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Washington State University
MAJOR CHANGE FORM - - REQUIREMENTS
(Submit original signed form and TEN copies to the Registrar's Office, zip 1035.)
See https://www.ronet.wsu.edu/ROPubs/Apps/HomePage.ASP *for this form.*

*Submit an additional copy to the Faculty Senate Office, French Administration 338, zip 1038.

Department Name Teaching & Learning

1. CHECK PROPOSED CHANGES.

*☐ Change department/program name *from* _____ *to* _____
*☐ New degree or program *in* _____
a *☑ Change name of degree *from* PhD in Mathematics Education *to* PhD in Mathematics and Science Education
*☐ Drop degree or program *in* _____
*☐ Extend existing degree or program *to* _____ campus

☐ New Major *in* _____
b ☐ Change name of Major *from* _____ *to* _____
☑ Revise Major requirements *in* _____
☐ Drop Major *in* _____
☐ Revise certification requirements for the Major *in* _____

☐ New Option *in* _____
☐ Revise requirements for the Option *in* _____
☐ Drop Option *in* _____

☐ New Minor *in* _____
☐ Revise Minor requirements *in* _____
☐ Drop Minor *in* _____

☐ New Undergraduate Certificate *in* _____
☐ Revise Undergraduate Certificate requirements *in* _____
☐ Drop Undergraduate Certificate *in* _____

☐ Other _____

Effective term/year Fall 2012

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Contact Person	**Contact Phone No.**	**Contact email**

2. GIVE REASONS FOR EACH REQUEST MARKED ABOVE. *(Attach additional paper if necessary; see reverse side.)* See attached proposal

4. SIGN AND DATE APPROVALS.

Darcy Hall 10-28-12 Rudy 11-5-12 _____
Chair Signature/date Dean Signature/date General Education Com/date

_____ _____ _____ _____
Catalog Subcom/date Academic Affairs Com/date Graduate Studies Com/date Senate/Date

Proposal for Modification of Existing Degree
Ph.D. in Mathematics and Science Education
Major Curriculum Change

Submitted by:

WSU Mathematics and Science Education Faculty
Department of Teaching & Learning

Kathy Baldwin, Janet Frost, Kristin Lesseig, Amy Roth McDuffie, Judy Morrison, Tamara Holmlund Nelson, Jo Olson, David Slavit

With:
Sandy Cooper, Libby Knott
Department of Mathematics

Current Program of Study for the Ph.D. in Mathematics Education

Foundational Core: Mathematics Education (12-18 credit minimum)

Math 590	Seminar in Undergrad Math (Var Cr)
T&L 512	Language and Cultural Factors in Mathematics (3 Cr.)
T&L 561	Elementary School Mathematics (3 Cr.)
T&L 562	Secondary School Mathematics (3 Cr.)
T&L 563	Seminar in Precollege Mathematics Education (3 Cr.)
T&L 5XX	Approved Alternative (see advisor for consent)

Note: T&L 562 and T&L 563 are no longer in the University Course Catalogue

Supporting Cognate Area: Mathematics (12 credit minimum)

OVERVIEW OF PROPOSED CHANGES:

- Change of name to: *Ph.D. in Mathematics* ***and Science*** *Education*
- Inclusion of three possible concentrations within the degree
- Expansion of cognate area option (currently, mathematics is the sole option)
- Restructuring of Foundational Core courses
- Expanded focus of instructional delivery across four WSU campuses

Ph.D. in Mathematics and Science Education

History

In the mid-1980's, the Department of Teaching & Learning began to offer the PhD in Mathematics Education. Two Pullman faculty were primarily responsible for the delivery of the degree to a small but vibrant group of students. These two original faculty members left in the early 1990's and were replaced by Verna Adams and David Slavit. The program continued successfully with a cadre of students until 1998, when the last two students received their PhD. That same year, David Slavit left the Pullman campus for Vancouver, and the degree has been relatively inactive since that time.

Since the mid-1990's, each campus (including Pullman) has had no or one tenure-track faculty position in mathematics and science education, and in many cases this single position was held at the assistant level. The exception is the current academic year, as the Vancouver campus now has two tenure-track mathematics education faculty members. Currently, there are 5 tenure-track mathematics education faculty and 3 tenure-track science education faculty across all four campuses in the College of Education. A search for positions in both mathematics and science education on the Pullman campus beginning in Fall 2013 will further expand the capacity on that campus. In addition, the Department of Mathematics has a full professor whose research and responsibilities are in the area of mathematics education. These new faculty appointments signify the university's commitment to the continued growth of mathematics and science education; moreover, the college is now positioned to support and sustain a doctoral program in mathematics and science education.

Since 1998, other significant changes have occurred in the mathematics and science education landscape at Washington State University. The mathematics and science education faculty at WSU have greatly increased their capacity and activity regarding cross-campus collaboration. The current group of WSU mathematics and science education faculty, while geographically dispersed, has worked collectively in various ways over the past several years. Among other things, faculty within and across campuses have developed research collaborations that have resulted in refereed publications and presentations at national and internal venues, applied for and obtained external funding, co-advised doctoral students in the EdD in Teacher Leadership, and engaged in program development for endorsements in middle level mathematics, middle level science, and secondary mathematics. This group has developed a collaborative culture and meet frequently via technology to advance the research and service mission of WSU regarding mathematics and science education.

In line with the research mission of WSU, the proposed changes to the current PhD in Mathematics Education will provide necessary support to these faculty in both fulfilling current research needs and obtaining external funding for future projects. Currently, mathematics and science education faculty from the COE are engaged in eight externally funded projects ranging from $400,000 to $5,000,000. Similar numbers and amounts can be found over the past 7 years. Though somewhat varied, these projects have primarily focused on research and professional development

involving strong partnerships with local school districts, a variety of WSU colleges, and/or other universities. Mathematics and science education faculty also continue to make significant contributions to the field, and publish and present research in leading national and international venues.

Rationale for Program Changes

Demand. A large gap has continuously existed in the U.S. between the demand for PhDs in mathematics and science education and the number of doctoral degrees granted in these fields. For example, a recent report by Robert Reys at the University of Missouri states that in 2005-06 over 40% of institutions of higher education searching for mathematics education faculty were unsuccessful in filling those positions (Reys et al., 2007). This study also reports that 20% of mathematics education faculty members are expected to retire by 2012, and that over 95% of responding institutions said there would be "more or many more mathematics education jobs than qualified applicants." Further, the number of new mathematics education programs has not been rising, as only 14% of the programs in this study were developed in the past 10 years (Reys et al., 2007). Barrow and German (2006) found similar results related to science education searches. They add that one-third of the successful searches in science education involved existing science educators.

Research and External Support. The PhD in Mathematics and Science Education would significantly enhance the research mission of Washington State University in this area. Currently, faculty have great difficulty including research assistantships in grants due to the lack of a relevant degree program. Further, mathematics and science education faculty have very little research support embedded into their work environment. Collaboration amongst this group has been strong, and faculty have found ways of working together, but there is not a strong, systemic infrastructure that can support the work of mathematics and science education faculty. The doctoral program would provide much-needed personnel and other resources to enhance this research mission.

University Mission. The PhD in Mathematics and Science Education, with its emphasis on research, is directly in line with key initiatives in the university's mission and strategic plan. The PhD would also support the mission of the WSU STEM Education Partnership; faculty from a variety of campuses and colleges across the university have come together to move the university forward in its research and educational efforts in STEM fields. The result has been the establishment of the STEM Education Partnership, which will be applying for status as a university center in the coming months. Approximately one dozen STEM-related projects across the university involving faculty associated with the Partnership, from a range of disciplines, are currently underway. Many of these faculty are looking to conduct research on their educational efforts; however, the university is sorely understaffed to handle the current demand for research expertise in STEM education. The PhD in Mathematics and Science Education would serve as a potential source of support for these STEM educational research efforts across colleges and campuses.

Innovation

We are proposing changes to the existing PhD in Mathematics Education in the Department of Teaching & Learning. The proposed changes to the degree represent several important innovations. The degree will allow students opportunities to explore educational issues in mathematics and science collectively, or focus in one content area. A collective focus is in line with the national movement towards treating STEM (science, technology, engineering, mathematics) disciplines in a more holistic, integrated manner. The degree will be multi-campus in nature, providing students access to faculty with a variety of expertise and who have access to schools and other educational sites across the state. The degree will also provide students a variety of individualized research experiences related to the expertise of current faculty, in line with student interests. For example, coursework that involves planning and conducting individualized research experiences is being embedded into the program. Research presentations that support students in developing and enacting educational research methodologies will be highly encouraged. These presentations will be held to a high standard of quality and be expected to result in a significant conference presentation and/or presentation to the College of Education. An ongoing research seminar will provide additional structure to this focus.

With a focus on authentic research experiences and individualized program options, this innovative program is rooted in new perspectives on mathematics and science learning as well as new insights on how to best prepare future education researchers. In this way, the revised Mathematics and Science Education doctoral program explicitly supports another university goal: "to provide high-quality undergraduate and graduate degree programs that prepare students for success in a global society." As evidenced by the explosion of jobs and national attention to STEM-related fields, this program is timely and responsive to current demand.

Student outcomes

The degree will prepare graduates for successful application to positions at research universities in the areas of mathematics, science, and STEM education. Graduates would also be well-suited for the growing number of positions in STEM education centers across the country.

Specifically, students will have:

- An emergent research program in mathematics, science, or STEM education
- Knowledge of key aspects of the field (main journals, conferences, leading researchers, professional norms of the field)
- Awareness of key funding sources
- Ability to teach content methods and other preservice courses
- Ability to teach masters and doctoral level courses in mathematics, science, or STEM education
- Knowledge and awareness to pursue other occupations in STEM education outside of university settings

Program Details

Description

The PhD. in Mathematics and Science Education is designed to develop scholars capable of making important contributions to the research base, professional context, and learning environments related to mathematics and science education. Areas of emphases can include student learning, teacher education, professional development, curriculum, and technology throughout the PK-16 grade spectrum.

Applicants are expected to have experience or be licensed to teach science/mathematics at the K-12 level. Preferably, applicants hold a degree in a field of study involving education, mathematics, science, technology, or other related field.

Areas of Concentration

Students can select one of three areas of concentration within the degree: mathematics education, science education, and mathematics & science education. The coursework, individualized research experiences, and dissertation will be chosen and developed in a manner that is consistent with the selected area of concentration.

Coursework

The program is designed to contain a blend of foundational courses, research courses, mathematics and science education courses, and individualized research experiences. As such, the PhD candidate can determine an individualized focus on mathematics, science, or cross-disciplinary study.

Videoconferencing technology allows courses and seminars to be jointly attended at four different WSU campuses. Other technologies allow for further connections and learning experiences across distances.

Advising

Students will be assigned an administrative advisor upon entering the program. Eventually, the student will select a dissertation advisor to oversee the final aspects of the program. The student and advisor do not have to be on the same campus; proximity of research interest will be a factor in this decision.

Required research, 15 credits *(bold indicates new course):*

EdRes 562 Epistemology, Inquiry, and Represention (3 cr)
EdRes 563 Principles of Doctoral Research (3 cr)
EdRes 564 Qualitative Research (3 cr)
EdRes 565 Advanced Statistical Analyses and Quantitative Research (3 cr)
T&L 531 Frameworks for Research in Mathematics and Science Education (3 cr)

Sample Program for the Ph.D. in Mathematics and Science Education:

Mathematics & Science Education Concentration

Fall 1	**Spring 1**	**Summer 1**
EdRes 562 (3) T&L 584 (3) T&L 598 (1) *7 credits*	T&L 531 (3) T&L 512 or 561 (3) T&L 598 (1) *7 credits*	EdRes 563 (3) Cognate (3) *6 credits*
Fall 2	**Spring 2**	**Summer 2**
EdRes 564 (3) T&L 581 (3) T&L 598 (1) *7 credits*	EdRes 565 (3) T&L 571 or 574 (3) T&L 598 (1) *7 credits*	T&L 591 (3) Cognate (3) *6 credits*
Fall 3	**Spring 3**	**Summer 3**
Cognate (3) Cognate (3) *6 credits*	Dissertation or other electives	Etc.
T&L 585 and T&L 591 would have a cross-disciplinary focus. Courses in the student's cognate area would share this content focus, as appropriate.		

Sample Program for the Ph.D. in Mathematics and Science Education:

Mathematics Education Concentration

Fall 1	**Spring 1**	**Summer 1**
EdRes 562 (3) T&L 584 (3) T&L 598 (1) *7 credits*	T&L 531 (3) T&L 512 (3) T&L 598 (1) *7 credits*	EdRes 563 (3) Cognate (3) *6 credits*
Fall 2	**Spring 2**	**Summer 2**
EdRes 564 (3) T&L 581 (3) T&L 598 (1) *7 credits*	EdRes 565 (3) T&L 561 (3) T&L 598 (1) *7 credits*	T&L 591 (3) Cognate (3) *6 credits*
Fall 3	**Spring 3**	**Summer 3**
Cognate (3) Cognate (3) *6 credits*	Dissertation or other electives	Etc.
T&L 585 and T&L 591 would be focused in mathematics education. Courses in the student's cognate area would share this content focus, as appropriate.		

Sample Program for the Ph.D. in Mathematics and Science Education:

Science Education Concentration

Fall 1	**Spring 1**	**Summer 1**
EdRes 562 (3) T&L 584 (3) T&L 598 (1) *7 credits*	T&L 531 (3) T&L 574 (3) T&L 598 (1) *7 credits*	EdRes 563 (3) Cognate (3) *6 credits*
Fall 2	**Spring 2**	**Summer 2**
EdRes 564 (3) T&L 581 (3) T&L 598 (1) *7 credits*	EdRes 565 (3) T&L 571 (3) T&L 598 (1) *7 credits*	T&L 591 (3) Cognate (3) *6 credits*
Fall 3	**Spring 3**	**Summer 3**
Cognate (3) Cognate (3) *6 credits*	Dissertation or other electives	Etc.
T&L 585 and T&L 591 would be focused in science education. Courses in a student's cognate area would share this content focus, as appropriate.		

Appendix A: Brief Descriptions of New Courses

T&L 531: Frameworks for Research in Mathematics and Science Education
In this course, students will be introduced to different research paradigms in mathematics and science education. These include theoretical and practical understandings of specific study designs prominent in the field as well as particular mixed methods, qualitative, and quantitative research methods.

T&L 581: Learning and Development in Mathematics and Science
Students will examine a variety of theories of mathematics learning. Students will be expected to read, discuss, summarize and report on a variety of mathematical learning theories and develop an overall understanding of theories of learning in mathematics. Students will be able to identify a particular learning theory in the literature and recognize and critique its relevance, including the implications of the learning theoretical frameworks that underlie mathematics education research.

T&L 584: Research in Teaching Mathematics and Science
This course will allow students to become fluent with the research literature that outlines the central issues related to mathematics and science teaching. Students will develop a rich understanding of the role of theoretical frameworks related to the research in this area, as well as exposure to seminal studies in the area of mathematics and science instruction.

T&L 585: Focused Reading and Conference in Math/Science Education
This course is designed to foster ongoing scholarship and support students' progress in the doctoral program through focused reading of mathematics and science research. The specific course readings will vary each term in accord with students' current academic focus and may be organized around a particular mathematics or science education issue, methodology, or theoretical perspective.

T&L 591: Research Internship in Math/Science Education
The internship course will provide PhD and EdD students with preparation for conducting dissertation research through immersion in an existing research project. The objective for the course is to provide an opportunity for students to work closely with an accomplished researcher to observe, learn, and practice research methods.

T&L 598: Research Seminar in Mathematics and Science Education
The seminar provides a venue for math and science education faculty and student presentations of current research and special topic discussions in mathematics and science education selected by the instructor. T&L 598 can be taken for 1 credit per semester, but must be taken for up to three credits.