# Student Handbook

**for the**

## Doctoral Program
## in
## Mathematics Education

**Department of Mathematics & Statistics**
**Portland State University**

**2020-2021**

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# Welcome!

Welcome to the Doctoral Program in Mathematics Education at Portland State University. We are excited to have you join our program. This student handbook was compiled to give you a resource for most of the information you will need as you progress through the program. The PSU bulletin (http://www.pdx.edu/academic-affairs/psu-bulletin) lays out the official rules for the program. This document provides important information about how these rules are specifically implemented. Please let any faculty member know of any issues you think should be covered in this handbook that might be of assistance to future students. Please feel free to talk to any of us with your questions and concerns.

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# I. General Degree Requirements/Program Components

Students are expected to complete an approved program of 84 quarter credit hours consisting of three major components: (1) coursework, (2) a research practicum experience, and (3) dissertation research. Prior to completing their program candidates in the Mathematics Education Ph.D. program will be expected to demonstrate competency in the following 8 areas: mathematics education, mathematics, supporting content areas, teaching, the use of technologies in teaching mathematics, the application of mathematics education in an urban setting, and research in mathematics education.

# I. A. Required Courses

Students are required to complete coursework in three areas: Mathematics Education, Mathematics, and Supporting Areas. Coursework must include 18 credit hours in Mathematics Education Research Courses (Mathematics 690 - 695); 18 credit hours of other 500-600 level mathematics courses; and 18 hours of graduate coursework in supporting areas outside of mathematics (such as curriculum and instruction, psychology, educational policy, science, computer science, philosophy, sociology, anthropology, etc.). We strongly encourage students to take at least one course in the psychology of learning and one course in statistics/quantitative methods. Please see Appendix A for a concise listing of required coursework.

## I. A. 1. Mathematics Education

Each student is required to complete the following 18 credit hours of core mathematics education coursework in the Department of Mathematics & Statistics. None of the following courses may be used to fulfill the 18 credit hours in mathematics or 18 credit hours in supporting area coursework. You are encouraged to repeat some of the 69_ courses, in consultation with the doctoral program coordinator (and this is particularly encouraged in cases where the instructor and course foci vary). ***In particular, you are encouraged to take MTH 695 more than once, as the topic of this course varies from year to year.***

MTH 690 (3 credits): Introduction to Research in Mathematics Education

MTH 691(3 credits): Curriculum in Mathematics Education

MTH 692 (3 credits): Research Methodology and Design

MTH 693 (3 credits): Research on the Learning of Mathematics

MTH 694 (3 credits): Research on the Teaching of Mathematics

MTH 695 (3 credits): Topics in Research in Mathematics Education

### I. A. 2. Mathematics and Statistics

Applicants to the Ph.D. in Mathematics Education are expected to have at least a masters degree in mathematics or a degree equivalent to the MS-MTch degree at Portland State University. Candidates must complete an additional 18 graduate-level credits in mathematics or statistics beyond the masters (or the equivalent of the MS-MTc degree at PSU) that together with their masters program reflects a sufficient breadth and depth of the topics in calculus and analysis, linear and abstract algebra, geometry and topology, and probability and statistics. Students should consult with the Doctoral Program Director to choose mathematics or statistics courses that fit with their interests and prepare them for the comprehensive exam in mathematics. Courses suitable to fulfill the mathematics and statistics course requirement include the MS-MTch courses (MTH 581-588) as well as any of the graduate-level courses in mathematics or statistics (MTH 500 or 600 level; STAT 500 or 600 level).

### I. A. 3. Elective Courses: Supporting Areas

The competency in supporting content area(s) can be met by successfully completing 18 graduate credit hours in areas outside of mathematics such as, curriculum and instruction, psychology, educational policy, science, computer science, philosophy, sociology, anthropology, etc. Candidates will be expected to plan this portion of their program in consultation with their advisor so that the 18 credits forms a coherent supporting focus and includes at least one course in the psychology of learning. We recommend that candidates take at least one course in applied statistics outside of the Department of Mathematics & Statistics (e.g., psychology, sociology). Supporting courses should prepare students to conduct research in mathematics education; hence, the courses should be chosen that will build a student's capacity as a researcher. Note: Students should always consult with the Doctoral Program Director when choosing courses to fulfill this requirement, as the Director is responsible for the formal approval through the DARS system: http://www.pdx.edu/registration/dars).

## I. B. Research

Students will be involved in research during each term of the program, in varying degrees. We encourage and invite students to participate in research projects throughout their programs. Some of the research experiences are formalized (e.g., the Research Practicum), while others occur on an ad-hoc basis. Students are encouraged to talk with faculty members regularly about their research and ongoing research projects.

### I. B. 1. Research Practicum

The purpose of the research experience will be to provide candidates with authentic research experiences early in the program and a more advanced research experience in the middle of the program. As such, the Practicum consists of two components:

### First Year Research Practicum:

During the first year of the program the student will sign up for 3 credits of MTH 606 with a faculty member to assist on an ongoing research project. This could involve working with the faculty member on their research or working with an advanced PhD student (who is completing their Advanced Research Practicum or working on their own dissertation project). NOTE: *While only one 3-credit First Year Research Practicum is required, it is recommended that each student look for opportunities to engage in research activities with each of the mathematics educators in the department.*

### Advanced Research Practicum:

After the first year and prior to advancement to candidacy, the student will complete the Advanced Research Practicum. The student will work with a faculty member sponsor, who will oversee the Advanced Research Practicum. Students will register for 3 credits of MTH 601. The *ideal* culmination of the Advanced Research Practicum is submission of a manuscript for publication in a peer-reviewed journal (the student should be first author or sole author of this paper and typically the practicum will be considered to be successfully completed when the student responds to journal reviewer feedback and resubmits the paper). However, different students have different strengths and different needs, so the advanced research practicum and the criteria for completion should be individualized. Students will coordinate the details of the Advanced Research Practicum with a sponsoring faculty member. Terms of the research practicum vary and will be negotiated between the sponsoring faculty member and student. *When the student and sponsoring faculty member have decided upon the terms of the Advanced Research Practicum, they will send a description of the Advanced Research Practicum project to the Doctoral Director for final approval.* The advanced research practicum is complete (and the research practicum requirement met) when the sponsoring faculty member has assigned a grade for this MTH 601).

## I. B. 2. Other Research Experiences in Conjunction with Faculty Members

Students will have many opportunities to engage with faculty in a variety of research experiences: from study design to publication preparation. Some faculty research projects are funded, and, as such, students will have opportunities to work as a paid RA on a project. Other projects are more ad-hoc and students may register for credit for working on a faculty research program. ***Students should not both register for credit and receive compensation for work on a research project during a single term***. We encourage students to work with a variety of faculty, in order to experience a range of research techniques and foci.

# I. C. Dissertation

The dissertation is the culminating research experience of the program. Students should talk to faculty early in their programs about possible dissertation topics. The dissertation research will be conducted under the guidance of a mathematics educator in the Department of Mathematics and Statistics. The dissertation involves identifying and researching a significant problem which builds upon previous research, and which will make an original contribution to an area of research in mathematics education. The dissertation project may be conducted in conjunction with a faculty research project or in an area of the students' choosing, not connected to a faculty research project. There are strengths and drawbacks to both approaches. Dissertation

committees consisting of a mix of faculty with expertise in mathematics education, mathematics, curriculum and instruction, and other areas outside of mathematics education are encouraged.

After completing the comprehensive examinations, the chairperson and dissertation committee will be appointed. The student will develop a dissertation proposal which will be defended in an oral presentation to the committee. When the proposal has been approved by the committee, and if necessary by the University Human Subjects research Review committee, the student will be considered a candidate for the Ph.D. in mathematics education. The dissertation must be completed according to the outlines of the proposal approved by the candidate's committee. Students must register for dissertation credit during each term they are engaged in dissertation research. Upon completion of doctoral thesis work, the candidate will defend the dissertation before the committee in an oral presentation that is open to other interested faculty and students. The student is expected to demonstrate knowledge of the research literature in mathematics education that relates to the particular problem chosen for research, and to show how the dissertation contributes to work in this area.

Students must register for a minimum of 27 hours of dissertation credits (MTH 603) before graduation. The dissertation credit hours may be used to account for a student's time at any point during the dissertation timeline: from proposal preparation to graduation. Note that once a student has advanced to candidacy (successfully completed all comprehensive examinations, and successfully defended the dissertation proposal, and secured IRB approval),they must be continuously registered until graduation (this excludes summer term).

# I. D. Teaching

Students are encouraged to garner teaching experiences in a range of settings: from undergraduate classes to elementary schools. If a student enters the program with an RA, she/he should seek out opportunities to TA for some terms and/or teach summer courses. Typically, graduate students teach entry-level courses such as MTH, 95, 111, 112 and STAT 243, 244. However, we encourage students to mentor with a faculty member or advanced graduate student to teach course such as MTH 251, 252, 253, 254 (Calculus sequence), MTH 211, 212, 213 (Mathematics for Elementary Teachers sequence), MTH 261 (Linear Algebra). Another opportunity for gaining experience at the post-secondary level is completion of the Undergraduate Mathematics Teaching Internship (MTH 610). There may also be opportunities for very advanced students to teach 300-level courses (Discrete Math, Geometry, etc.). There will be opportunities for students to work in K-12 classrooms and/or with K-12 mathematics teachers, and we encourage all students to gain experience at the K-12 setting. At a minimum, candidates must demonstrate competency in teaching mathematics for at least one of these two levels (K-12 or post-secondary).

# I. E. The use of Technologies in Teaching Mathematics

Students are expected to acquire background and experiences in how students best learn mathematics within technologically enhanced learning environments. The Department of Mathematics & Statistics offers a course in using computational technology (such as Geogebra, Desmos, or Matlab) in mathematics teaching, MTH 588, which students are encouraged to take. The role of technology in mathematics education will be addressed throughout the doctoral program. Students may also gain experience using technology when working with faculty on research projects, in the mathematics education doctoral coursework, or by working with students in K-12 classrooms or by teaching courses in the department that utilize technology (e.g., pre-calculus, calculus, linear algebra, or differential equations).

## I. F. The Application of Mathematics Education in an Urban Setting

Portland State University and the Portland Metro area provide a "natural laboratory" for conducting research on the teaching and learning of mathematics within an urban setting. Moreover, integral to the mission of Portland State University is a commitment to work with community partners in the promotion of educational reform K-16. Candidates in the Ph.D. program will be expected to demonstrate competency in working with urban populations and settings either by providing service or conducting research with community partners.

# II. Evaluation

Students will be evaluated on their progress in the program using a variety of measures, including annual evaluations, course grades, and exams. The faculty want to ensure that students are making satisfactory and timely progress in the program in order to develop into an independent mathematics education researcher.

## II. A. Yearly Evaluation

### II. A. 1. Annually Updated Program Progress Form

At the end of each academic year, all students will submit an updated Program Progress Form (see Appendix) to the Doctoral Director. If any concerns are noted, faculty will work with the students to develop a plan to address them.

### II. A. 2. Second Year Evaluations

During the summer following the second year of the program, the faculty will prepare a review of the students' progress in the program, culminating in a one-page document of strengths, areas of difficulty, if any, and suggestions for improvement. The faculty will discuss the document, preparing, if they wish, a draft of the document to be shared with the student. A date will be set in the fall of the student's third year for the student to meet with the Mathematics Education PhD Committee to discuss, in a collaborative manner, the evaluation information. The student will be expected to contribute to the discussion on strengths, areas of difficulty if any, and suggestions for improvement. A final document will then be prepared, signed by the

student to indicate they have read the document, and signed by the Doctoral Director. The student may prepare a one-page supplement to accompany the evaluation, if desired.

# II. B. Course Grades

Students must maintain a 3.0 or "B" average in the program to maintain status in the program. Per University regulations, an admitted student is placed on probation if:

- The student's cumulative graduate GPA at Portland State University, based on the completion of 9 letter-graded graduate credits at Portland State University, is below 3.00 at the end of any term; or
- The student's term graduate GPA, based on a minimum of 6 letter-graded graduate hours, is below 2.67 for a given term.

While on academic probation the student will not be permitted to graduate, to be advanced to doctoral candidacy, to receive or continue to hold a graduate assistantship, or to register for more than a total of 9 credit hours in any term. Removal of academic probation occurs if the cumulative graduate GPA is brought to 3.00 within the next 9 graduate credits in letter-graded courses in the case of probation due to a low cumulative GPA, or both cumulative and term GPA of 3.00 or above in the case of probation due to a low term GPA.

Students are responsible for keeping their advisors informed about their grades, particularly any grade below a B and any grade of I (incomplete).

# II. C. Comprehensive Examinations

## II. C. 1. Mathematics

*PSU Bulletin Description:* Prior to being advanced to candidacy, students must pass and orally defend a written comprehensive exam in mathematics that covers the big ideas of analysis, linear and abstract algebra, plus one of the following areas: probability, statistics, topology, geometry, or applied mathematics. Students will sit for the exam but will have the opportunity to defend their responses orally before an examination committee.

In the following, we further clarify the specific structure of the mathematics comprehensive exam.

The mathematics comprehensive exam consists of two components. Algebra and Analysis will be the focus of Component 1, which will emphasize advanced mathematics and its connection to K-14 math. Component 2 will address K-14 mathematics more generally and will emphasize the specialized kinds of mathematical knowledge needed by educational researchers and teachers.

A useful way to think about the foci of the two components is provided by the framework Deborah Ball and colleagues (see Ball, Thames, & Phelps, 2008) have developed for delineating the kinds of knowledge needed

for teaching mathematics. While not a perfect fit for capturing the purpose and expectations of the mathematics comprehensive exam (given that we are training scholars of mathematics education rather than classroom teachers), the Ball et al. paper is a good reference for understanding how this exam may differ from a standard comprehensive exam in mathematics (say that a research mathematician would complete as part of their PhD program).

The first component of the exam (Algebra & Analysis for Educators) can be seen as focusing (approximately) on what Ball and Colleagues refer to as *Common Content Knowledge* and *Horizon Content Knowledge*.

The second component of the exam (Mathematics of Students, Teachers, and Curriculum) can be seen as focusing (approximately) on what Ball and Colleagues refer to as *Specialized Content Knowledge, Knowledge of Content and Students, Knowledge of Content and Curriculum, and Knowledge of Content and Teaching.*

## Component 1: Algebra & Analysis for Educators

Students will be assessed on their understanding of the core ideas of analysis and algebra as they appear at all levels from elementary school through junior year (300- level) college course work. The exams are also meant to assess students understanding of connections between concepts (within the topic area and between topic areas). The emphasis is on depth of understanding, so students will be assessed on how well they understand the meanings of the key concepts. This is also the component that is intended to assess students understanding and facility with advanced mathematics.

Two helpful "rules of thumb" for thinking about the standard for passing this component are:

1) The student should be able to demonstrate that they could be successful in teaching a course related to analysis or algebra at any level up to the 300-level at Portland State (in the sense that their ability to succeed would be supported rather than constrained by their common content knowledge of algebra and analysis).

2) The student should be able to demonstrate a strong understanding of the *trajectory* of the key ideas of algebra and analysis throughout the curriculum from elementary school through graduate school. For example, a student should be aware of how area is handled in elementary school, how integration is developed in high school, how advanced calculus works out some of the rigorous foundations of integration theory, and how this rigorous development is continued in real analysis.

***Recommended Preparation for this component***: It is recommended that a student complete at least two of the relevant 500-level courses (e.g., 541, 542, 543, 544, 545, 511, 512, 513).

The "*Advanced Mathematics for Educational Researchers"* course (currently numbered MTH 610) will be useful to students preparing for this exam.

Further, students may want to intern, tutor, or sit-in on relevant 200 or 300-level courses (Math 261, 311, 312, 313, 344, 345).

You should meet with the program director and/or your advisor for consultation on the best plan given your background.

## Component 2: Mathematics of Students, Teachers, and Curriculum

Students will be assessed on their understanding of mathematics in ways necessary for making sense of and assessing student thinking, analyzing curriculum, and making instructional decisions. Students will be asked mathematical questions in the context of teaching and learning situations. Problems could involve mathematical analyses of curricular tasks, student solution strategies, or pedagogical options in specific classroom scenarios. The idea behind this exam is that while it is necessary for an educational researcher or teacher professional development provider to know mathematics in much the same way (but not to the same extent) as a mathematician, there other ways of knowing and doing mathematics that are of specific value to educational researchers (and teachers). In particular the purpose of this component is to assess 1) whether a student has the mathematical knowledge necessary to train K-14 teachers and 2) whether a student has the mathematical knowledge necessary to conduct research in mathematics education.

Any mathematical topic from elementary school, middle school, high school, or community college mathematics is fair game for the exam. Students will be expected to be familiar with any mathematics that a teacher at any of these levels would be expected to teach. One section of the exam (approximately 1/3 of the exam) will focus on a mathematical topic of the students choosing. This section will consist of questions that students can address with reference to the mathematical area of their choosing (e.g., probability, statistics, discrete mathematics, topology, geometry, or applied mathematics). For example, a question might ask the PhD student to "explain the development of a fundamental idea in your chosen mathematical area from elementary school through advanced undergraduate mathematics and describe some of the key challenges learners are likely to face as they experience this idea throughout their formal (in school) education."

***Recommended Preparation for this component***: As with any PhD comprehensive exam, there is no perfect fit between the content assessed on the exam and some specific course or set of courses. Here we recommend some experiences that would likely be helpful.

It is recommended that a student complete an instructional internship in Math 211, 212, or 213. If this is logistically impossible, a student should develop another strategy (e.g., tutoring) to become familiar with these courses.

It is also recommended that a student complete at least one of the core courses in the MS-MTCH program (581-588) or find another way to learn about what goes on in these courses.

The *"Mathematics of Students, Teachers, and Curriculum for Educational Researchers"* course (currently numbered MTH 610) will be useful to students preparing for this exam.

### Scheduling

Students should begin taking their mathematics comprehensive exam components as early in the program as possible. Component 1 will be administered (as needed) each September, and Component 2 will be administered (as needed) each December/January. If you intend to take Component 1 you must let the PhD Coordinator know your intentions before the end of the previous Spring term. If you intend to take Component 2 you must let the PhD Coordinator know your intentions by the third week of the previous Fall term. Study questions will be provided to students approximately two weeks before they sit for the written exam component. The actual exam component will consist of a smaller collection of questions that will be the same or similar to those on the study list.

### Written and Oral Exam Evaluation and Expectations

Comprehensive examination committees will be composed of faculty from the Department of Mathematics & Statistics. Whenever possible, faculty who have taught key courses in a particular content area will be recruited to serve on the examination committees. The written part of the exam component will be evaluated as pass, conditional pass**,** or fail. If you *conditionally pass* the written part of the exam component then you move on to the oral defense. Students will be contacted within 3 weeks of their written exam component to find out if they have received a conditional pass and to schedule an oral defense.

Written work on the exam components is expected to be complete, thorough, and appropriately detailed. Additionally, written work should show depth of understanding, including attention to coherence and connections among ideas.

At the oral defenses, the student will be asked to address omissions and mistakes found in the written exam component. Additionally, students may be pressed to provide additional details or explanations of their responses or to discuss foundational ideas that support their written responses. The oral defense will end in either a pass or a fail.

If a student fails the exam component, then the student will need to take the exam component again within a year. Failing the same exam component more than once *or* failing each component one time will result in dismissal from the program.

## II. C. 2. Mathematics Education

Prior to being advanced to candidacy, students must pass and orally defend a written, comprehensive exam that covers the key developments and theoretical perspectives on the history of mathematics education, the teaching and learning of mathematics, and the development of curriculum in mathematics. The implications of this information for urban populations and settings will also be included. It is recommended that this exam be attempted when a student is nearly ready to begin work on their dissertation proposal (so that the exam can be customized most effectively).

## Scheduling and Preparing for the Mathematics Education Exam

The mathematics education comprehensive exam is scheduled in consultation with the Ph.D. Director and advisor. The student must initiate the scheduling process no later than the first week of the term during which they intend to take the exam.

The following guidelines add clarity to the process of preparing for and requesting to take the mathematics education comprehensive exam, writing the exam, advancing to the oral defense, and the possible outcomes of the exam.

- The faculty will construct a 'starter list' list of core readings to send out to students as a start to their own bibliography. This list of core readings can be found in the Appendix. When students request to take the Mathematics Education Comprehensive Examination, they will submit a reading list reflecting their research interests and expansion of the 'starter list'. The 'starter list' should be expanded with readings in three ways:
    - The expanded list should include a selection of readings from a "breadth of knowledge" area. This is an area (e.g., teacher professional development or students' understanding of proof in advanced mathematics) determined by the student and their advisor to represent an important gap in their training to that point. The student and advisor may wish to seek assistance from another faculty member in producing a good reading list. These should be listed under the heading "Breadth"
    - The expanded list should include a selection of readings the student and advisor see as most relevant to the students intended dissertation work. These should be listed under the heading "Dissertation Focus"
    - The expanded list should include a selection of readings from a "depth of knowledge area." This is an area of research that the student and advisor identify as the major area of expertise for the student but not the narrow focus of the students dissertation work. These should be listed under the heading "Depth"

## Format of the Mathematics Education Exam

The exam committee will prepare three questions. The most common format for the mathematics education comprehensive exam is a three-question format as described below. However, the exam committee reserves the right to deviate from this format as appropriate (and will inform the student if they intend to do so). Students will have two weeks to compose their responses, which they will defend orally before an examination committee.

One question will focus narrowly on the students' dissertation topic with the intention that in addition to serving examination purposes, the experience of addressing the question will help prepare the student for preparing their dissertation proposal.

One question will focus on the student's general area of expertise as represented by the student's "Depth" reading list.

One question will focus on the area represented by the student's "Breadth" reading list.

### Written and Oral Exam Evaluation and Expectations

The written part of the exam will be evaluated as **conditional** pass or fail. If the student conditionally passes the written part of the exam then they move on to the oral defense. There are two ways to advance to the oral defense. A student conditionally passes the written part of the exam if all of the responses are approved by the committee. The student may be asked to rewrite 1 (only one) question prior to the oral defense (oral defense will be scheduled after the approval of the rewrite, resulting in a conditional pass). Otherwise, the exam must be retaken.
If a student fails the exam, then the student will need to take the exam again the next time it is offered. A student will have one additional opportunity to pass the mathematics education exam if they fail it once. Failing the mathematics education exam more than once will result in dismissal from the program.

## II. D. Tracking your Progress

The Graduate School has an auditing system for tracking student progress toward the degree, the Degree Audit Reporting System (DARS). This system is used to determine when key program requirements have been satisfied, and which requirements still remain for completion of the degree. Although the Graduate School will send a DARS report to the graduate program administrator and program director at certain stages of the student's time in the program so that we may check it against our internal records for accuracy, students are also encouraged to use the system to track their own progress. Information about DARS, including FAQs and how to access your own information, can be found at (https://www.pdx.edu/ogs/dars). The graduate program administrator or program director notifies the Graduate School when certain degree requirements have been met via official forms that are submitted to their office. Although these forms are typically handled solely by the program administrator or program director, it may be useful to be aware of their content. The most relevant of these forms are:

- Report on Passing Comprehensive Examinations (GO-22)
- Appointment of Doctoral Dissertation Committee (GO-16D)
- Doctoral Request for Advancement to Candidacy (GO-23)
- Recommendation for the Degree (GO-17D)

These forms and others that may be of use can be found at (https://www.pdx.edu/ogs/forms). Additionally, deadlines for the submission of some of these documents, as well as other key deadlines related to the Graduate School may be found at (https://www.pdx.edu/ogs/graduate-candidate-deadlines).

The Mathematics Education Program Progress Form and 2nd year evaluation form serve as an additional means for students and their advisors to track their progress in the program. These forms will be submitted to the program administrator by the program director so that they may be made available to students' advisors.

# III. Policies

## III. A. Residency

Residence credit is defined as credit taken at PSU after formal admission to a graduate degree program. Residency requirements are intended to ensure that students work in close association with other graduate scholars in the intellectual environment of PSU. In a master's program, to meet the residency requirement a student must earn a minimum of two-thirds of the credits applied to the degree after formal admission to a master's degree program at PSU.

In a doctoral program, the residency requirement can be satisfied in one of the follow ways:

- Three terms of full-time enrollment (minimum 9 graduate credits applicable to the degree program each term) during the first two years after admission to the program. This may include one or more summer terms.
- Six terms of part-time enrollment (minimum 1 graduate credit applicable to the degree program each term) during the first two years after admission to the program. This may include one or more summer terms.
- A doctoral student who was enrolled in the same major at PSU, and whose matriculation to the doctoral program immediately follows (within one calendar year) the master's degree program, may fulfill the residency requirement during the period in which the student was enrolled in the master's program.

## III. B. Time Limits

For students entering a doctoral program with a master's degree, a maximum of five years will be allowed from admission to completion of all required comprehensive examinations. For students entering with a bachelor's degree, a maximum of two additional years will be added to this limit, for a maximum of seven years from admission to completion of all comprehensive examinations. Doctoral programs may have stricter requirements. Failure to meet this time limit will result in cancellation of admission to the doctoral program.

A maximum of three years will be allowed from the completion of comprehensive examinations to advancement to candidacy (doctoral programs may have stricter requirements). Failure to meet this time limit will result in cancellation of admission to the doctoral program.

A doctoral candidate has a minimum of four months and a maximum of five years from the effective date of advancement to candidacy to complete all requirements for graduation, including defense of the dissertation and its final approval by the Office of Graduate Studies (within this time frame, doctoral programs may have stricter requirements). Candidates must be continuously enrolled during that period. Failure to meet the five-year limitation will invalidate passing of the comprehensive examinations and remove the student from candidacy.
Advancement to a second period of candidacy requires the passing of the regular, or a special, comprehensive examination. Approvals for a second period of candidacy are required from the doctoral program and the

Dean of Graduate Studies; the maximum time limit (which will be less than five years) will be determined by the doctoral program and the Dean of Graduate Studies

After a student is advanced to candidacy, they must be continuously enrolled at PSU in every term (except summer) from the term of advancement to the term of graduation.

## III. C. Satisfactory Academic Progress and Dismissal Policy

Students must maintain satisfactory academic progress (SAP) during the course of the PhD program. Failure to do so may result in dismissal from the program.

In order to maintain satisfactory academic progress students must:

- Enroll in and satisfactorily complete at least one credit per term toward their PhD in Math Ed degree (summer terms and terms for which there is an approved leave of absence are exempt from this requirement).
- Complete at least 12 credits toward their PhD in Math Ed degree each academic year until coursework is completed.
    - Earn a B- or higher (or a P) in each course taken within the department.
    - Maintain a term GPA of at least 3.0, and a cumulative GPA of at least 3.25, for all courses taken within the department. The student has the first 12 credit hours to attain this GPA. Note that these GPA standards are higher than those set by the Graduate School to maintain good academic standing.
    - Resolve incomplete grades within one term.
- Receive positive progress reports by their advisors and the program committee. The program committee will conduct annual reviews of each student, in consultation with the student's advisor (see Annual Degree Progress and Planning Form).
- Satisfy the program's criteria for each of the program milestones.
    - Twice failing a component of the Mathematics comprehensive exam (failing one component twice or failing both components) or twice failing the mathematics education exam will result in automatic dismissal from the program.
    - Failure to satisfy the other SAP criterion will result in a written statement explaining the criteria that have been violated and an explanation of what must be done, and within what timeframe, to restore proper SAP status. If the student fails to satisfy the conditions given in this statement, they will be dismissed from the program. In case of dismissal, the student and Graduate School will be notified in a written statement that includes the basis for dismissal.

## III. D. Registration

Students are responsible for registering for classes each term. Registration information, including current course schedules, is available on-line at http://www.pdx.edu/registration/. Remember to get all payment and forms in on time to avoid late fees.

## III. E. Leave of Absence

A student admitted to a graduate program and in good academic standing may petition for leave of absence for up to one calendar year. Leave of absence status assures the student a continuation of the student's admission in the program during the period of the leave of absence. Application for leave of absence, endorsed by the department chair or program director, must be filed in the Office of Graduate Studies not later than the Friday of the second week of the term for which the leave of absence should take effect. A leave of absence will not be approved retroactively. A leave of absence is granted only to graduate students in good academic standing and does not constitute a waiver of the time limit for completion of the graduate degree at PSU, nor does it extend the regular one-year limit for completion of a course.
A student may petition for a second leave of absence from a graduate program, but approval is required from the department chair or program director and graduate committee of the college or school as well as the Office of Graduate Studies. Students who have not enrolled for three terms (excluding summer) must submit a Graduate Re-Enrollment Request.

# IV. Preparing for Graduation

The information below outlines the process after completion of coursework and examinations, through advancement to candidacy and to completion of the dissertation. You should become familiar with the policies, procedures, and timelines of the Office of Graduate Studies at http://www.pdx.edu/ogs/procedures-doctoral-degrees. This website includes important dates for the submission of forms, as well as information about the format and structure of your dissertation.

## IV. A. Dissertation Proposal Defense

After passing the comprehensive examination and identifying a dissertation topic, a dissertation committee is appointed (in consultation with the dissertation advisor) and the student must pass a proposal defense. **The dissertation committee must be approved by the Office of Graduate Studies using the Appointment of Doctoral Dissertation Committee form (GO-16D) before the defense of the dissertation proposal.** The GO-16D form can be found at: http://www.pdx.edu/ogs/forms.

### IV. A. 1. Dissertation Committee

After passing the comprehensive examination and identifying a dissertation topic, a dissertation committee is appointed and the student must pass a proposal defense. The dissertation committee must be approved by OGS using the Appointment of Doctoral Dissertation Committee form (GO-16D). The dissertation committee must consist of four to six PSU faculty members: the dissertation adviser, a minimum of two and

a maximum of four regular members, and the Graduate Office Representative. The chair of the dissertation committee and the Graduate Office Representative must be regular, full-time PSU instructional faculty, tenured or tenure-track, assistant professor or higher in rank; the other two to four committee members may include adjunct or fixed-term faculty and/or one member of the OHSU faculty. If it is necessary to go off-campus for one committee member with specific expertise not available among PSU faculty, a curriculum vitae (CV) for that proposed member must be presented with the GO-16D form. This off-campus member may substitute for one of the two to four regular committee members. All committee members must have doctoral degrees. No proposal defense shall be valid without a dissertation committee approved by OGS.

## IV. A. 2. Dissertation Format

There are two options for the format of the dissertation.

https://www.pdx.edu/ogs/electronic-thesis-and-dissertation-etd-formatting-requirements.
"There are two standard formats for the dissertation—the monograph format and the multi-paper format. The monograph format focuses on a single subject and has a single author whereas the multi-paper format is a compilation of papers (typically three), often in a journal article style format, and may have co-authors (as second or third authors, not first). The multi-paper format is more commonly used in dissertations than theses. In the multi-paper format the papers do not have to be closely related to each other, but it is required that there be both an introductory and concluding chapter that link the papers together with a common theme. The decision whether to use a monograph or multi-paper form is made in conjunction with your adviser and committee."

Regardless of the format, the research should make a significant contribution to the research literature and should be high in quality. For dissertations in a "three paper format", each of the papers should be nearly ready for submission (but not necessarily ready for publication).

## IV. A. 3. Structure of the Dissertation Proposal

The student prepares a written dissertation proposal and submits it to the approved dissertation committee for evaluation, modification, and final approval. The final proposal submitted to the committee for approval should be sufficiently detailed and clear to provide a blueprint for the study to follow. The proposal is expected to include the following:
1. General nature and present status of knowledge of the problem.
2. The theoretical and empirical framework within which the proposed problem exists.
3. A thorough review of relevant literature.
4. The significance of the proposed research and its likely contributions.
5. The research methodology to be used and results of pilot studies, if applicable.

Note that for a "three paper format" dissertation, the proposal will consist of an overall proposal document (which will contain some of the information listed above) ***and*** (for each of the three papers) either an outline, a rough draft, or a proposal for the specific paper (whichever is deemed most appropriate by the candidate and their advisor).

*It will be important that the proposal provide evidence that you can do the work you are proposing. In particular, any draft, outline, or proposal for a specific paper must include evidence that you will be able to generate the required data and successfully conduct data analysis. This can be in the form of a reported pilot study or selected sample analyses of pre-existing data.*

The student must deliver a draft of the dissertation proposal to all members of the approved committee no fewer than 14 days before the proposal defense.

### IV. A. 4. Proposal Defense and Advancement to Candidacy

All appointed committee members, or alternates approved in advance by the Office of Graduate Studies, must be present for the proposal defense; one regular committee member (not the Chair or Graduate Office Representative) may participate via speakerphone. The proposal defense must be a formal meeting of the entire approved dissertation committee at which the student will make an oral presentation of the written proposal for discussion, evaluation, and suggested modification.

The student will work with the committee members to schedule a time for the dissertation proposal defense and work with staff in the Department of Mathematics & Statistics to reserve a room for the defense. The student will prepare a brief (approximately 30 minute) presentation to the committee, which serves as an overview of the dissertation proposal. After the presentation, the committee will engage in a questions and discussion session with the student. The doctoral program recommends the student for advancement to candidacy once the dissertation proposal has been approved.

When the dissertation committee has approved the proposal, the dissertation approval/request for advancement to candidacy form is submitted to the Office of Graduate Studies. The student submits their Human Subjects Application to the HSRRC office (Unitus Building, 6th floor) for approval. If the student has not satisfied the residency requirements, a plan for doctoral residency compliance must also accompany the request for candidacy.

The student is informed by the dean of Graduate Studies of advancement to candidacy for the doctoral degree. The candidate has a minimum of four months and a maximum of five years from the effective date of advancement to candidacy to complete all requirements for graduation, including defense of the dissertation and its final acceptance by the Office of Graduate Studies. Candidates must be continuously enrolled during that period.

## IV. B. Human Subjects

Most dissertations in the program will involve Human Subjects. As such, you will need to prepare and submit an application to conduct research on human subjects with the Human Research Protection Program (HRPP) office. Information about the Human Subjects application process can be found at https://sites.google.com/a/pdx.edu/research/integrity/hrpp/IRB. Students should work with their advisor to develop a draft Human Subject application. Once the dissertation proposal has been approved by the committee, a final draft of the Human Subject application must be submitted to the HRPP office for approval. Data collection cannot begin until Institutional Review Board (IRB) approval is granted.

## IV. C. Dissertation Defense

Candidates must register for a minimum of 27 hours of dissertation (603) credits before graduation. A minimum continuing enrollment of one graduate credit is required through the term a student graduates.

Under direction of the chair of the dissertation committee, and in consultation with the members of the dissertation committee, the candidate prepares a preliminary draft of the dissertation. The draft is revised and corrected as directed by the dissertation committee until it meets the approval of the committee.

The candidate files the Application for Awarding of Master's or Doctoral Degree form with the Office of Graduate Studies no later than the first week of the anticipated term of graduation. At least two weeks prior to the final oral examination (dissertation defense), the chair of the dissertation committee submits copies of the final draft to each member of the committee.

The final oral examination must be passed and all degree requirements completed no later than five calendar years after advancement to candidacy for the doctoral degree. Candidates must be continuously enrolled.

The final dissertation must be submitted to the Office of Graduate Studies not later than three weeks prior to close of the term of application for graduation. For detailed information about formatting, submission, and specific deadlines, as well as information about microfilming and copyright of the dissertation, contact the Office of Graduate Studies.

The National Research Council Survey of Earned Doctorates must be completed by the student and returned to the Office of Graduate Studies. There is no charge involved.
Incomplete or In Progress grades in any course (excluding dissertation, see 11 below) which is in the approved program must be removed no later than two weeks before graduation.

All M (Missing) grades in PSU graduate courses that could potentially be letter graded must be removed no later than two weeks before graduation, even if the courses are not listed on the student's approved doctoral program of study.

The doctoral program completes the Recommendation for the Degree form (GO-17D) which is forwarded to the Office of Graduate Studies no later than the last week of the term of graduation. In-progress grades for 603 dissertation credits are changed on this form, eliminating the need for the Supplemental Grade Report for these courses. The Dean of Graduate Studies certifies that all requirements for the degree have been met and recommends the awarding of the degree.

# V. Conferences and Professional Societies

Membership in professional societies and participation in research and professional conferences are important components of your graduate training and your professional career. Faculty will encourage you (often with financial support) to attend and present at mathematics education conferences. Talk to faculty members often about conference schedules and appropriate conferences to attend and to find information regarding possible funding sources.

# V. A. Research Conferences

As an active and novice mathematics education researcher, it is important for you to attend conferences so that you can stay current on research trends and results, network with other researchers, and start to disseminate the results of your work. There are numerous local, regional, national, and international conferences for you to attend and at which to present. Typically, a student will submit a proposal to speak at a conference in conjunction with a faculty member. If you are submitting a proposal on your own, you should receive feedback from faculty members before submitting it.

Common conferences include:

| | |
|---|---|
| January | Joint Meetings of the Mathematical Association of America and the American Mathematical Society |
| February | Conference on Research in Undergraduate Mathematics Education |
| | Association of Mathematics Teacher Educators Conference |
| March-April | National Council of Teachers of Mathematics Annual Conference |
| | American Educational Research Association Conference |
| July | International Group for the Psychology of Mathematics Education |
| October | North American Chapter of PME |
| | Northwest Mathematics Conference |

# V. B. Membership in Professional Societies

An important part of an active mathematics education researcher is her or his contribution to the broader field of mathematics education researchers and practitioners. One way researchers and practitioners regularly interact with each other is through professional organizations. Membership in professional organizations keeps you abreast of timely issues in the field, new research findings, and provides a community of other professionals. Typically, membership in professional societies affords you yearly subscriptions to organizational journals and newsletters, discounts for attending meetings and conferences sponsored by the organization, and information about employment opportunities. Most organizations have special graduate student sub-communities and some organizations have elected graduate student representation on their leadership teams.

There are many professional societies which to belong and likely you will need to make choices about which one(s) is/are most important to you. Most societies offer discount memberships to graduate students. Some of the most common professional societies are:

*National Council of Teachers of Mathematics (NCTM)*

*Mathematical Association of America (MAA) and the Special Interest Group on Research in Undergraduate Mathematics Education (SIGMAA on RUME)*

*American Mathematical Society (AMS)*

*American Educational Research Association (AERA) and the Special Interest Group on Research on Mathematics Education (SIG-RME)*

*Association of Mathematics Teacher Educators (AMTE)*

*International Group for the Psychology of Mathematics Education (PME)*

*North American Chapter of the International Group for the Psychology of Mathematics Education (PME-NA)*

*Association of Women in Mathematics (AWM)*

All of these professional societies have websites with which you should familiarize yourself throughout your program.

# V. C. Journals

There are numerous journals worldwide that publish research in mathematics education. Patrick Thompson at Arizona State University has compiled a list of such journals at http://www.pat-thompson.net/zdmzs.html#Top . A few major journals are listed below. You should consider a student-rate subscription to at least the Journal for Research in Mathematics Education (this journal is included in your student membership to NCTM).

*American Educational Research Journal. A Quarterly Publication of the American Educational Research Association*

*American Mathematical Monthly. An Official Publication of the Mathematical Association of America*

*Anthropology and Education Quarterly*
*Australian Journal of Education*
*British Educational Research Journal*

*CASTME Journal*

*Cognition*

*Cognition and Instruction*

*Cognitive Development*

*College Mathematics Journal*

*College Teaching*

*Education Evaluation and Policy Analysis*

*Educational Researcher*

*Educational Studies in Mathematics*

*Elementary School Journal*

*Focus on Learning Problems in Mathematics*

*For the Learning of Mathematics: An International Journal of Mathematics Education*

*Hiroshima Journal of Mathematics Education*

*International Journal of Computers for Mathematical Learning*

*International Journal of Mathematics Education in Science and Technology*

*Journal for Research in Mathematics Education*

*Journal of Educational Psychology*

*The Journal of Mathematical Behavior*

*Journal of Science and Mathematics Education in Southeast Asia*

*Journal of Statistics Education*

*Journal of Teacher Education*

*Learning and Instruction: The Journal of the European Association for Research on Learning and Instruction (EARLI)*

*Mathematical Didactica: Zietschrift fur Didaktik der Mathematik*

*Mathematics Education Research Journal (Australia)*

*Mathematics Teaching in the Middle School*

*The Mathematics Educator*

*The Mathematics Teacher*

*The Montana Mathematics Enthusiast*

*Phi Delta Kappan*

*Research in Collegiate Mathematics Education*

*Science*

*Teachers College Record*

*Teaching and Teacher Education*

*Teaching Children Mathematics*

*ZDM: International Reviews on Mathematical Education (Germany)*

# Appendix A. Mathematics Education Program Progress Form

**Doctoral Program in Mathematics Education**
Department of Mathematics & Statistics
Portland State University

Student Name_____ PSU ID _____

Address _____

Home Phone_____ Work Phone_____ Term/Yr Admitted ____

*Please update this form at the end of each academic year and send (via email) to the Ph.D. Director*

**Course concentrations in three areas (Minimum 18 hours/area)**
Mathematics and Statistics (MTH / STAT 500 or 600 level). (Minimum 18 hours)

| Course | Title | Grade | Credits | Term | Instructor/Institution |
|---|---|---|---|---|---|
| | | | | | |
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| | | | | | |
| | | | | | |

Note: Mathematics education courses with MTH prefixes such as MTH 504, MTH 606, or MTH 690-695 should not be used to fulfill this requirement.

Mathematics Education* (Minimum 18 hours)

| Course | Title | Grade | Credits | Term | Instructor |
|---|---|---|---|---|---|
| MTH 690 | Introduction to Research in Mathematics Education | | 3 | | |
| MTH 691 | Curriculum in Mathematics Education | | 3 | | |
| MTH 692 | Research Methodology and Design | | 3 | | |
| MTH 693 | Research on the Learning of Mathematics | | 3 | | |
| MTH 694 | Research on the Teaching of Mathematics | | 3 | | |
| MTH 695 | Topics in Research in Mathematics Education (Insert Topic) | | 3 | | |

*MTH 69X Courses

Supporting Content Area(s) (Minimum 18 hours)

| Course | Title | Grade | Credits | Term | Instructor/Institution |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**First Year Research Practicum (Minimum 3 hours)**

| Course | Project Title | Grade | Credits | Term | Project Advisor |
|---|---|---|---|---|---|
| MTH 606 | PROJ: | | | | |
| Product (Presentation/Paper): | | | | | |

**Third Year Research Practicum (Minimum 3 hours)**

| Course | Project Title | Grade | Credits | Term | Project Advisor |
|---|---|---|---|---|---|
| MTH 601 | RES: | | | | |
| Product (Presentation/Paper): | | | | | |

**Comprehensive Examinations**

| Area | | Committee | Date Completed |
|---|---|---|---|
| Mathematics | Algebra/Analysis Component | | |
| | Mathematics For Educators Component | | |
| Mathematics Education | | | |

**Additional Coursework**

| Course | Title | Grade | Credits | Term | Instructor |
|---|---|---|---|---|---|
| | | | | | |
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**Dissertation Credits (Minimum 27 hours)**

| Course | Title | Credits | Term | Instructor |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
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| | | | | |
| | | | | |

**Other Scholarly Activities (e.g., presentations, research experiences, articles submitted)**

| Date | Description |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |

## Program Requirement Checklist

| | Date | Approver |
|---|---|---|
| First Year Practicum Completed (606) | | |
| Third Year Practicum Proposal Approved (advisor and chair) | | |
| Third Year Practicum Completed (601) | | |
| Mathematics Comprehensive Exam:<br>● Algebra/Analysis Component Passed | | |
| ● Mathematics For Educators Component Passed | | |
| Mathematics Education Comprehensive Exam Passed | | |
| Dissertation Committee Form Approved | | |

| | | |
|---|---|---|
| Dissertation Proposal Submitted (2 weeks before defense) | | |
| Dissertation  Proposal Approved | | |
| Dissertation Submitted (2 weeks before defense) | | |
| Dissertation Defense Passed | | |

# Appendix B. Mathematics Education 2nd Year Evaluation Form

**Doctoral Program in Mathematics Education**
Department of Mathematics & Statistics
Portland State University

Student Name_____ PSU ID _____

Address _____

Home Phone_____ Work Phone_____ Term/Yr Admitted ____

What are the student's areas of strengths?

What are the student's areas of difficulty?

Suggestions for improvement?

# Appendix C. Mathematics Education Comprehensive Examination Bibliography "Starter List"

***[Under Construction.]***


Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching what makes it special?. *Journal of Teacher Education, 59*(5), 389-407.

Carpenter, T., Dossey, J. & Koehler, J. (Eds.) (2004). *Classics in mathematics education research.* Reston, VA: National Council of Teachers of Mathematics.

Cobb, P. (2000). Conducting teaching experiments in collaboration with teachers. In A. E. Kelly & R. Lesh (Eds.), *Handbook of research design in mathematics and science education* (pp. 307-334). Mahwah, NJ: Lawrence Erlbaum Associates.

Sfard, A. (1991). On the dual nature of mathematical conceptions: reflections on processes and objects as different sides of the same coin. *Educational Studies in Mathematics, 22*, 1-36.

Shaughnessy, J. M. (2007). Research on statistics learning and reasoning. In F. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 957-1010). Reston, VA: National Council of Teachers of Mathematics.

Steffe, L. & Thompson, P. (2000). Teaching experiment methodology: Underlying principles and essential elements. In A. E. Kelly & R. Lesh (Eds.), *Handbook of research design in mathematics and science education* (pp. 267-306). Mahwah, NJ: Lawrence Erlbaum Associates.