University of Massachusetts, Amherst
College of Education
Department of Teacher Education and Curriculum Studies

Mathematics Education, Science Education and Learning Technology (MSLT) Concentration Doctoral Program Handbook

A. Mission and Values……...p. 1

B. Doctoral Student Competencies……p. 1

C. Summary of Course Requirements……...p. 2

D. Doctoral Program Sequence and Stages……...p. 4

E. Comprehensive Exams and Defense…….p. 5

F. Dissertation Exams and Defense……...p. 6

Appendices

1. Mathematics Education Doctoral Advising Form……..……..……p. 7

2. Science Education Doctoral Advising Form……p. 9

3. Learning Technology Education Doctoral Advising Form……..p. 11

Mathematics Education, Science Education and Learning Technology (MSLT) Concentration Doctoral Program

Program Overview

A. Mission and Values

MSLT prepares graduate students to improve the learning and instruction of Science, Technology, Engineering, and Mathematics (STEM) disciplines. To achieve that goal, we are deeply committed to research and scholarship, using both basic and applied research.

We put a premium on developing principled approaches to affect educational practice and pursuing rigorous theory building about educational phenomena. We apply such knowledge in developing curriculum and state of the art instructional designs. These efforts grow from an understanding of educational practice and close work with practitioners in both formal and informal learning settings.

Importantly, we recognize that certain social groups have been historically marginalized from STEM disciplines, education, and work. We seek to understand the processes and structures contributing to the systematic exclusion of these groups and to actively contribute to correcting such inequities. Our work draws from a variety of disciplines including cognitive science, sociology, anthropology, the learning sciences, psychology, and computer science.

B. Doctoral Student Competencies

Graduates of the MSLT doctoral concentration will demonstrate excellence in their content area, teaching, research and scholarship that reflects critical examination of past and current theories and work, an engagement in new inquiry, and an active involvement in the ongoing work of mathematics education, science education and learning technology. Through coursework, practical experiences, assessments, comprehensive examination and dissertation work, graduates will demonstrate excellence in the following five key areas:

- **Content Knowledge and/or Content Knowledge for Teaching.**
  Graduates will demonstrate deep content knowledge and/or content knowledge for teaching and/or designing in their chosen field of study. Such knowledge, which builds the foundation for research and scholarship, includes the history and philosophy of their chosen field of study, and may include skills and competencies expected of pre- and in-service teachers, best practices to developing these skills and competencies, issues related to student learning, an understanding of assessment practices, knowledge of the use of technology in teaching and learning, ability to design curriculum and/or digital learning environments and current debates in the fields of MSLT.

- **Understanding of Social Justice Issues.**
  Graduates will demonstrate an understanding of issues, problems or questions from multiple perspectives (e.g., economic, social, political, racial, ethnic, gender, disability, sexual orientation, or language) and within the context of a classroom, school, school district, work setting, and/or community. They will demonstrate the capacity to apply their knowledge in designing and implementing a project or investigation to improve the context.

- **Becoming a Skillful and Creative Educational Researcher.**
  Graduates will demonstrate expertise in educational research by developing skills in using sound methodologies to generate new knowledge in the fields of MSLT. They will seek opportunities to work with faculty on research projects, write conference presentations and publishable papers based on their own original research, present at conferences, and submit their work to peer-reviewed journals.

- **Understanding of Foundational Theories and Works.**
  Graduates will demonstrate an understanding of foundational theories and works in the fields of MSLT, teaching and learning, mathematics and science teacher education, design of digital learning environments, and other related disciplines. They will demonstrate excellence in summarizing, interpreting, and applying such theories and works to their scholarly work.

- **Growing as a Professional.**

Graduates will demonstrate the capacity to apply their scholarly knowledge, contextual awareness, and research skills in developing and conducting studies in their chosen field. They will engage collaboratively with others both within and outside academia. And they will require competence in understanding and using ethical guidelines for the protection of human subjects in their scholarly work, especially when those research subjects are vulnerable minors.

C. Summary of Course and Credit Requirements

Doctoral students must complete a minimum of 57 credit hours after the master's degree towards the doctoral degree. This includes a minimum of 18 dissertation credits to be completed during the dissertation phase of the degree and a minimum of 39 credits of graduate coursework, completed prior to the dissertation phase. Of these 39 course credits, students must complete a minimum of 4 foundational graduate courses for a total of 15 credits in the MSLT concentration, 2 courses from your chosen field of study (6 credits), 4 research methods courses (12 credits), and 2 elective courses in any department (6 credits). Students must complete 692K Theories of Learning or the equivalent as a prerequisite.

The 4 foundational MSLT courses (15 credits) must include the following:

Two required foundational courses (6 credits) for all entering doctoral students (to be completed in the first two years of study):

- EDUC 792Q: Introduction to Research in Mathematics, Science, and Learning Technologies
- EDUC 738: Survey of Mathematics and Science Education Research

One required foundational course to be taken each year until the student has a comprehensive proposal accepted (6 credits minimum):

- EDUC 693B: MSLT Research Practicum

One social justice course is required. This course may be taken either within the MSLT concentration or another concentration within the College of Education (3 credits). This course must be approved by your advisor. Below are the two social justice education courses taught with a focus on Mathematics, Science, and Learning Technology:

- EDUC 693F: Teaching Social Justice Through Science, Technology and Mathematics
- EDUC 704: Issues of Gender in Science and Science Education

A minimum of two MSLT Concentration Courses (6 credits) must be taken in one's chosen field of study. These courses must be approved by the faculty advisor. Below is a partial list of courses that may be chosen from:

Mathematics education:

- EDUC 651: Teaching Mathematical Problem-Solving
- EDUC 710: Seminar in Mathematics Education
- EDUC 711: Recent Developments in Secondary Mathematics
- EDUC 790A: Mathematics Curriculum Issues and Trends

Science education:

- EDUC 706: Workshop in Science Education
- EDUC 725: Recent Developments in Secondary Science
- EDUC 838: Seminar in Science Education

Learning technology:

- EDUC 737: Educational Media Theory
- EDUC 693K: Designing Digital Media for Teaching and Learning
- EDUC 897C: Seminar in Digital Media Learning
- EDUC 597S: Service Learning and Teaching with Computational Media
- EDUC 618C: Computer Programming for Educators I

A minimum of two elective courses (6 credits). These courses can come from the specialty courses listed above, the general MSLT courses list below, and/or from another department. These courses must be approved by the faculty advisor. Below is a partial list of courses that may be chosen from:

- EDUC 591SM: Introduction to Secondary Mathematics Education
- EDUC 603: Computer Mediated Communication
- EDUC 667: Theory of Learning and Teaching in STEM Education
- EDUC 692K: Foundations and Theories of Learning
- EDUC 693F: Teaching Social Justice Through Science, Technology and Mathematics
- EDUC 694G: Theories of Interest and Motivation
- EDUC 697CC: Secondary Mathematics Curriculum Topics and Innovations
- EDUC 697 ME: Professional Seminar in Mathematics Education
- EDUC 697SE: Professional Seminar in Science Education
- EDUC 704: Issues of Gender in Science and Science Education
- EDUC 718: Action Research in Schools
- EDUC 794C: Clinical Methods Study
- EDUC 837: The Influence of the Social Context of Schools and the Politics of Reform on Teaching and Learning
- EDUC 897B: Research Topics in Science and Mathematics
- EDUC 615GR

A minimum of four research methods courses (12 credits) must be approved by the faculty advisor. Of those, at least 2 must be quantitative research courses and 1 qualitative research course. The fourth course can be either quantitative or qualitative based on students' interest and advisors approval. Find the list of approved courses here.

D. Doctoral Program Sequence and Stages

To complete a doctorate with a concentration in MSLT, all students must complete a series of courses, activities, and milestones. The typical timeline and sequence for a *full-time* student is as follows:

Years 1-3:	Coursework (D-1, D-2)
Year 3-4:	Comprehensive paper(s) and exam; Defend dissertation proposal (D-3; D-4)
Years 4-6:	Dissertation data collection and writing; Defend dissertation (D-5)

While moving through the program, a doctoral student must also engage in a variety of professional and scholarly activities. To graduate, all MSLT students must complete the following activities. If not noted below, the timing and approach for fulfilling these activities will be determined in consultation with the faculty advisor:

- Create an E-portfolio and showcase it at a MSLT interactive poster conference (during the first three years).
- Write a paper on foundational theories in chosen field of study (e.g., EDUC 792Q, EDUC 738, EDUC 693B).
- Conduct a mini action research project focusing on an issue, problem, or question of social justice (during social justice course).
- Attend a regional or national conference (scholarly or practitioner).
- Present a paper at a regional or national conference (scholarly or practitioner).
- Submit a paper for publication to a peer-reviewed scholarly or practitioner journal.
- Gain relevant teaching experience; the form of which to be decided in consultation with your advisor.

- Gain relevant research or clinical experience; the form of which to be decided in consultation with an assigned advisor.

- Complete the CITI training for human subject research through the UMass research office.

E. Comprehensive Exams and Defense

Goals and Purposes:
The comprehensive/qualifying examination is the transition point at which the doctoral student demonstrates the foundational knowledge, understanding and scholarship relevant to their course of study. Falling after coursework and prior to the dissertation proposal, the comprehensive/qualifying examination is the doctoral student's opportunity to demonstrate their proficiency in MSLT's five competencies.

The comprehensive/qualifying examination consists of an empirical research study centered on a specific problem in the student's field of study. The paper must include the following components: introduction with problem statement/research question(s); situating the research question/problem within the relevant literature and describe alternative ways of understanding and conceptualizing your research question/problem; involve either a qualitative, quantitative or mixed methods study; a description and discussion of results; and implications of your results for your field of study.

Students will present a proposal for their comprehensive/qualifying examinations to their committee for feedback. The proposal will be 5-10 pages in length and will clearly explain the nature of the work to be undertaken. Typically, the proposal is disseminated two weeks in advance of a meeting with the committee. The committee will provide feedback to the student on the proposal. When the committee has approved the proposal, the committee signs the D3 form provided by the student. Usually, approval is given at the meeting. It is expected that students will complete and defend their comprehensive exams within one year of the signing of the D3. Students who fail to make adequate progress on their comprehensive exams may have their case referred to the concentration faculty for further disposition.

Composition and responsibility of the committee:
- The composition of the comprehensive/qualifying examination committee follows D3 requirements, however; at least one member should be within the student's disciplinary area.
- The committee chair will provide feedback on the comprehensive/qualifying examination paper in a timely manner.
- Upon approval of the committee chair the doctoral student will set the defense date with the committee.
- Committee members will receive the paper at least two weeks prior to the defense date.

Comprehensive/qualifying examination defense:
The comprehensive/qualifying examination defense is a two-hour oral exam comprised of a 30 to 40 minute presentation of the doctoral student's work followed by 40 minutes of questions from the committee members. The comprehensive/qualifying examination oral defense is open for the public during the presentation and questions from the committee. At the discretion of the committee chair, questions from the audience may be entertained. After the question and answer segment of the exam, the doctoral candidate and the public will leave the room in order for the committee to discuss the doctoral student's performance. Performance outcomes are pass, fail or revisions. If revisions are recommended, the committee will decide which committee members will review the revised paper and this decision will be communicated to the student. If the revisions made are not adequate, the doctoral student may, at this point, fail to advance to candidacy and the student will be recommended for a terminal degree at the master's level.

F. Dissertation Exams and Defense

Goals and Purpose:
The dissertation is the final milestone at which the doctoral student demonstrates foundational knowledge, understanding and scholarship relevant to the student's course of study. Falling after coursework and

comprehensive/qualifying examination the dissertation is the doctoral student's opportunity to demonstrate their proficiency across MSLT's five competencies.

Prior to conducting her/his dissertation research the doctoral students will design and defend their dissertation proposal as outlined below. Only after passing the dissertation proposal defense will the doctoral student conduct their dissertation research.

Composition and responsibility of the committee:

- The composition of the dissertation committee follows D4 requirements, however: At least one member should be within the student's disciplinary area.
- The committee chair will provide feedback to the dissertation proposal and the dissertation in a timely manner.
- Upon approval of the committee chair the doctoral student will set the defense date with the committee.
- Committee members will receive the dissertation proposal at least two weeks prior to the defense date and the dissertation at least four weeks prior to the defense date.

Dissertation proposal:
The dissertation proposal outlines the student's plan for an empirical research study of a significant problem, issue, or question in a chosen field of study. The proposal is comprised of an introduction with problem statement/research question(s), a review of the relevant literature that situates the research question/problem within the field of study, a description of the theoretical framework, and the research methodology.

Dissertation proposal defense:
The dissertation proposal defense is an approximately 90-minute oral exam comprised of a 20-minute presentation of the doctoral student's work followed by questions from the committee members and suggestions for improvement and/or changes of the proposed study. Revisions to the dissertation proposal may be requested at this time.

Dissertation:
The dissertation is comprised of an empirical research study centered on a specific problem in the student's chosen field of study. The dissertation must include the following components: introduction with problem statement/research question(s); situating the research question/problem within the relevant literature (including provision a conceptual framework) and describe alternative ways of understanding and conceptualizing the research question/problem; involve either a qualitative, quantitative or mixed methods study; a description and discussion of results; a description of limitations of the research; and implications of the results for the field of study.

Dissertation defense:
The dissertation defense is an approximately two-hour oral exam comprised of a 30-minute presentation of the doctoral student's work followed by 90 minutes of questions from the committee members and the committee's discussion regarding pass/fail and/or revisions.

The dissertation oral defense is open for the public during the presentation and questions from the committee. At the discretion of the committee chair questions from the audience maybe entertained. The doctoral candidate and the public will leave the room during the committee's conference regarding the doctoral student's exam. During this time, the committee will decide if the doctoral student will pass and/or needs to revise her/his dissertation. If revisions are necessary, the candidate will have six months within which to submit the revisions to the committee chair. The committee will review the revisions and assess their adequacy for completion of the degree.

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MATHEMATICS EDUCATION DOCTORAL ADVISING FORM

Name_____ Year Program Began_____

The doctoral program in MSLT is committed to research and scholarship, using both basic and applied research in a specialty area. To achieve the goals of the doctoral program and that of the candidate, thoughtful advising about program development is essential. This form is meant to help advisors and doctoral candidates conceptualize and keep track of their formal progress through the doctoral program.

PREREQUISITE

The following course or the equivalent:

_____EDUC 692K: Theories of Learning

CORE COURSES

Each of the following:

_____EDUC 792Q: Intro to Research in MSLT
_____EDUC 738: Survey of Math & Science Ed Research
_____EDUC 693B: MSLT Research

1 of the following:

_____EDUC 693F: Teaching Social Justice Through Science, Technology and Mathematics
_____EDUC 704: Issues of Gender in Science and Science Education

SPECIALTY EXPERIENCES

2 of the following, selected in consultation with your faculty advisor:

_____EDUC 667: Theories of Teaching and Learning in STEM
_____EDUC 710: Seminar in Mathematics Education
_____EDUC 711: Recent Developments in Secondary Mathematics
_____EDUC 790A: Mathematics Curriculum Issues and Trends
_____ EDUC 590ED: Educational Data Mining and Learner Analytics

2 additional courses, which can come from the Specialty Experiences above, from the following, or from the elective courses, selected in consultation with your faculty advisor:

_____EDUC 651: Teaching Mathematical Problem-Solving
_____EDUC 694G: Theories of Interest & Motivation
_____EDUC 697CC: Secondary Math Curriculum Topics and Innovations
_____ EDUC 697 ME: Professional Seminar in Math Education
_____ EDUC 6XX: Problem-Solving in Mathematics
_____EDUC 722: Research on Teacher Education
_____EDUC 7XX: Research & Evaluation of Learning Technology
_____EDUC 897B: Research Topics in Science & Math

RESEARCH COURSES

A minimum of four research methods courses (12 credits) must be approved by the faculty advisor. A minimum of 2 quantitative research courses and 1 qualitative course must be taken. The fourth course the student may choose either quantitative or qualitative. Find the list of approved courses here.

_____ EDUC 590ED: Educational Data Mining and Learner Analytics

ELECTIVE COURSES

_____EDUC 591M: Intro to Secondary Math Ed
____HUMDEV 660: Theories of Human Development
_____EDUC 718: Action Research in Schools
_____EDUC 790C: Historical and Social Foundations of Education
_____EDUC 791S: Using Video in Research & Teaching
_____EDUC 837: The Influence of the Social Context of Schools & the Politics of Reform on Teaching & Learning

While moving through the program, a doctoral student must also engage in a variety of professional and scholarly activities. To graduate, all MSLT students must complete the following activities. If not noted below, the timing and approach for fulfilling these activities will be determined in consultation with the faculty advisor:

- □ Create an E-portfolio (see possible contents below) and showcase it at a MSLT interactive poster conference (during the two years). (EDUC 693B)
- □ Write a paper on foundational theories in chosen field of study (e.g., EDUC 792Q, EDUC 738, EDUC 693B, EDUC 667, EDUC 692K). (E-portfolio)
- □ Conduct a mini action research project focusing on an issue, problem or question of social justice (during social justice course). (E-portfolio)
- □ Present a paper at a regional or national conference (scholarly or practitioner). (E-portfolio)
- □ Submit a paper for publication to a peer-reviewed scholarly or practitioner journal. (E-portfolio)
- □ Gain relevant teaching experience; the form of which to be decided in consultation with your advisor.
- □ Gain relevant research experience (e.g., research assistant, research practicum, clinical experience); the form of which to be decided in consultation with your advisor.
- □ Complete <u>all</u> CITI training modules for human subjects research through the UMass research office.

SCIENCE EDUCATION DOCTORAL ADVISING FORM

Name_____ Year Program Began_____

The doctoral program in MSLT is committed to research and scholarship, using both basic and applied research in a specialty area. To achieve the goals of the doctoral program and that of the candidate, thoughtful advising about program development is essential. This form is meant to help advisors and doctoral candidates conceptualize and keep track of their formal progress through the doctoral program.

PREREQUISITE

The following course or the equivalent:

_____EDUC 692K: Theories of Learning

CORE COURSES

Each of the following:

_____EDUC 792Q: Intro to Research in MSLT
_____EDUC 738: Survey of Math & Science Ed Research
_____EDUC 693B: MSLT Research

1 of the following:

_____EDUC 693F: Teaching Social Justice Through Science, Technology and Mathematics
_____EDUC 704: Issues of Gender in Science and Science Education

SPECIALTY EXPERIENCES

2 of the following, selected in consultation with your faculty advisor:

_____EDUC 667: Theories of Teaching and Learning in STEM
_____EDUC 706: Workshop in Science Education
_____EDUC 725: Recent Developments in Science Education
_____EDUC 697SE: Professional Seminar in Science Education

2 additional courses, which can come from the Specialty Experiences above, from the following, or from the elective courses, selected in consultation with your faculty advisor:

_____EDUC 694G: Theories of Interest & Motivation
_____EDUC 722: Research on Teacher Education
_____EDUC 7XX: Research & Evaluation of Learning Technology
_____EDUC 897B: Research Topics in Science & Math

RESEARCH COURSES

A minimum of four research methods courses (12 credits) must be approved by the faculty advisor. A minimum of 2 quantitative research courses and 2 qualitative courses must be taken. Find the list of approved courses here.

ELECTIVE COURSES

____HUMDEV 660: Theories of Human Development
_____EDUC 692K: Foundations & Theories of Learning
_____EDUC 718: Action Research in Schools
_____EDUC 790C: Historical and Social Foundations of Education
_____EDUC 791S: Using Video in Research & Teaching
_____EDUC 794C: Clinical Methods Study
_____EDUC 837: The Influence of the Social Context of Schools & the Politics of Reform on Teaching & Learning

While moving through the program, a doctoral student must also engage in a variety of professional and scholarly activities. To graduate, all MSLT students must complete the following activities. If not noted below, the timing and approach for fulfilling these activities will be determined in consultation with the faculty advisor:

- □ Create an E-portfolio (see possible contents below) and showcase it at a MSLT interactive poster conference (during the two years). (EDUC 693B)
- □ Write a paper on foundational theories in chosen field of study (e.g., EDUC 792Q, EDUC 738, EDUC 693B, EDUC 667, EDUC 692K). (E-portfolio)
- □ Conduct a mini action research project focusing on an issue, problem or question of social justice (during social justice course). (E-portfolio)
- □ Present a paper at a regional or national conference (scholarly or practitioner). (E-portfolio)
- □ Submit a paper for publication to a peer-reviewed scholarly or practitioner journal. (E-portfolio)
- □ Gain relevant teaching experience; the form of which to be decided in consultation with your advisor.
- □ Gain relevant research experience (e.g., research assistant, research practicum, clinical experience); the form of which to be decided in consultation with your advisor.
- □ Complete <u>all</u> CITI training modules for human subjects research through the UMass research office.

LEARNING TECHNOLOGY DOCTORAL ADVISING FORM

Name_____ Year Program Began_____

The doctoral program in MSLT is committed to research and scholarship, using both basic and applied. The doctoral program in MSLT is committed to research and scholarship, using both basic and applied research in a specialty area. To achieve the goals of the doctoral program and that of the candidate, thoughtful advising about program development is essential. This form is meant to help advisors and doctoral candidates conceptualize and keep track of their formal progress through the doctoral program.

PREREQUISITE

The following course or the equivalent:

_____EDUC 692K: Theories of Learning

CORE COURSES

Each of the following:

_____ EDUC 792Q: Intro to Research in MSLT
_____ EDUC 738: Survey of Math & Science Ed Research
_____ EDUC 693B: MSLT Research (min. 6 credits)

1 of the following:

_____ EDUC 693F: Teaching Social Justice Through Science, Technology and Mathematics
_____ EDUC 704: Issues of Gender in Science and Science Education

SPECIALTY EXPERIENCES

2 of the following, selected in consultation with your faculty advisor:

_____EDUC 737: Educational Media Theory
_____EDUC 792F: Computational Literacy
_____EDUC 897C: Seminar in Digital Media Learning

2 additional courses, which can come from the Specialty Experiences list above, from the following, or from the elective courses to the right, selected in consultation with your faculty advisor:

_____ EDUC 603: Computer Mediated Communication
_____ EDUC 693K: Instructional Design of Educational Technology
_____ 615GR: Teaching & Learning in Technology
_____ EDUC 612: Educational Web Design
_____ CMPSCI 691O: Tools and Explanatory Tutoring Systems
_____ COMM 791Q: Technology and Society

_____ EDUC 711: Recent Developments in Secondary Mathematics
_____ EDUC 790A: Math Curriculum Issues & Trends

RESEARCH COURSES

A minimum of four research methods courses (12 credits) must be approved by the faculty advisor. A minimum of 2 quantitative research courses and 2 qualitative courses must be taken. Find the list of approved courses here.

ELECTIVE COURSES

_____ *EDUC 692K: Foundations & Theories of Learning*
_____ *EDUC 694G: Theories of Interest & Motivation*
_____ *EDUC 718: Action Research in Schools*
_____ *EDUC 791S: Using Video in Research & Teaching*
_____ *EDUC 794C: Clinical Methods Study*
_____ *EDUC 837: The Influence of the Social Context of Schools & the Politics of Reform on Teaching & Learning*
_____ *EDUC 897B: Research Topics in Science & Math*
_____ _____
_____ _____
_____ _____

While moving through the program, a doctoral student must also engage in a variety of professional and scholarly activities. To graduate, all MSLT students must complete the following activities. If not noted below, the timing and approach for fulfilling these activities will be determined in consultation with the faculty advisor:

- □ Create an E-portfolio and showcase it at a MSLT interactive poster conference (during the first three years). (EDUC 693B)

- □ Write a paper on foundational theories in chosen field of study (e.g., EDUC 792Q, EDUC 738, EDUC 693B, EDUC 667, EDUC 692K). (e-portfolio???)

- □ Conduct a mini action research project focusing on an issue, problem or question of social justice (during social justice course). (E-portfolio???)

- □ Present a paper at a regional or national conference (scholarly or practitioner).

- □ Submit a paper for publication to a peer-reviewed scholarly or practitioner journal.

- □ Gain relevant teaching experience; the form of which to be decided in consultation with your advisor.

- □ Serve as a research assistant or complete a research practicum. Gain relevant research experience (e.g., research assistant, research practicum, clinical experience) in consultation with your advisor.

- □ Complete all CITI training modules for human subjects research through the UMass research office.