department offers a Master of Natural Science Degree with a High School Certification option through their College of Education. Students in this program have the option to receive a middle school endorsement as well. Northern Arizona University is reorganizing their Master’s of Arts Degree in Teaching so that it is accessible through distance learning. Their program is aimed primarily towards in-service high school teachers working part-time.

With NSF funding, the Arizona Mathematics Department is perfectly poised to create the state’s only graduate degree in Mathematics designed specifically to address the needs of middle school teachers while the other state universities concentrate high school teachers. Further, the generous NSF provides just the financial assistance necessary to specifically design a program for full time school teachers working part time on the degree. The NSF and the UofA Mathematics Department are hopeful that the materials developed will spread the Master’s Degree in Middle School Mathematics to various universities around the country. The Arizona Mathematics Department and the NAU Mathematics have had preliminary discussions about a partnership that would make it easier for NAU to reach high school teachers in the southern part of the state and for Arizona to share NAU’s existing distance learning capabilities to make the proposed degree accessible throughout the state. The partnership with the State’s largest school district and the federal funding make Arizona the ideal place to establish such a dedicated degree.

V. EXPECTED FACULTY AND RESOURCE REQUIREMENTS—Describe the resources necessary for the program such as courses, faculty, equipment, and library resources, if these data are available.

NSF has contributed over $4.5 million toward a master’s degree program for middle school and junior high school teachers over the next 5 years. For now, teachers in this program will pursue the Department’s existing Master’s Degree with a teaching option that was designed primarily for high school teachers. This NSF funding should cover all the required resources for the duration of the grant. However, the NSF proposal was designed to draw on existing departmental resources as much as possible, so that the degree program can continue after the grant runs out.

On the one hand, in five years the loss of financial incentives offered to TUSD teachers under the NSF grant will reduce the number of candidates. At the same time, a new degree will encourage additional middle school teachers to look to the UofA for a graduate degree in mathematics. Also, recent state and federal laws encourage teachers to become certified highly qualified teachers which may also increase interest in such a degree.
It is hard to judge the long term demand for this degree, but at the rough size planned in the NSF project, it should not place a burden on the graduate program of the Department or the University that would be greater than it would expect without this separate teaching master’s degree. It appears, however, that the University will be playing an increasing role in the advanced training of all of the State’s teachers in any case. Approval of this degree now will allow the UofA to influence the quality of the State’s mathematics education by seeing that middle school and junior high teachers are properly served at the graduate level.
Appendix I: Evaluation Plan

Research shows that in addition to improvement in teacher practice and student learning, the evaluation of professional development should be based on “the degree to which the professional development is characterized by … a focus on content, active learning, and coherence delivered with sufficient duration and collective participation” (Desimone, Garet, Birman, Porter, & Yoon, 2003, p. 642). These principles will guide the assessment plan.

The overall outcome will be improved student achievement in mathematics in the schools participating in the grant, as a result of increased teacher knowledge of mathematics. The other outcomes include an increase in the number of highly qualified teachers, increased capacity to produce teacher mentors and postdoctoral fellows each year, increased skills to run a Master’s level program in Middle School Mathematics Leadership, an increase in the number of Middle School Mathematics Leaders as the result of increased distance learning capacity and an increase in the number of Middle School Mathematics Leaders regionally and nationally during the term of the grant.

An external evaluator hired by the project will work with the TUSD internal evaluator through the Accountability and Research department to obtain student achievement data, student course failure in mathematics at participant schools, attendance and other relevant data. The evaluator will also develop project instruments, a documentation log to determine if project objectives and activities are being accomplished within timelines.

Formative evaluation will determine the strengths and weaknesses of the program through survey instruments developed by the evaluator. A process evaluation will be conducted within 6 months of the start of the project. Process evaluation will utilize a model that provides continuous information about the program in progress and calls for continuous improvement through design, management, assessment and communication. It will be carried out during the program in the spring and fall through student surveys, parent surveys, staff surveys, staff logs and student records. The evaluator will survey partners to determine what is going well, what barriers have been encountered, and what could be done to improve the project’s implementation. Results will be discussed with the principal investigators and used to guide the program development.

The outcome evaluation will use quantitative and qualitative measures, including standardized norm-referenced test results on the TerraNova mathematics subtest, and results on the mathematics portion of the Arizona Instrument to Measure Standards, both given in 8th grade on a yearly basis. This data is all available in TUSD on the district’s website: http://tusdstats.tusd.k12.az.us/planning/assessment_main.asp. For the AIMS test, results are available on a school and teacher level. The evaluator will establish a baseline before the project starts, and compare yearly results to results in the previous year, both in schools and classrooms impacted by the grant and in schools and classrooms with similar demographics.

Other quantitative data will include the number of course failures, attendance rates, number of faculty at the University of Arizona with a knowledge and understanding of how to support effective teacher preparation and inservice professional development, number of certified teacher leaders and Ph.D. mathematicians who have the knowledge and understanding to implement the program in their local areas, number of Middle School Mathematics Leaders produced nationally each year, and the number of Teacher Mentors and Postdoctoral Fellows produced each year. Ratings and self-report instruments, student enrollment data and student records participation, and discipline will also be of a quantitative nature.

Qualitative methods will include surveys and self-report instruments, including some open-ended. Classroom observations and interviews are other methods that may be utilized to obtain qualitative information. One such instrument will be a survey developed by the evaluator to determine the satisfaction of the school district and site principal on the quality of services provided by the grant.

Complete results on mathematics assessments will be made available and disaggregated by grade level, ethnicity, socioeconomic status, gender, and disability. This information will be used to determine if there are achievement gaps that should be addressed in future years, and will be useful to others interested in replicating the project.

Participants on the program will be given pre- and post-tests on their knowledge of mathematics and teaching. For the participants in the Master’s program, permission has been obtained to use tests of teacher knowledge for middle school teachers developed at the University of Michigan. Feedback via a survey of site principals, university professors, and TUSD middle school mathematics teachers will be obtained and analyzed. Classroom observations will be conducted to determine if the project participants are meeting the Arizona Professional Teacher Standards.

For the Teacher Institute, participants will be asked to complete a survey at the end of the Institute to determine if they have benefited from attendance and plan to utilize the skills they have gained. A follow-up survey will be sent after 6 months to determine if they have implemented any of the strategies learned in the Institute.

Throughout the project period, the evaluator will meet at least monthly with the principal investigator to share assessment results and to see if there should be any additions to the evaluation design.