UMass | Dartmouth

Department of STEM Education & Teacher Development

PH.D. PROGRAM
MATHEMATICS EDUCATION

STUDENT HANDBOOK

AY2015-2016

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I. INTRODUCTION

This handbook provides important information about the Ph.D. program in Mathematics Education. It includes policies and procedures established by and specific to the program.

It is designed to supplement the University of Massachusetts Dartmouth (UMassD) *Graduate Catalog* that contains material related to student rights, academic policies, registration, tuition, fees, financial aid, campus facilities, and course offerings. A full listing of UMassD graduate requirements can be found in the *Graduate Catalog*. Students are responsible for being familiar with these requirements. Rules and procedures pertaining to the code of student conduct, confidentiality of academic records, resolution of problems, human subjects protection, faculty conduct, and student governance are not reproduced in this handbook.

This handbook is not a contract. While every effort is made to ensure the accuracy of the information in this handbook, the program reserves the right to make changes.

II. PURPOSE AND GOALS

II.A. Program Link with Campus Mission Priorities

The goals and purposes of the Ph.D. in Mathematics Education are firmly in line with the mission of the University: "The University of Massachusetts Dartmouth distinguishes itself as a vibrant public university actively engaged in personalized teaching and innovative research, and acting as an intellectual catalyst for regional and global economic, social, and cultural development." It advances the university's mission by creating an environment to conduct research through collaboration with industry, research and academic institutions, and practitioners of innovative mathematics education research at the national and international level, and by using best teaching practices in educating its students.

II.B. Program Purpose

The primary aim of the doctoral program is to produce stewards of the discipline, as defined by *The Carnegie Foundation for the Advancement of Teaching* (see http://classifications.carnegiefoundation.org/) in its Initiative on the Doctorate: "to educate and prepare those to whom we can entrust the vigor, quality, and integrity of the field." (Walker, Golde, Jones, Bueschel & Hutchings 2008, p. 2)[1] Moreover, its explicit interdisciplinary approach, that has deep connections nationally and internationally and reflects cutting-edge technological innovations in program delivery, is intended to address specific challenges identified by the Carnegie Initiative (Walker et al., 2008). These challenges involve new technologies in "altering and accelerating the way new knowledge is shared and developed" (p. 2), a vision of a global marketplace for scholarship, and recognition that "much of the most important, path-breaking intellectual work going on today occurs in the borderlands between fields, blurring boundaries and challenging traditional disciplinary definitions" (p. 2). Our program pays particular attention to how curricular and research components can be integrated systematically to connect students' learning to faculty scholarship and thereby provide authentic learning experiences that produce graduates with strong research skills. We are guided by a metaphor of apprenticeship as a "theory of learning and a set of practices that are widely relevant" (p. 91); the activity of apprenticing encompasses and strengthens all curricular and research components of the doctoral program.

[1] Walker, G. E., Golde, C. M., Jones, L., Bueschel, A. C., & Hutchings, P. (2008). *The formation of scholars: Rethinking doctoral education for the Twenty-First century*. San Francisco: Jossey-Bass.

The Ph.D. in Mathematics Education builds on the success of existing research programs at UMass Dartmouth, particularly those situated in the Kaput Center for Research and Innovation in STEM Education (hereafter noted as the Kaput Center). Our program and the Kaput Center share common goals and approaches. Much more than a collection of projects, the Kaput Center is an intellectual community that fosters "intellectual risk taking, creativity, and entrepreneurship" (see Walker et al., 2008, p. 11) and, in the spirit of the Carnegie Initiative's formation of scholars, offers incubation through which a doctoral program can provide "real partnerships between faculty and students, habits of respect for and interest in one another's work, and the lively exchange of ideas in which new knowledge is formed and transformed" (p. 11).

The innovative research of the STEM Ed faculty within the Kaput Center provides core strength for the program and establishes its uniqueness in comparison with other doctoral programs in the Commonwealth of Massachusetts and beyond.

The research interests of the STEM Ed faculty cover grades K-20 and a wide range of contemporary issues in mathematics education: Algebraic thinking grades K-20, improving mathematics teaching through district-wide collaboration, integrating technological innovations (e.g., wireless connectivity and haptic devices) in K-12 mathematics classrooms and its impact on participation and motivation, developing proof-based reasoning from elementary through undergraduate classrooms, undergraduate mathematics education especially in Calculus, Analysis and Geometry, evolution of symbol use and symbolic thinking in mathematics, theories of mathematical learning and teaching from multi-disciplinary perspectives, teacher knowledge and professional development in the middle grades, efficacy studies and diffusion of innovation. A majority of these interests are being explored through projects funded by the National Science Foundation and the U.S. Department of Education.

Mathematics education is critical in a global economy for which understanding the technical sciences is an essential currency. The doctoral program in Mathematics Education at UMass Dartmouth offers innovative answers to critical needs in teaching and learning mathematics by providing future mathematics educators with the educational infrastructure and advanced research training to become leaders in the field of mathematics education.

II.C. Learning Objectives: Knowledge and Skills to be Developed by Program Graduates

The program is designed to attract and educate students of diverse backgrounds for employment in a variety of educational and scientific institutions, industries, and federal agencies. It focuses on interdisciplinary perspectives within mathematics education research. Our graduates will be highly competitive in today's marketplace for educational scholars within a wide range of employment classifications. Furthermore, our Ph.D. students and candidates will enjoy multiple opportunities for enhancing traditional scholarly training through participation in such practical academic endeavors as publishing and organizing lectures and colloquia.

The doctoral program will provide students with the knowledge and skills to

a. re-construct, appropriate, and develop knowledge of the field of mathematics education;
b. explore different approaches that emerge from the study of the research literature in the field of mathematics education and related disciplines; and
c. write original research that represents their own contribution to knowledge.

Graduates of the program will produce original research reflecting deep social and cultural commitments. It is expected that they will become independent, creative thinkers. The Ph.D. program is designed to build the intellectual skills that our graduates will need to utilize new and future technologies and communication infrastructures and to develop these into knowledge environments. In so doing, graduates will formulate and design solutions to complex educational problems in our world today. The PhD program aims to offer a global education.

The Ph.D. in Mathematics Education is also designed to create a focused track of study over 4 years to build skills in the following critical areas:

a. the nature of scientific inquiry in mathematics education and related disciplines;
b. appropriate methods of research design regarding data collection and analysis, particularly focused on contemporary qualitative and quantitative methods (e.g., HLM, discourse analysis, micro-analytical video analysis)
c. the production of new researchable questions, especially on the boundaries of particular disciplines (e.g., learning sciences), and
d. the ability to design and conduct a research study with unique findings to advance the field of mathematics education.

This experience will involve a continual and iterative research process beginning in the first year of study that culminates in a Ph.D. dissertation at the end of 4 years.

II.D. Strategies for Assessing Graduates' Skills and Ongoing Program Quality and Effectiveness

The program employs the following three strategies to ensure effective delivery:

a. Student e-Portfolios;
b. Faculty Evaluation and Assessment Procedures; and
c. Internal and External Advisory Councils;

II.D.1. Student e-Portfolios

Students will construct e-Portfolios of their learning experiences across the course of the program as determined by the Graduate Committee. Students will upload assessments of individual courses and end-of-year program evaluations based on expected learning outcomes of the program. Students will also upload extramural activities such as papers or presentations that they have developed with or without the support of faculty, as well as other artifacts that they count as evidence of their learning. Faculty, the Chair of the department, the Dean of College of Arts and Sciences, the Associate Provost for Graduate Studies and other evaluators, will assess the resulting reflections and artifacts.

II.E. Benchmarks to Determine the Accomplishment of Program Goals

Benchmarks designed to determine accomplishment of program goals are designed around 5 key areas: Faculty; Students; Research; Program of Study; and Resources. Indicators for each of these areas include the following:

II.E.1. Faculty

- Faculty members meet the requirement of the institution for graduate education with all faculty members holding a relevant doctorate in STEM Education.
- Faculty members conceptualize and implement productive programs of research and scholarship.
- Faculty members design and deliver high quality instruction synergistically linked to current research as well as their own particular research programs.
- Faculty members create an environment in which mentoring, socialization of students, and the existence of a community of scholars is evident.

II.E.2 . Students

- Students are selected from a pool of highly qualified applicants in accordance with admission criteria consistent with those of the institution.
- Students actively develop research skills and knowledge of the field to prepare them as "stewards of the discipline."
- Students develop an expertise of scholarship through participation in authentic learning experiences.

II.E.3. Research and Scholarship

- Research is an explicit component of the mission of the institution and a core feature of the program design.
- Strong research programs, developed over a number of years and now facilitated through the Kaput Center, exist to support the goals of the program.
- Faculty will maintain a level of scholarly productivity commensurate with the needs of the program.

II.E.4. Program of Study

- The program of study reflects the interdisciplinary nature of mathematics education, drawing on multiple fields of knowledge to strengthen scholarship.
- Core content is provided through an approach that integrates curriculum and research activity.
- Student scholarship is developed through progressive research experiences based on collaborations with faculty at the host institution as well as partner institutions.

II.E.5. Resources

- Faculty resources will be added to maintain the program and accomplish its goals.
- Technical and support services are available and accessible to faculty and students.
- Library and database resources are available to support the program.
- Space and equipment (e.g., computers; seminar rooms; study and social areas) are available to students.

Data on these indicators will be periodically collected and reviewed to assess needs for program improvement.

III. PROGRAM OF STUDY

III.A. Description of the Curriculum

The program includes a series of foundational required courses supplemented by specific electives. In particular, students will complete 72 credits that include 18 credits of introductory coursework to develop their knowledge of research tools, methodologies and theories in mathematics education research, 18 credits of preparatory coursework to refine and focus students' understanding of the research process and theory building, and 36 hours of advanced doctoral coursework including dissertation research (24 hours).

The Ph.D. in Mathematics Education falls into three distinct phases:

1. Introduction Phase for introducing mathematics education research,
2. Preparation Phase for advancement to advanced doctoral status, and
3. Production Phase of advanced courses and final dissertation.

At an appropriate level, all courses feature authentic learning experiences in research institutions and projects, and an interactive thinking/writing process to develop cutting-edge research and discovery as part of the student's experience. Research scholarship thus pervades the curriculum, uniting theory and practice. Technology is also embedded throughout: wherever possible, courses will be blended with a variety of delivery methods, including on-line video seminars, iTunesU/Podcasting, and active use of Blogs and Wikis, as part of the regular mode of sharing and learning content and expressing evolving ideas in and around coursework. A central Blog/Wiki will be available for students to interact and share their ongoing work outside of classes.

Because of the program's central focus on the development of research scholarship, specific attention is given to the development of research ethics, including appropriate acknowledgement of sources, proper protocols for conducting research on human subjects, understanding the process of Institutional Review Board (IRB) approval and institutional certification for conducting research (i.e., CITI certification).

III.B. Academic Integrity and Subject Area Coverage

Academic integrity of the program is maintained through the administration of a strong, connected program of coursework and research experiences that reflect the demands of the field of mathematics education. In particular, the program includes relevant, focused coursework that addresses foundational issues in mathematics education. A focus on the development of research skills and practices is threaded

throughout this coursework to support students' transition from the practice of research skills with supervision to independent mastery of research scholarship. In particular, students will be mentored through the Introductory and Preparatory Phases of the program (Years 1 and 2) in the practices of research and will demonstrate their skills in successful completion of the qualifying examination. Years 3 and 4 are designed to support increasing autonomy in students' ability to design and implement a research study, culminating in the dissertation.

The program's faculty are leaders in the field of mathematics education, and through their established research programs and international connections with researchers through the Kaput Center present a program that not only addresses contemporary issues but also relevant research paradigms and methodologies appropriate for complex questions in the field today.

III.C. Course Sequencing

Figure 1 offers a schematic outline of how the program can be completed by a full-time student in 4 years. For each element, we describe the individual components and rationale. In summary, students will complete 72 credits that include:

a. 18 credits of introductory coursework to develop students' knowledge of research tools, methodologies and theories;
b. 18 credits of preparatory coursework to refine and focus students' understanding of the research process; and
c. 36 hours of doctoral work (12 hours of doctoral coursework and 24 hours of dissertation research advising to support and guide the production of the final dissertation).

While the program is intended to be a four-year program students are permitted to complete their requirements in up to six years. Requests for extensions will be considered on a case-by-case basis consistent with the rules and regulations for graduate study at UMass Dartmouth.

Year	Fall Semester	Spring Semester
1 (Introduction)	Introduction to Qualitative Methods (MTE 650) – 3 cr. Introduction to Quantitative Methods (MTE 651) – 3 cr. Introduction to Mathematics Education Research (MTE 652) – 3 cr.	Theories of Mathematical Learning (MTE 653) – 3 cr. Research Seminar – *Capstone Course* (MTE 654) – 3 cr. Developing Research Skills Pt. 1 (MTE 655) – 3cr.
Total	*9 credits*	*9 credits*
2 (Preparation)	3 Topics in Mathematics Education Research (MTE 660-679) – 9 cr. This can include 6 credits of MTE 680 (Internship)	Research Seminar – *Capstone Course* (MTE 681) – 3 cr. Developing Research Skills Pt. 2 (MTE 682) – 3 cr. *Qualifying Exams*
	Authentic Learning - Internship (MTE680) – 3-9 cr.	
Total	*9 credits (average)*	*9 credits (average)*
3 (Production)	2 Advanced Doctoral Courses from MTE 750-769 – 6 cr. Dissertation Research (MTE 772) – 3 cr. *Select Dissertation Committee Chair*	2 Advanced Doctoral Courses from MTE 750-769 – 6 cr. Dissertation Research (MTE 772) – 3 cr. *Dissertation Proposal Defense (end-of-year)*
Total	*9 credits*	*9 credits*
4 (Production)	Dissertation Research (MTE 772) – 9 cr.	Dissertation Research (MTE 772) – 9 cr. *Final Oral Defense (end-of-year)*
Total	*9 credits*	*9 credits*
Grand Total	36 credits	36 credits

Figure 1. Program of study

Year 1 requires core courses to be successfully completed; there is no variation in the offerings.

Year 2 allows for some choice of topics within the courses outlined below (subject to courses offered). Additionally, there is some flexibility in when students can take their internship (MTE 680) in Year 2. In particular, the internship can be completed in the Fall or Spring semester, extended throughout Fall and Spring and/or summer, or entirely during the summer. Decisions about this aspect of the internship will depend on the nature of the internship, including particularly whether the student wants to travel out-of-state or be part of an International Exchange project or whether the internship is best facilitated by a long-term field experience. An essential criterion is that the internship reflects at least a compulsory 3-credit course extending to a 6-credit option (i.e., in addition counts for one elective) or 9-credit option (i.e., in addition counts as 2 electives) The 9-credit option will be allowed in exceptional circumstances where the student has a strong background in research prior to beginning the program or has shown a promising research record as a doctoral student. Internships will be flexibly scheduled on a case-by-case basis in coordination with the faculty advisor and Department Chair, with the representative course (MTE 680) being offered all year round. The variable course option will be designated by different course sections, i.e., MTE 680-01 = 3 credit option, MTE 680-02 = 6 credit option and MTE 680-03 = 9 credit option.

An extended internship (MTE 770) can be taken in Years 3-4 as advanced doctoral coursework with the same options of 3-9 credits (i.e., count as 1-3 courses). Students who wish to follow this track are expected to closely align their dissertation project with the purpose of the internship (e.g., while working at a Center elsewhere they are collecting data for the dissertation). Approval of such an internship is at the discretion of the Graduate Program Director and Department Chair.

As part of the required coursework (specifically, MTE 655, 682 and, depending on the student's focus, MTE 680), students will be expected to design and complete a preliminary research study during Years 1 and 2. This requirement will necessarily relate closely to content and skills addressed in coursework in Years 1 and 2, which will be part of the qualifiers. This is likely to be part of a research project conducted at the Kaput Center or through one of its associates, or students may start their own research project in educational settings (informal and formal). The study should reflect the student's synthesis of knowledge gleaned from coursework during the Introductory and Preparatory phases and concerning the nature and process of research, the use of

appropriate methodologies, the application of relevant theories of learning, and the development of scholarly writing skills.

Upon satisfactory completion of the 36 credits designated in Years 1 and 2[2], students are eligible to take the qualifying examination to enter the Production Phase of the doctoral program. Students may apply for a Masters of Science (MS) degree through the University Registrar's office upon successful completion of the coursework for Years 1 and 2. Successful completion of coursework requires that the student have a cumulative GPA not less than 3.0. Students who fail to pass the qualifying examinations may be offered one opportunity for remediation. Following the successful completion of the qualifying examination for the Preparation Phase, along with the successful completion of any additional coursework to address deficiencies identified in the student's admission to the program, the student will start advanced doctoral coursework and the dissertation.

Students who enter the program with a bachelor's degree will complete the entire course sequence. "Advanced Standing" can be given to applicants who enter with an advanced degree in an appropriate background (e.g., MS/MA in Mathematics Education, Mathematics, or a related social or technical science). Advanced Standing may exempt the student from up to 24 credits of first and second year courses. This decision is based upon sufficient evidence of courses or experiences completed prior to applying to the program. As such, a designation of Advanced Standing or waiver of courses within Years 1 and 2 is rare. A decision to recommend Advanced Standing or to require additional coursework to address background deficiencies is made along with other admissions decisions by the Graduate Committee. Advanced Standing must be approved by the Graduate Program Director, the Department Chair, the Dean of the College of Arts and Sciences, and the Associate Provost for Graduate Studies.

Advising is important, and students interrelate closely with faculty at all levels of study. Students are assigned to or may select a faculty member in the first 2 years to advise them on their research experiences that culminate in the qualifying examination. More than one faculty member can thus serve an introductory student, and the faculty member(s) may be different than the student's Dissertation Committee Chair selected for the Production phase for Years 3-4. Work in the first two years will develop a student's potential to conduct research and the skills necessary to complete his/her final dissertation. This is assessed in the qualifying examination. At the Production stage in Years 3-4, a student will choose one faculty member as his/her Dissertation Committee

[2] Additionally, students with provisional acceptance into the program will also be required to complete any additional coursework, identified in their official notification of admission, prior to entering the Production Phase.

Chair for the remainder of the program (this faculty member will be the instructor of record for Dissertation Research MTE 772 to that student).

The following courses will be required for completion of the program.

III.C.1. Year 1

6 core requirements

MTE 650 – Introduction to Qualitative Methods
MTE 651 – Introduction to Quantitative Methods
MTE 652 – Introduction to Mathematics Education Research
MTE 653 – Theories of Mathematical Learning
MTE 654 – Research Seminar
MTE 655 – Developing Research Skills Part 1

III.C.2. Year 2

Semester one

Students will be offered three topics courses from the following list

MTE 615 – Interdisciplinary Colloquium Series in STEM Education Part I
MTE 661 – Research on Mathematics Teacher Education Part 1
MTE 662 – Research on Mathematics Teacher Education Part 2
MTE 663 – Developing & Implementing STEM Curriculum
MTE 666 – Frameworks for Research Analysis
MTE 667 – Research in Elementary Grade Mathematics
MTE 669 – Research in Undergraduate Mathematics Education
MTE 670 – Development of Theory
MTE 690 – Special Topics

Semester two

MTE 680 – Authentic Learning (Internship)
MTE 681 – Research Seminar
MTE 682 – Developing Research Skills Part 2

The program will offer two core mathematics courses to students admitted conditionally based on a deficiency in their mathematical preparation.

MTE 520 – Advanced Mathematical Thinking Part I
MTE 521 – Advanced Mathematical Thinking Part II

These courses focus on the development of smart mathematical knowledge that develops students' understanding of the use and application of this knowledge in mathematics education. The courses will address a K-20 approach to the following essential topics in mathematics:

(1) Algebraic Thinking
(2) Mathematics of Change and Variation
(3) Mathematical Proof
(4) Geometric Reasoning
(5) Discrete Structures
(6) Number Theory
(7) Mathematical Problem Solving

Students admitted conditionally based on a mathematics deficiency will be required to take one or both of these courses *in addition to existing program course requirements*.

Additionally, students who have no K-16 teaching experience will be advised to complete a teaching internship.

Any identified deficiencies regarding admission requirements will be met prior to entering the advanced doctoral phase of the program (Production Phase).

III.C.3. Qualifying Examination Process

The Qualifying Examination Process should demonstrate the skill set that the student has developed through the Introductory and Preparatory Phases of the doctoral program.

Students are eligible for the qualifying examination process upon satisfactory completion of the 36 credit hours of coursework (with no incomplete grades) designated for Years 1 and 2. The process involves compiling the following portfolio of work and submitting it to the Graduate Committee for evaluation:

1. submission of an 8000-word paper, based on the student's research study completed during Years 1 and/or 2, to the Graduate Committee for evaluation along the lines of the skill sets developed in the student's coursework;
2. submission of a proposal to present a research paper (not poster or discussion group) to a national or international conference or submission of a paper to a journal for publication;
3. an oral presentation of the student's research study (e.g. in the Kaput Center or

department seminar series); and
4. satisfactory evaluation in a final examination. This examination is comprised of a set of questions from five key areas: Theory, Methodology, Learning, Teaching, and Electives. Students will answer a subset of the candidate questions within a 48-hour window.

Upon approval of successful completion of these criteria by the Graduate Committee, the Graduate Program Director certifies to the Office of Graduate Studies and Admissions that the student has satisfactorily completed the Qualifying Examination.

Successful completion of Qualifying Examination[3] admits the student to candidacy for the Ph.D. degree and enables the student to begin formal work on the dissertation.

III.C.4. Year 3

During the Production Phase, students will continue their doctoral training through advanced coursework. In addition, they will conduct Dissertation Research with a faculty member. During Year 3, dissertation research is expected to focus on conducting a full literature review, framing the main issues and guiding points of the study, and collecting research data. It is expected that the student will also complete the preliminary writing phase of the dissertation in preparation for the proposal defense at the end of Year 3. It is expected that the student will keep the selected faculty advisor through the completion of the Ph.D. Dissertation during Years 3 & 4. During the third year, the student will identify a Dissertation defense committee and chair (assumed to be their main faculty advisor), and complete the defense of the Dissertation proposal at the end of Year 3 after all coursework is completed. (See also section III.E. Dissertation).

During Year 3, students will complete 4 advanced doctoral courses from the following list:

MTE 715 – Interdisciplinary Colloquium Series in STEM Education Part II
MTE 750 – Analyzing Participation and Engagement in Mathematics Classrooms
MTE 751 – Contemporary Issues in K-8 Classrooms
MTE 752 – Thinking and Learning in Mathematics/Science
MTE 753 – Research on Proof and Reasoning in Mathematics
MTE 756 – Social Justice and STEM Education

[3] Students with provisional admission into the program will be expected to have completed any specified additional preparation before advancing to the Production Phase.

MTE 757 – STEM Education Reform in a Political Context
MTE 770 – Advanced Authentic Learning (Internship)
MTE 790 – Special Topics
MTE 795 – Independent Study
MTE 796 – Directed Study

Students can take up to 6 credits to satisfy 700-level elective requirements from other departments at UMass Dartmouth with the approval of the program/dissertation advisor, Graduate Program Director, and the Graduate Committee. The decision regarding the transfer of those 6 credits will be made on a case-by-case basis.

Dissertation Research
While students' dissertation research will be supervised by a member of the faculty from the Department of STEM Education & Teacher Development who has a terminal degree in a field related to STEM Education and is research active within the standards of the department, faculty from other departments or institutions can be included as members of the dissertation committees (if approved by the Graduate Program Director in consultation with the PhD Committee, the Department Chair and the Dean of the School). The use of an external faculty member can provide an authentic learning experience that converges lines of research and coursework to enrich the project and experience of the student.

A student's dissertation is expected but not required to build on his/her work completed in the preliminary years, relying on research skills developed particularly in courses MTE 655/682 (Developing Research Skills Parts 1 & 2) and research projects completed in MTE 654/681 (Research Seminar 1 & 2).

MTE 772 (Dissertation Research) permits a student to receive 6 credits of instruction to assist in the completion of his or her research study and the writing of the final dissertation.

III.C.5. Year 4
Students will be expected to work primarily on their final dissertation, through registration in MTE 772 (Dissertation Research). This course permits a student to receive 18 credits of instruction to assist in the completion of his or her research study and the writing of the final dissertation. Students will also complete any remaining required advanced doctoral courses if they were not completed in Year 3.

The final oral defense examination will be completed at the end of Year 4 on submission of the final dissertation.

III.D. Course Descriptions

All courses are 3 credits each unless otherwise stated.

MTE 615 – Interdisciplinary Colloquium Series in STEM Education I
Presentations made in the Kaput Center's Interdisciplinary Colloquium Series provide a wide variety of perspectives on foundational issues in educational research. Over the course of one year a coherent synthesis of the themes presented in these talks and the related scholarly work of each speaker will be developed.

MTE 650 – Introduction to Qualitative Methods
This course examines qualitative research methods applied to mathematics education research. In particular, students will learn about qualitative research design, including techniques for collecting and analyzing qualitative data. The course will draw on exemplary research, primarily in mathematics education, and will involve students in the process of conducting qualitative research. Student projects will include the development of a researchable topic in mathematics education, selection and implementation of an appropriate qualitative research design, and analysis and interpretation of data. Results of the project will be written in APA format and presented orally in class or in other venues.

MTE 651 – Introduction to Quantitative Methods
Integrates research design, data collection, interpretation and analysis and APA format report writing across the main paradigms of education research. Understand how to collect data to answer or address a specific hypothesis, reduce data into usable constructs, and model large data sets. The course includes the use of the SPSS statistical software to explore methods for univariate parametric and some non-parametric models. The course contains a strong experimental component to prepare students for thesis writing. The primary focus is to understand which statistical methods are necessary to model data, how to visualize data easily using modern software, and most importantly how to interpret data to further research.

MTE 652 – Introduction to Mathematics Education Research
This course will introduce students to fundamental problems pertaining to mathematics education that have been instrumental to constitute and define it as a research field The students will be introduced to important ideas in the field and why these ideas are significant in defining the activity of research in mathematics education. The study of

how these theoretical and pragmatic problems have been approached by a community of researchers, will help the students to understand, in broad terms, the nature of research in the field and, at the same time, offer a panorama of new areas of inquiry that are being transformed presently, into research programs.

MTE 653 – Theories of Mathematical Learning
This course will examine contemporary theories of learning psychologies and their applications to research in mathematics education. It is intended to help students understand ways of knowing and how this drives research and will critically examine the literature regarding the role and plurality of theories in mathematics education. Particular attention will be given to understanding the nature of research paradigms and types of research frameworks, enabling students to situate their research in relevant frameworks, and understanding the implications of theoretical frameworks for research design. Students will apply their learning through the design of a researchable topic, situated in an appropriate theory of learning, and the subsequent development of a sample proposal.

MTE 654 – Research Seminar
This is a capstone course designed to synthesize critical research processes, theories of learning, and current research themes in mathematics education to which the student is introduced to in their first year. From this synthesis, students are expected to select and refine a topic for their pilot study to be conducted during the introductory and preparatory phases of the doctoral program (Years 1 and 2).

MTE 655 – Developing Research Skills Part 1
This course will focus on building the skill set necessary to conduct research, including the exploration, analysis, synthesis, and writing skills critical to the research process. It will also address ethics of research, including issues associated with research on human subjects. As part of the course, students will be expected to identify a problem for which they will conduct a pilot study during the Introductory and Preparatory phases of the program (Years 1 and 2). The pilot study will culminate in the qualifying examination at the end of the Preparatory Phase. The design of the pilot study is expected to synthesize other relevant coursework during the Introductory Phase regarding appropriate research methods, theories of learning, and so forth. As part of the course, students will be introduced to funding resources and will write a sample grant proposal for their pilot study.

MTE 661 – Research on Mathematics Teacher Education Part 1
Introduces students to research on pre-service and in-service teacher learning and teacher education. It includes a critical examination of the research base concerning

contemporary learning theories and applications to teacher learning, effective forms of teacher professional development, and assessments of teacher knowledge. Students will critique competitive grants funding teacher education research to develop grant-writing skills.

MTE 662 – Research on Mathematics Teacher Education Part 2
Extends MTE 661 in a critical examination of research in mathematics teacher education, including applications of contemporary learning theories to teacher learning and analyses of research-based findings for what constitutes effective teacher education. Develops research skills through design and review of mock research grant proposals in teacher education.

MTE 663 – Developing & Implementing STEM Curriculum
This course focuses on analyzing grades K-16 curriculum, intentions for students' learning outcomes, associated pedagogical styles and integration. Students will examine existing reform and basal curricula texts, and the development of new activities and activity structures that replace or transform existing texts. Students will also be introduced to issues related to curriculum implementation including fidelity issues and hidden agendas.

MTE 666 – Frameworks for Research Analysis
Focus on a specific set of research tools relevant to the study of mathematical reasoning in a variety of contexts. Frameworks include the analysis of mathematical discourse, gesture, flow of interaction, through micro-analytic video analysis and learning outcomes such as pre-post tests of content. Attention will be spent connecting research methods to theoretical frameworks and practical outcomes of analysis.

MTE 667 – Research in Elementary Grade Mathematics
Critically examines current research in elementary grades mathematics. It includes a study of critical research in the field, research designs framing this work, and relevant theories of learning and their applications in the research base. The course overviews significant areas of research and connections to current educational reforms. Students will conduct original research on teaching or learning elementary grades mathematics.

MTE 669 – Research in Undergraduate Mathematics Education
Critically examines research in undergraduate mathematics education, including the nature of advanced mathematical thinking, theories of learning associated with advanced mathematical thinking, and research on issues of teaching unique to advanced mathematical thinking. Reviews relevant reform documents and policy

initiatives in undergraduate mathematics education to analyze their alignment with the research base.

MTE 670 – Development of Theory
Extended examination of fundamental problems and issues in mathematics education research that have been instrumental in constituting and defining the field. Study how theoretical and pragmatic problems in mathematics and science education have been approached by a community of researchers to define the field and new areas of inquiry.

MTE 680 – Authentic Learning (Internship)
An internship conducted at a local research institution, the Kaput Center or at an institution out of state or internationally. Students will be mentored by an adjunct research associate at the host institute to develop their research skills in the field including data collection and analysis, and enhancing their awareness of the complexities of educational research.

MTE 681 – Research Seminar
Capstone course designed to synthesize critical research processes, theories of learning, and current research themes in mathematics education. From this synthesis, students are expected to select and refine a topic for their pilot study to be conducted during the preparatory phase of the doctoral program. A major product of this course is to generate materials relevant for their qualifying exams.

MTE 682 – Developing Research Skills Part 2
This course synthesizes prior coursework to focus on methods and research questions in preparation for students' dissertation. Students will develop essential experience/skills in designing research, reading research critically, writing scholarly work, and developing proposals for research funding. Students will give oral presentations on their research topics and plan of study for peer review.

MTE 690 – Special Topics
Topics not included in the regular offerings of the department. The specific topic is stated when the course is scheduled. May be repeated with change of content. The course satisfies 600-level elective requirements for the Mathematics Education PhD.

MTE 715 - Interdisciplinary Colloquium Series in STEM Education II
Presentations made in the Kaput Center's Interdisciplinary Colloquium Series provide a wide variety of perspectives on foundational issues in educational research. Over the course of one year a coherent synthesis of the themes presented in these talks and the related scholarly work of each speaker will be developed.

MTE 750 – Analyzing Participation & Motivation in the Classroom
Various models used to analyze how people participate in classrooms and the intersecting role of motivation. We will draw on the field of linguistics in particular linguistic anthropology, gesture and discourse analysis to categorize how students and teachers demonstrate their participation and motivation through speech and physical actions.

MTE 751 – Contemporary Issues in K-8 Classrooms
Recent advances in the teaching and learning of mathematics relevant in K-8 classrooms. Areas to be covered will typically include: development of children's mathematical reasoning and algebraic thinking; recent research on key K-8 content; technology use in elementary mathematics; teacher professional development; and school implementation and effecting policy.

MTE 752 – Thinking and Learning in Mathematics/Science
Advanced doctoral course on deep examination of particular concepts in mathematics/science. The course focuses on mathematics/science content, epistemological obstacles related to learning, and the pedagogical strategies to enhance student thinking about concepts. Students will be deeply engaged in content and situating their thinking through the analysis and synthesis of existing literature on learning. Students will conduct or participate in a project by exploring and synthesizing the epistemological development, the research on student thinking, and effective pedagogical approaches about a given mathematics/science concept.

MTE 753 – Research on Proof and Reasoning in Mathematics
Historical and epistemological examinations of dimensions of proof and research on proof and reasoning across grades K-16, including how proof is conceptualized in research at different grade domains, the nature of students' proving, how it evolves, and how curriculum and instruction can support this. Includes the development of research skills using novel applications in this research domain.

MTE 756 – Social Justice and STEM Education
Exploration of social justice oriented research and scholarship in STEM education. Students will examine social justice oriented research that underlines the importance of STEM in/for socially transformative education. Students will engage with a range of perspectives and theorists that can inform their own research from topics as diverse as gender equity, sustainability, social inequality and racisms/colonialisms.

MTE 757 – STEM Education Reform in a Political Context

Advanced doctoral course on the influence of political agendas and the design and implementation of curricula. Areas to be covered will typically include: the development of the content standards; historical perspectives on STEM education; and politically motivated reports that have shaped mathematics and science education.

MTE 770 – Advanced Authentic Learning (Internship)
An internship conducted at a local research institution, the Kaput Center or at an institution out of state or internationally. Students will be mentored by an adjunct research associate at the host institute to develop their research skills in the field including data collection and analysis, and enhancing their awareness of the complexities of educational research.

MTE 772 – Dissertation Research (24 credits)
Focuses on developing the dissertation proposal, including conducting a full literature review, identifying the theoretical perspectives and relevant research framing the proposed dissertation research, a clear statement of the research questions and significance of the problem, a description of the research methods and design, and a work plan that identifies how data will be collected and analyzed.

MTE 790 – Special Topics
Course focuses on a topic not included in the regular offerings of the department. The specific topic is stated when the course is scheduled. May be repeated with change of content. This course satisfies 700 level elective requirements for the Mathematics Education Ph.D.

MTE 795 – Independent Study
Study under the supervision of a faculty member in an area not otherwise part of the discipline's course offerings. Conditions and hours to be arranged.

MTE 796 – Directed Study
Study under the supervision of a faculty member in an area covered in a regular course not currently being offered. Conditions and hours to be arranged.

III.E. Dissertation

The Ph.D. dissertation is an original body of work in which the candidate demonstrates an in-depth understanding of a substantive area in mathematics education. The dissertation demonstrates the candidate's ability to effectively incorporate theoretical, conceptual, and methodological tools in a line of inquiry that produces a new, scholarly contribution to research in mathematics education.

While dissertation planning begins early in the Ph.D. Program, normally the dissertation process begins after the student has passed the qualifying examination and has been admitted to the Production Phase.

III.E.1. Dissertation Committee

The Ph.D. candidate selects a dissertation committee and chair. The candidate must submit the name of the Dissertation Committee Chair to the Graduate Program Director and the Ph.D. Committee for review and approval upon completion of the qualifying examination. The candidate, in consultation with the Dissertation Committee Chair, selects the committee members, elicits their willingness to serve, and submits their names to the Graduate Program Director and the Ph.D. Committee prior to completion of the first semester of coursework after completing the Qualifying Exam (Year 3, Semester 1). The committee must have a minimum of three (3) and no more than five (5) members. At least two (2) members should be faculty from the Ph.D. Committee in the Department of STEM Education & Teacher Development. The students are encouraged to have at least 2 members with expertise in Mathematics Education in their committee.

The Dissertation Committee Chair is a member of the University of Massachusetts Dartmouth Department of STEM Education & Teacher Development who serves as the research mentor of the candidate. A faculty member may serve as an advisor on a student's dissertation study as long as she or he:

- Is full-time faculty in the Department of STEM Education and Teacher Development or otherwise affiliated with the Department;
- Holds a terminal degree in a field related to STEM Education; and
- Is research active within the standards of the department.

The Chair guides the candidate in research and funding processes as well as University protocols for research and scholarship. The Dissertation Committee Chair has expertise in the area of the candidate's research.

While many students' dissertation research will be supervised by a member of the core faculty from the Department of STEM Education & Teacher Development, faculty from other departments or institutions can be included as members of the dissertation committees (if approved by the Graduate Program Director in consultation with the PhD Committee, the Department Chair and the Dean of the School). The use of an external faculty member can provide an authentic learning experience that converges lines of research and coursework to enrich the project and experience of the student.

The other members of the dissertation committee function as content or methods experts and assist the candidate in producing substantive research that makes a contribution to the field.

III.E.2. Dissertation Proposal

The research proposal defense is expected to be completed by the end of Year 3, that is, the first year following completion of the Qualifying Exam.

The dissertation proposal defense is an opportunity for the candidate to receive feedback from members of the committee. Proposal defenses are similar to dissertation defenses, but there are a few key differences. As with all parts of the dissertation process, preparation for the defense should be done in consultation with the Dissertation Committee Chair. The guidelines below outline the process for the Dissertation Proposal Defense:

- The Dissertation Committee Chair is responsible for determining when a proposal is ready for committee review
- The committee must receive a draft of the proposal 3 weeks prior to the defense.
- Committee members should forward their questions to the full committee (including the chair) 72 hours in advance of the proposal defense
- Committee members are expected to attend the proposal defense (virtually or in person)
- Outcomes of the defense can be (1) approve; (2) approve with minor changes; (3) action deferred pending major revisions; or (4) disapprove
- The proposal defense may be open to the entire department at the candidate's discretion
    - If members of the department are invited, they are observers only. The committee and the candidate are the only speakers in the defense.
- The candidate will present for 15-20 minutes. This presentation should primarily focus on the research questions and methods, but should touch on other important aspects of the proposal.
- The chair will negotiate the questioning structure with the committee members. A typical structure would be to provide each member of the committee with 15-20 minutes to ask questions and add another 15-20 minutes for general committee discussion at the end. Another common structure might be spend 15-20 minutes on each of the major sections of the proposal with time allotted at the end for overall discussion.
- The committee will typically reserve about 30 minutes for deliberation at the end of the defense. During this time, the meeting will be closed with the candidate

and any observers leaving the room. Upon completion of this discussion, only the candidate will rejoin the committee for discussion of his or her next steps.

In the case of approval with minor revisions, the candidate need only resubmit the revised proposal to the Dissertation Committee Chair and any other specified committee members. Once approved, the chair forwards a copy of the proposal to the Graduate Program Director with a letter stating that all minor revisions have been satisfactorily completed. This will be circulated to the Graduate Committee and Department Chair by the GPD.

In the case of major revisions, the candidate must resubmit the proposal to all committee members. The candidate must complete both minor and major revisions within three months. In the case of a rejection, the committee will meet with the candidate and decide how to proceed.

All dissertation work should follow the format of the *American Psychological Association Manual for Publication, 6th Ed.* and the relevant University guidelines in *Requirements for Theses and Dissertations* available at http://www.umassd.edu/graduate/administration.cfm. Although the length of the proposal will vary with the candidate and the topic, the proposal must include the following elements:

a. cover page;
b. table of contents;
c. 300-400 word abstract;
d. introduction that clearly states the problem, establishes its significance, and states the research questions to be examined;
e. critical review of the literature that synthesizes the current research on the problem, explores related bodies of knowledge that contribute to the understanding of the problem, and explores the theoretical framework of the study;
f. thorough description of the methodology including research design, a description of the study population and sample, a plan to access the study population, human subjects considerations, data collection methods, and the plan for data analysis;
g. work plan that identifies needed resources, indicates how they will be obtained, and presents a realistic time line for data collection and analysis;
h. references; and
i. appendices with informed consent letters and instruments.

III.E.3. The Dissertation

The candidate works closely with the chair and other appropriate committee members throughout the data collection, data analysis and final writing phases of the dissertation. The candidate should expect repeated iterations of the dissertation to accommodate the Dissertation Committee Chair's and members' input and guidance.

The dissertation contains all of the elements listed under Dissertation Proposal above. In addition, the methods section is revised to report the actual protocol for data collection and analysis. The following content areas are added to the dissertation manuscript:

a. Findings
b. Identify new and/or confirmed knowledge
c. Relate this new knowledge to the research question(s), theoretical framework and previous literature discussed earlier in the paper
d. Identify limitations of the data/study
e. Summarize the findings
f. Discuss implications of these findings for mathematics education, specifically as these implications relate to the dissertation's focus area
g. Identify further research questions that arise in this study.

III.E.3.a Guidelines for the Inclusion of Media in Dissertations

The dissertation can include any kinds of multimedia materials provided the following two conditions are met:

1. the use of any data must be within IRB restrictions as described by the approved consent form the candidate asked participants to sign and
2. the materials must supplement a written explanation. That is, the multimedia element(s) provide addition modes of presentation, not the sole presentation of materials. Students may include dynamic examples and/or video clips of their work, but those are used in addition to written explanations.

Standard APA guidelines for directing the reader to multimedia materials will be used in the final (printed) document in place of hyperlinks until such time that the library can support electronic dissertations. Such supplemental materials will be added to the written document per the university's guidelines for such materials outlined in the Thesis/Dissertation Guidelines.

III.E.4. Dissertation Defense

The dissertation defense is an important milestone in one's doctoral career. Students are expected to work closely with their Dissertation Committee Chair not only in the

development of the dissertation but also in the preparation of the dissertation defense. The following guidelines are offered as a means to provide transparency for the process.

- The Dissertation Committee Chair is responsible for determining when a dissertation is ready for defense. The Dissertation Committee Chair will schedule the defense.
- The committee must receive a draft of the dissertation 3 weeks prior to the defense.
- Committee members should forward their questions to the full committee (including the chair) 72 hours in advance of the proposal defense
- Committee members are expected to attend the dissertation defense. Although external committee members are encouraged to participate in the defense in-person, they can also participate through venues such as Skype and conference call.
- The candidate may bring the dissertation document to the defense.
- Dissertation defenses are open to the public. This is a UMass Dartmouth policy.
- The dissertation defense is typically two-hours long, though this may vary in the case of larger committees. Extensions, however, should be the exception and not the norm.
- The candidate will present the dissertation study for members of the committee and the public. The presentation portion of the defense will last 15-20 minutes.
    - It should focus primarily on the research questions and main findings.
    - The student is welcome to use any multimedia elements allowed by IRB during that presentation time, but should be encouraged to keep such materials brief to stay within the allotted time. The multimedia should be used to support the main findings and or set-up the main findings.
- There will be a question and answer period for members of the committee to ask questions of the candidate. This will be moderated by the Dissertation Committee Chair.
- Members of the public, including other students in the department, will be allowed to ask questions in the dissertation defense during a 15-minute window that is moderated by the Dissertation Committee Chair. This window of discussion will follow the presentation of the dissertation by the candidate and the formal questioning by the candidate's committee.
- Once the public questioning session has ended, the candidate and the public will be asked to leave the room. The committee will then deliberate to generate a recommendation. There are four possible recommendations: 1) approve; 2) approve subject to minor changes; 3) action deferred pending major revisions; and 4) disapprove. During this deliberation, the Dissertation Committee Chair will take notes on any changes that need to be made to the dissertation. Once

feedback is decided upon, the candidate is called back into the room to hear the results, which are delivered with the entire committee present.

- The Dissertation Committee Chair will take primary responsibility for explaining necessary revisions (or other decisions) to the candidate.
    - When the committee "approves subject to minor changes", the Dissertation Committee Chair can take full responsibility for overseeing that the requested corrections are made and the committee does not need to re-read the dissertation. In such a case, edits should be completed within two weeks.
    - In the case of more substantial edits are requested ("action deferred pending major revisions"), committee members may opt to reread all or portions of the dissertation to ensure their points have been adequately addressed. Such revisions will be completed on a timeline agreed to by the candidate and the Dissertation Committee Chair.

Once the dissertation has been accepted, the Dissertation Committee Chair forwards copies of the dissertation cover sheet to the Graduate Program Director and the candidate should prepare three copies of the dissertation for binding and microfilming according to the *Requirements for Theses & Dissertations* (http://www1.umassd.edu/graduate/currents/thesis_guide.pdf)

The dissertation manuscript must conform to *Requirements for Theses & Dissertations* at the University of Massachusetts Dartmouth: http://www1.umassd.edu/graduate/currents/thesis_guide.pdf

Publication Manual of the American Psychological Association, 6th Ed. is the required format for organization, tables, illustrations and references.

It is the student's responsibility to pay particular attention to deadlines and the timing of the dissertation defense to allow enough time for a completed manuscript to be filed prior to Commencement exercises.

III.E.5. Human Subjects

The university's Institutional Review Board (IRB) must review all research and research-related activity proposed by any member of the UMassD community that involves human subjects in any way[4]. This requirement is based upon the University's assurance given to the federal Department of Health and Human Services that UMD

[4] Students can complete an IRB waiver with their professor to collect data involving human subjects for a class project that will not be published.

researchers—faculty, students, administrators, staff—are aware of and follow all federal rules and regulations concerning the protection of human subjects in research as contained in the Code of Federal Regulations, Title 45, Part 46 (45 CFR 46). In addition, the Federal code requires that all researchers be trained and certified in the assessment of risk, informed consent, and research involving special populations such as children or prisoners. All students are required to complete Collaborative Institutional Training Initiative (CITI) certification (www.citiprogram.org).

Graduate students in our program need to be aware of the issues related to collecting data on human subjects, protection of participants' rights, ethics, informed consent and the overall process of IRB approval progressively through our program. A typical approach would be:

Year 1

- Be presented with issues related to collecting data on human subjects in methodology courses. Students complete CITI certification.
- Complete a class-project form in at least one of their classes and in particular the Capstone course. This will allow students to construct a consent form for use with human subjects and collect data but not have to go through IRB approval.

Year 2

- Continue to collect data for educational purposes.
- Build on pre-existing datasets. This will allow students to complete part of the IRB Application Form utilizing data from an IRB-approved dataset under a faculty advisor.

Years 3 & 4

- Complete a full IRB application as part of writing their dissertation. This should be done after the proposal is successfully defended. At this stage many of the sections of the IRB application will be easy for the student to complete, e.g., background and significance of project, methodology and analytical framework. These are often underdeveloped early on for the student.

Students do not have to initiate a novel human subjects project requiring data collection in their first two years (Introduction and Preparation phases) of the program. There are plenty of opportunities for students to do their own original research using existing datasets/projects through the Kaput Center and external partnerships on already IRB-approved projects. Research using existing datasets might require exemption approval though. If a student is using a dataset from a currently approved active project then the

PI should submit an amendment to add the student to the project and if the proposal does not capture the student's activities then the amendment should also update the proposal to include the student's research activities. If a student is using a dataset from a non-active but previously approved IRB project then the student should submit an application for exempt pre-existing data analysis. This process utilizes the standard IRB application form and proposal form but many questions are not applicable. Relevant questions to be addressed focus on inserting: a new hypothesis, new title, new PI, a brief outline of background and significance, a brief outline of analytical method, and a clear indication of where the dataset was obtained naming the faculty advisor. NB. *Significant* differences would necessitate the student PI to obtain re-consent of participants. Because of the complexity involved in doing such a task the collection of a new dataset would be advised. The Director of the Office of Institutional Compliance will review both procedures in an expeditious manner. PIs will receive a letter to be used as necessary.

Both Capstone projects will need to be *original* research and *not* be a subsidiary of other research projects conducted by the program faculty or through internship collaborations with other institutions.

Human participant projects completed for class projects should utilize a "class project" form. Class project forms can only be utilized in a class under guidance and approval from the professor/instructor. Class projects can only qualify as class projects if they are done for class credit under the direction of a faculty member. Class project forms require a signature from the faculty member instructing the class. Students cannot follow this process on their own.

All forms and information about human participants can be obtained from the Office of Institutional Compliance or online at: http://www.atmc.umassd.edu/institutional_compliance/irb.cfm. If a student wishes to disseminate data obtained for a class project later on, the student should submit an IRB exemption application for the analysis of pre-existing data. All exemptions must be approved prior to dissemination.

III.F. Graduation Requirements

Successful completion of the program of study will be to complete all required coursework (including any additional required coursework identified as part of the student's admission into the program) with a GPA of 3.0 or higher, complete the qualifying examination, defend a dissertation proposal to the satisfaction of the student's dissertation committee, defend a final dissertation to the satisfaction of the

student's dissertation committee, and obtain approval of the dissertation for library submission.

IV. FINANCIAL SUPPORT AND ASSISTANTSHIPS

IV.A. Information Concerning Financial Aid

Students should consult with the Financial Aid Office regarding their eligibility for need-based assistance. Effort is made to secure financial support for students enrolled in the program.

See also the *Graduate Catalog* or the Office of Graduate Studies and Admission website http://www.umassd.edu/graduate/administration.cfm for more information. To qualify for any University assistantships, students must be in good academic standing, with a GPA of at least 3.0.

IV.B. Research and Teaching Assistantships

There are graduate research and teaching assistantships available for full-time students. Students are strongly encouraged to apply for these assistantships to develop critical research and teaching skills. The Kaput Center has a strong history of funded research to support research assistantships. Please contact the Director of the Kaput Center for more information. Additionally, qualified students are eligible to serve as instructors in the Department of STEM Education & Teacher Development or other departments. For more information, contact the Department Chair.

V. ADMISSION REQUIREMENTS

V.A. Admission Criteria

Students are admitted to the Ph.D. program based on the analysis of a comprehensive set of measures used to determine their readiness for doctoral study. While admission is into the doctoral program (not into a master's level program), students may apply for a Masters of Science (MS) degree through the University Registrar's office in the progression towards completion of the doctorate.

Prospective students will meet the following criteria for admission into the program:

a. A minimum overall GPA of 3.0 in all post-secondary education. Students will be required to submit transcripts from all post-secondary institutions.
b. Acceptable scores on the Graduate Record Examination.
c. Where applicable, a minimum TOEFL score of 500 (paper version) or 213 (computer version)

Criteria for admission are based on providing evidence of ability and motivation to succeed in a mathematics education research program, with potential to make a scholarly contribution to the field. As a field of research, mathematics education draws on an eclectic blend of disciplines. As such, the Ph.D. program is intentionally designed to be inclusive of applicants with diverse backgrounds of academic preparation in the technical and social sciences. It is anticipated that this diversity will enrich not only the overall experience of all doctoral students in the program, but the potential contribution students can make to mathematics education research. It is preferred that an applicant holds an appropriate Master's Degree for admission into the program.

This diversity notwithstanding, any perceived deficiencies in the applicant's previous course work that should be addressed by additional pre-requisite preparation will be determined by the Graduate Program Director in consultation with the Graduate Committee and stated along with the official notification of admission. Students will be expected to meet any program deficiencies before qualifying for the Production Phase (Advanced Doctoral Phase).

V.B. Application to the Program

In addition to meeting the criteria for admission, applicants will be expected to submit the following as part of their application process:

- Completed UMass Dartmouth application form
- A letter of intent addressing two issues:
    i. Applicant's qualifications and motivation for application to the program, including personal and career goals. This should discuss recent research and development experience and any publications, formal presentations, grants, or patents in which the applicant has been involved.
    ii. An outline of potential research interests and potential connections to faculty work.
- Current resume
- Official transcripts of all post-secondary education
- Official scores on the Graduate Record Examination. Information about the test and about the locations of test centers is available from:

    Educational Testing Service
    Box 6000, Princeton
    New Jersey, 08541-6000
    tel. 609 771-7670 voice/TDD/text: 609-734-9362
    www.gre.org

- Three letters of recommendation from individuals familiar with the applicant's academic ability and potential to conduct research at the doctoral level.

The application process can be completed online at http://www.umassd.edu/graduate/.

V.C. Application Review Process

The Graduate Program Director in consultation with the Graduate Committee will determine a recommendation for admission. The recommendation will then be reviewed by the Associate Provost for Graduate Studies, who confers official admission of all graduate students to UMass Dartmouth.

VI. ACADEMIC PROGRESS

VI.A. Academic Advising

Upon entering the program, each student is assigned a faculty member to serve as his or her program advisor. The role of the program advisor involves monitoring the student's course of study and ensuring appropriate coursework and program benchmarks are completed. While the student's Dissertation Committee Chair might also serve as his or her program advisor, these advising roles represent two distinct purposes.

VI.B. Academic Review

At the end of each semester, the Graduate Program Director and the Graduate Committee will review each student's transcript and assess the adequacy of each student's progress in achieving program objectives.

If a student is not performing to the program requirements, the student will be placed on probation and the Graduate Committee will prescribe a course of action to be completed in order for the student to return to good standing in the program. The Graduate Program Director will inform the student in writing that she/he is not meeting program requirements and will indicate what the committee prescribes as corrective action. A copy of this correspondence will be in the student's file.

VI.C. Electives

Students may take doctoral level courses at other universities with the approval of the program advisor and Graduate Program Director. The student must make the request in writing and submit a copy of the course syllabus. Only 6 credits from other universities may be applied to this program. The students can also take up to 6 credits as 700-level electives from other departments at UMass Dartmouth with the approval of the program/dissertation advisor, Graduate Program Director, and the Graduate Committee.

VI.D. Full-time Status

Full-time students are expected to take eighteen (18) credit hours per year. Full-time continuous students should complete all their course work in four years of study.

Any student who wishes to register for more than the maximum credit load must secure written permission from the program advisor, Graduate Program Director and Department Chair

VI.E. Grades

All students are required to receive a cumulative GPA of 3.0 or higher in order to remain in the program. A student who has attempted at least 9 hours and who has not earned the minimum GPA will be referred to the Graduate Committee. Failure to achieve the minimum GPA through re-taking the course or remedial work will result in dismissal from the program.

VI.F. Incomplete

The program does not support use of the *Incomplete* (I) grade but rather the *In Progress* (IP) grade and then only in extreme circumstances and programmatic needs.

These include:

1. An unexpected circumstance such as a medical leave or call for public service
2. The need to complete a course across several semesters or the summer. Such courses presently include (but are not limited to) MTE680/770 Authentic Learning (Internship), MTE615/715 Colloquium Series, MTE654/681 Research Seminar (Capstone Project), and MTE 772 Dissertation Research.

Requests related to item (1) should be submitted to the Instructor and copies to the Chair of the department with supporting evidence as soon as the case is relevant. The Ph.D. Program requires that the student and faculty member complete a written contract that specifies the in progress work and an agreed upon time frame for completion. Both the student and the faculty member must sign the form and retain a copy. A third copy is filed with the Graduate Program Director.

In most cases, in progress work from one semester should be finished before the start of the subsequent semester except for the dissertation. Students with in progress work in more than one course will not be allowed to enroll in additional courses until all in progress work has been completed.

Students must complete course work identified in the program of study for Years 1 and 2 prior to the qualifying exam.

VI.G. Independent Study

Students may complete an independent study to fulfill required or elective credits. Independent study credits vary from 1 to 3 credits depending on the scope of the project. The independent study should consist of study and work at the doctoral level with a specified written product. The faculty member who agrees to work with the student in independent study must be a recognized expert in the content area. The student and faculty member must agree to the number of credits, scope of the work and the amount of supervision required (for example, weekly or biweekly meetings). The Graduate Program Director and Department Chair must approve a written agreement—signed by the student and the faculty member—with copies retained by each.

VI.H. Leave of Absence

Leaves of Absence are granted for extenuating circumstances such as call to service and serious illness. A student seeking a leave of absence (LOA) must petition the Graduate Program Director. An approved LOA does not extend the statute of limitations for degree completion by the length of the leave. The University requires that each matriculated graduate student must maintain continuous registration until the degree has been formally awarded. If the student does not register for courses or dissertation credits during any semester, the student must pay a fee per semester to maintain continuous registration.

VI.I. Statute of Limitations

Students must make satisfactory progress toward completion of a degree within the Statute of Limitations for the degree. Each Mathematics Education Ph.D. student is expected to complete all degree requirements within six (6) calendar years. The Graduate Committee on a case-by-case basis will review any requests for extensions. The Statute of Limitations will reflect the need for additional time for program completion by those students accepted into the program with additional provisions.

VI.J. Transfer Credit Policy

Students who have completed graduate course work at other accredited institutions may request to transfer those credits towards the completion of the degree requirements. Up to the equivalent of six (6) credits from courses that meet the following requirements may be considered for transfer: 1) the student received a grade of B or higher; 2) the courses have not been used to fulfill requirements for another degree; and 3) the course credit must have been earned no more than six (6) years prior to the student's matriculation.

All transfers require recommendation by the program advisor and approval by the Graduate Program Director on a standard form.

VI.K. Waiver Policy

A student may seek a waiver from a required course in the Program if he or she has completed a course with substantially equivalent content at another institution or an equivalent educational experience. A maximum of twelve (12) credit hours may be waived. Waivers do not replace credits required to complete the program at UMass Dartmouth. Students will be required to complete alternative courses (e.g., electives) to fulfill the credit-requirement of the program.

Course waivers will be decided on a case-by-case basis, through negotiation between the student seeking the waiver and the faculty member who teaches the course. All waived courses require approval of the faculty member, the program advisor and the Graduate Program Director on a standard form.

Appeal of a denied waiver may be made to the Department Ph.D. Committee.

VII. COMMUNICATION WITH STUDENTS

Program information will be communicated to students by email and on-site mailboxes. Students will receive an UMassD e-mail account upon matriculation. This is the e-mail address that will be used to contact students with important information. Students keep their UMassD e-mail account for life.

Additionally, information about the program is available at:

http://www.umassd.edu/mathedphd

and

http://www.kaputcenter.umassd.edu/Ph.D./

VIII. REFERENCES

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