

**SOUTH DAKOTA BOARD OF REGENTS**

**Academic and Student Affairs**

**AGENDA ITEM: 6 – G (3)**

**DATE: May 9-11, 2017**

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**SUBJECT: Intent to Plan: NSU MS in Mathematics for Teachers**

Northern State University (NSU) has submitted an Intent to Plan requesting approval to develop a Master of Science (MS) in Mathematics for Teachers. Approval or waiver of an Intent to Plan is required prior to the submission of a formal program proposal. The program would provide curriculum in both pedagogy and Mathematics. The program also includes a minimum of 18 hours in the content area, a necessary component for teaching concurrent and dual credit courses due to recent policy changes made by the Higher Learning Commission (HLC), the accreditation body for South Dakota’s postsecondary institutions. The program would target existing certified and/or practicing teachers with focus on content knowledge and strategies for teaching math courses at all levels of education.

**University Mission and System Strategic Goals**

The proposed degree supports the statutory mission of NSU. SDCL 13-59-1 provides the mission as “*the preparation of elementary and secondary teachers, and a secondary purpose is to offer pre-professional, one-year and two-year terminal and junior college programs. Four-year degrees other than in education and graduate work may be authorize by the board of regents.*” The proposal also supports the Board’s implementation of the statutory mission in [Policy 1:10:6](#), authorizing master’s degrees in education.

The proposal supports [Board of Regents Strategic Plan 2014-2020](#) by growing the number of approved graduate programs, documenting that academic programs are of high quality, increasing the number of STEM graduates, and revising teacher preparation programs to prepare professionals to work in standards-based schools. The proposal also supports state and national initiatives to grow the number of qualified teachers in STEM fields, including Mathematics. The proposal also supports requirements of the HLC that postsecondary instructors have a minimum of 18 graduate credit hours in the discipline or subfield in which they teach.

(Continued)

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**DRAFT MOTION 20170509\_6-G(3):** I move to authorize NSU to develop a proposal for a Master of Science (MS) in Mathematics for Teachers as Presented.

### **Related Programs in the System**

USD offers an MA in Secondary Education with a Specialization in Science, Math, and Technology. SDSU offers a Master of Education in Curriculum and Instruction with a Specialization in Secondary Education (without specific Mathematics coursework). BHSU is currently seeking authorization to develop a proposal for a Master of Arts in Teaching (MAT) in Mathematics.

### **Workforce Need, Student Demand, Projected Graduates**

South Dakota suffers from workforce shortages for math teachers as noted in national reports published by the US Department of Education. Employment growth for Mathematical Science teachers is expected to grow by 15.7% in South Dakota between 2014 and 2024, roughly 9% above the demand for all jobs. NSU estimates graduating 5 students per year after full implementation.

### **Board Policy**

NSU is not requesting any exceptions to Board policy.

### **Off Campus and Distance Delivery**

NSU is requesting authorization to deliver the program online.

### **Budget and Resources**

NSU does not request any new State resources to implement or maintain the proposed program.

### **Conditions for Approval**

The approval of this request will be contingent upon the following:

1. The university will research existing curricula, consult with experts concerning the curriculum, and provide assurance in the proposal that the program is consistent with current national standards and with the needs of employers. This includes completion of an external review as required by [Board Policy 2:1](#).
2. The proposal will define the specific knowledge, skills, and competencies to be acquired through the program, will outline how each will be obtained in the curriculum and will identify the specific measures to be used to determine whether individual students have attained the expected knowledge, skills, and competencies.
3. The university will not request new state resources and the program proposal will identify the sources and amounts of all funds needed to operate the program and the impact of reallocations on existing programs.

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Use this form to request authorization to plan a new baccalaureate major, a new associate degree program, or a new graduate program. The Executive Director or the Board may request additional information.

<b>UNIVERSITY:</b>	<b>Northern State University</b>
<b>DEGREE(S) AND TITLE OF PROGRAM:</b>	<b>Master of Science in Mathematics for Teachers</b>
<b>INTENDED DATE OF IMPLEMENTATION:</b>	<b>Fall 2018</b>

**University Approval**

To the Board and the Executive Director: I certify that I have read this intent to plan, that I believe it to be accurate, and that it has been evaluated and approved as provided by university policy.

/s/ Timothy Downs

President of the University

3/28/17

Date

After approval by the President, a signed copy of the proposal should be transmitted to the Executive Director. Only after Executive Director review should the proposal be posted on the university web site and the Board staff and the other universities notified of the URL.

**1. What is the general nature of the proposed program? What is the expected demand for graduates in South Dakota? What is the need for the proposed program?**

Northern State University (NSU) requests authorization to develop a proposal for a Master of Science in Mathematics for Teachers (MSMT). The degree would be designed to enhance the content knowledge but also pedagogical skills of math teachers. Thus, the program will tentatively include math courses enhanced with education courses. Training will target certified and/or practicing teachers with focus on content knowledge and how to teach math courses at all levels of education, particularly at the middle to high school level. The courses will be taught by math faculty and will be housed in the Department of Biology, Chemistry, Physics, and Mathematics. The proposed program will comply with the accreditation requirements of the Council for the Accreditation of Educator Preparation (CAEP).

The need to increase the quantity and quality of math teachers perpetuates in secondary education. Roughly 75% of 8<sup>th</sup> graders in the United States are not proficient in math (NRC, 2011)<sup>1</sup>, part of which is a result of the lack of effectiveness of Science, Technology, Engineering, and Mathematics (STEM) education. Students that are not proficient in math at the 8<sup>th</sup> grade level will continue to struggle throughout their academic career due to increasing

<sup>1</sup> National Research Council. (2011). *Successful K-12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics*. Committee on Highly Successful Science Programs for K-12 Science Education. Board on Science Education and Board on Testing and Assessment, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

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demands of math and science courses. According to the Math Advisory Panel (2008)<sup>2</sup>, “Greater achievement is associated with covering fewer topics.” As a result, organizations, such as Association of Public and Land-Grant Universities (APLU) and National Science Foundation (NSF), have launched nationwide efforts to provide guidance on actions to take to help produce teachers equipped with knowledge in content areas with the capability to successfully deliver such content (<http://www.aplu.org/document.doc?id=4098>, and [http://www.nsf.gov/attachments/117803/public/2b--Preparing\\_Teachers.pdf](http://www.nsf.gov/attachments/117803/public/2b--Preparing_Teachers.pdf)). Coble and Presley (2012)<sup>3</sup> stated, “Teachers need to know the discipline they are teaching and have the pedagogical skills to teach it.” Many current teachers have not had adequate math training and the ongoing shortage of K-12 math educators makes added teacher preparation in math increasingly important.

The proposed program is a low-residency, research, and/or project based degree program that will advance knowledge and skills of professional, working math educators. The program is designed to provide a solid background in mathematics principles and enhance teachers’ practices in the classroom. The program is proposed for certified and/or practicing teachers who wish to enhance their knowledge and skill in math. The planned format will combine online (fall and spring semesters) and on-campus (summer semester) coursework. Online coursework will include graduate level mathematics courses, and on-campus coursework will focus on delivery of such knowledge. During the summer, students will use NSU’s Math Lab resources to gain an understanding of an effective math tool. In addition, we will employ a cohort model, in which students start and end together, to ensure understanding of the information, enhance relationships, and to retain students. Coursework will include a core of professional education courses and electives in math and science. This program is not designed to lead to standard teacher certification. We hope to develop a model for educators in which they can obtain content knowledge in math and improve their ability to deliver it. This model may be adapted for use at the state or national level.

Undergraduate enrollment in Math and Math Education consists of 22 students, and 82% of the students pursuing a mathematics degree at NSU are Mathematics Education majors. Last academic year, we graduated two BSED Math students; considering NSU’s size, this is a significant number. We anticipate a similar number this academic year based on field placement data. Though Math has not seen an increase in student numbers over the past few academic years, NSU’s success rate in math literacy is worth noting. The overall pass rate in all non-major math courses at NSU has increased from 54% to 70% over a five-year period. We have the highest pass rate of all SD Regental schools, and continue to have success with student pass rates due to the Math Lab program. Given our success in the mathematics field, it would be advantageous to provide the opportunity for graduate level training to NSU graduates.

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<sup>2</sup> National Mathematics Advisory Panel. (2008). *Foundations for success: The final report of the National Mathematics Advisory Panel*. Washington, DC: U.S. Department of Education. Available at: <http://www2.ed.gov/about/bdscomm/list/mathpanel/report/finalreport.pdf>.

<sup>3</sup> Coble, C. R., & Presley, J. B. (2012). *Seeking Consensus on the Essential Attributes of Quality Science and Mathematics Teacher Preparation Programs*. Association of Public and Land-Grant Universities.

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Because NSU hosts the Center for Statewide E-Learning as well as the Rising Scholar program, we also propose to train more teachers across South Dakota for the purposes of expanding online high school and Rising Scholar course offerings. Teacher preparation at the graduate level is a must for these programs, and the MSMT is a method in which teachers can obtain the appropriate level of training to build our online high school and Rising Scholar programs.

NSU is currently accredited by the National Council for the Accreditation of Teacher Education (NCATE) and the Higher Learning Commission (HLC). As such, this program will be coordinated by the NSU Department of Biology, Chemistry and Physics, and Mathematics, and will include courses and offered by departmental faculty at NSU in the College of Arts and Sciences and the School of Education to achieve success in the proposed MSMT degree.

Expected Workforce Demand within South Dakota

The proposed degree would help meet both the pedagogical and educational needs of current math teachers by providing much needed opportunities for professional development and advancement. It is expected that this will increase the retention of math educators, especially those in smaller school districts, who will have more opportunities to advance to an increased level of salary compensation upon completion of the program.

The majority of teachers have a baccalaureate degree as per requirements of the South Dakota Department of Education (<http://doe.sd.gov/ofm/statdigest.aspx>), but very few have taken graduate coursework. Graduate level training will not only assist teachers in continuing their education but also address meeting students' needs in the dynamic field of math. Moreover, some teachers, particularly in smaller districts, are certified to teach math disciplines with little background in the math field. Because certification in South Dakota requires teachers to pass national Praxis exams, which many do with minimal content training, these teachers are eligible to teach math to our students. The MSMT is a viable option for both math educators and those teaching in science fields who wish to solidify their professional advancement while strengthening their math skills.

According to the Labor Market Information Center at the South Dakota Department of Labor, the employment projections for STEM teaching occupations in South Dakota are predicted to increase by the year 2022 (see Table 1). To add to this, the South Dakota Department of Education (SDDOE) notes the shortage of math teachers in South Dakota (<http://doe.sd.gov/oatq/shortageareas.aspx>). Further, the United States Department of Education (USDOE) identified mathematics as critical needs areas in which teacher shortages are currently observed and expected to continue for years if more teachers are not properly prepared in these fields (<http://www2.ed.gov/about/offices/list/ope/pol/tsa.pdf>).

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Table 1 South Dakota Employment Estimates and Projections, STEM Teaching Occupations, 2012-2022						
SOC* Code	Occupational Title	2008 Base Number of Jobs	2018 Projected Number of Jobs	Actual Change	Percent Change	Average Annual Demand for Workers
25- 2031	Secondary School Teachers, except Special and Career/Technical Education	3,425	3,505	80	2.3%	101
25- 2022	Middle School Teachers, except Special and Career/Technical Education	2,045	2,230	185	9.0%	63

*\*Standard Occupational Classification, U.S. Bureau of Labor Statistics: <http://www.bls.gov/soc/socguide.htm#LINK2>  
Source: Labor Market Information Center, SD Department of Labor, October 2014:  
[http://dol.sd.gov/lmic/menu\\_projections.aspx#occupations](http://dol.sd.gov/lmic/menu_projections.aspx#occupations) accessed October 13, 2014.*

### Student Demand for the Program

In an effort to enhance SD students' knowledge of math, the Governor's Office has supported a statewide STEM directive to promote and enhance opportunities in all STEM fields to students and educators at all educational levels throughout the state (<http://sd.gov/governor/stem.aspx>). Teachers with graduate-level training in STEM fields will help provide additional science and math training and educational opportunities to students. Students from South Dakota will become more competitive here and elsewhere if trained by more knowledgeable STEM educators.

The need and support for a well-developed graduate level math program with focus on math content and delivery of such content is apparent. We consulted the Aberdeen School Superintendent, the SDDOE, a high school science faculty member, and the NSU Dean of the School of Education. Each supports a MSMT program, and mentioned that this program is needed and will address the science needs in this area. Appendix A provides anecdotal testimonies of professionals in education and/or math fields.

Teachers that provided comments were from middle and high schools settings and this proposed program will focus efforts at the middle to high school levels.

## **2. What is the relationship of the proposed program to the University's mission as provided in South Dakota statute and Board of Regents Policy?**

Northern State University mission statement, SDCL 13-59-1:

*The primary purpose of Northern State University, at Aberdeen in Brown County, and Black Hills State University, at Spearfish in Lawrence County, is the preparation of*

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*elementary and secondary teachers, and a secondary purpose is to offer preprofessional, one-year and two-year terminal and junior college programs. Four-year degrees other than in education and graduate work may be authorized by the Board of Regents.*

Board Policy 1:10:6 Northern State University Mission Statement provides degrees authorized:

#### A. Undergraduate Programs

*Associate degree programs in arts and sciences, business, education, and fine arts. Baccalaureate degree programs in arts and sciences, business, education, and fine arts.*

#### B. Graduate Programs

*Master's degrees in Banking and Financial Services, Education, E-learning, and Music Education.*

The University offers graduate degrees in:

- M.M.E. in Music Education
- M.S. in Banking and Financial Services
- M.S. in Training and Development in E-learning
- M.S.Ed. in Counseling
  - Clinical Mental Health
  - School
- M.S.Ed. in Educational Studies
- M.S.Ed in Instructional Design in E-learning
- M.S.Ed. in Leadership and Administration
- M.S.Ed in Sport Performance and Leadership
- M.S.Ed. in Teaching and Learning

NSU has a long history of offering degrees in science and math education and has prepared South Dakota STEM teachers for decades. Three programs are offered at the present time:

- Bachelor of Science Biology Education
- Bachelor of Science Chemistry Education
- Bachelor of Science Mathematics Education

Many students who have graduated from our department are math and science teachers in South Dakota and often seek out additional educational opportunities at NSU, their alma mater.

### University Priority

Northern State University's strategic plan is titled **2010 Strategic Planning: Mission Forward**. Priority 1 of the strategic plan is to: "Recruit, retain, challenge, and graduate citizens with the highest capacity to enrich their communities through their professional lives and civic engagement." The Master of Science in Math and Science Education is a high priority for NSU because it would support the following objectives of Priority 1:

- Grow graduate student enrollment by 50%.

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- Double the number of course offerings delivered in online, alternate schedule, and workshop format.

System Goals and Priorities

The proposed program meets the expectations of the South Dakota Board of Regents Strategic Plan 2014-2020, including but not limited to increasing the number of STEM graduates, increasing the number of new graduate programs, and fostering partnerships with K-12 to increase student success in STEM programs.<sup>4</sup>

The proposed program also supports the system strategic goals (Policy 1:21):

- Economic Development & Quality of Life: Expand graduate education.
- Economic Development & Quality of Life: Offering off-campus and online programs: The proposed program would require online courses during the school year and campus courses during the summers.

**3. Are there any related programs in the regental system? If there are related programs, why should the proposed program be added? If there are no related programs within the system, enter "None."**

The University of South Dakota offers a Master of Arts in Secondary Education with a Specialization in Science, Math, and Technology<sup>5</sup>. South Dakota State University offers a Master of Education in Curriculum and Instruction with a Specialization in Secondary Education<sup>6</sup>. Black Hills State University is currently working on a proposal for a Master of Arts in Teaching (MAT) in Mathematics, and we will contact this institution to determine if any overlap exists.

The proposed NSU program will provide for improved math trained teachers in K-12 schools. Masters programs currently offered in the Regental system are focused on curriculum and instruction related to secondary education as a whole rather than specific content in the math fields. This program will provide specialized instructional training to math educators in and outside of South Dakota, since the program will be delivered partly online. It will provide an accelerated opportunity for enhancement and development of pedagogical and laboratory skills and career advancement with the least amount of disruption to their teaching schedule. The MSMT is a natural extension of the Bachelor of STEM Education degrees and endorsements NSU currently offers.

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<sup>4</sup> SD Board of Regents System Strategic Plan

([https://www.sdbor.edu/theboard/agenda/2014/October/16\\_BOR1014.pdf](https://www.sdbor.edu/theboard/agenda/2014/October/16_BOR1014.pdf))

<sup>5</sup> MA in Secondary Education ([http://catalog.usd.edu/preview\\_program.php?catoid=14&poid=2123&returnto=652](http://catalog.usd.edu/preview_program.php?catoid=14&poid=2123&returnto=652))

<sup>6</sup> MEd Curriculum and Instruction ([http://catalog.sdstate.edu/preview\\_program.php?catoid=23&poid=4522](http://catalog.sdstate.edu/preview_program.php?catoid=23&poid=4522))

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**4. Are there related programs at public colleges and universities in Minnesota, North Dakota, Montana, and Wyoming?<sup>7</sup> If there are related programs in these states list below under each state and explain why the proposed program is needed in South Dakota. If there are no related programs in a state, enter "None" for that state.**

## Minnesota

Institution & title of program or None

1. Minnesota State University, Mankato – Master of Science in Mathematics Teacher Education. This program is offered in a traditional residency format.
2. University of Minnesota - Master of Mathematics with emphasis in Math Education. This program is offered in a traditional residency format.

## North Dakota

Institution & title of program or None

1. Minot State University – Master of Arts in Teaching Mathematics. This program is offered in a traditional residency format.
2. University of North Dakota - Master of Mathematics Education. This program is offered in a traditional residency format.

## Montana

Institution & title of program or None

1. Montana State University - Master of Mathematics Education. This program is offered in a traditional residency format.
2. University of Montana - Master of Mathematics. This program is not specialized in secondary education STEM fields and is offered in a traditional residency format.

## Wyoming

Institution & title of programs or None

1. University of Wyoming - Master of Science in Teaching Mathematics. This program is offered in a traditional residency format.

**5. Are students expected to be new to the university or redirected from other programs? How many majors are expected in the first years of the program? How many graduates are expected?**

NSU expects that all MSMT students will be new to the university and does not expect students from its other graduate programs to transfer to the new program.

NSU expects that between 4 and 6 students will enter the program each year based on the current undergraduate enrollment of 22 Math and Math Education majors.

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NSU expects to graduate between 3 and 5 per year when the program reaches full implementation.

**6. Does the university intend to seek authorization to deliver this entire program at any off-campus locations?** *If yes, enter location(s) and intended start date(s).* **Does the university intend to seek authorization to deliver this entire program by distance technology?** *If yes, identify delivery method(s) and intended start date(s).*

Off-campus	No
Distance delivery	Yes

Courses offered during the academic school year will be available online and summer courses and seminars will be conducted on campus. Summer courses may include workshops, which incorporate the use of NSU's Math Lab facilities and program.

**7. What are the University's plans for obtaining the resources needed to implement the program?** Indicate "yes" or "no" in the columns below.

	Development/Start-up	Long-term Operation
Reallocate existing resources	Yes	Yes
Apply for external resources*	Yes	Yes
Ask Board to seek new State resources	No	No
Ask Board to approve new or increased student fee	No	No

**Program Cost and Projected Revenue**

The university anticipates that tuition from each cohort as well as external funding sources will support the faculty salaries. However, current student numbers at the university have increased significantly. Though math has not seen significant growth, we hope to expand delivery options to help do so. We recently hired a Math Education professor who is trained in content and delivery. This individual will spearhead the MSMT program.

EPSCoR monies are available for a five-year period, and monies from this sub-award will be used to support graduate level curricula and research as well as K-12 outreach related to math and science. With these monies, we will hire a Biology faculty member and a greenhouse manager, both of whom may support the MSMT program.

Marketing this program will be integral to its success. Thus, the School of Education, the Blue Ribbon Task Force, and the E-learning program will all be involved with cross-marketing strategies to help enlist students interested in all these programs. In addition, we will employ a "cohort recruitment" strategy that allows groups of students to start and finish the MSMT together, which will retain students due to the establishment of relationships and camaraderie. Other marketing tools will be conducted, as they come to fruition, to help implement and sustain the MSMT degree.

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\*External resources may include monies available through the USDOE, SDDOE, EPSCoR, or Sanford PROMISE.

**8. Curriculum Example: Provide (as Appendix A) the curriculum of a similar program at another college or university. The Appendix should provide the required and elective courses in the program. Catalog pages or web materials may be used. Identify the college or university and explain why the program may be used as one model when the proposed program is developed.**

Two schools, one in Nebraska and one in Texas, are closely aligned with the envisioned MSMT program. The University of Nebraska Lincoln (UNL) has a Master of Arts for Teachers with a concentration in Mathematics. This has been a successful program, providing advanced training to certified teachers in mathematical concepts at the middle and high school level (<http://online.unl.edu/programs-and-courses/graduate-doctorate-programs/master-of-arts-teachers.aspx>). The University of Texas Arlington (UTA) provides a Master of Curriculum and Instruction with specialization in Math Education or Science Education (<http://academicpartnerships.uta.edu/documents/Program-Overview.pdf>) program, which focuses on research and mathematical understanding. Our program, however, will focus on content knowledge and delivery of such knowledge at the middle and high school levels, so students will take eight (8) mathematics content courses focused on mathematics knowledge, three (3) mathematics education courses focused on delivery of discipline-specific subject matter, and one (1) research methods course focused on advancing mathematics. The UNL and UTA programs will provide a framework in which we plan to design our program. To provide further evidence of our commitment and course preparation related to the MSMT, we have provided an appendix, i.e., Appendix B, detailing our tentative MSMT program.

Provided below is information collected from University of Nebraska Lincoln.

In the Master's program at UNL, students take eight (8) mathematics courses (Math) and four (4) education courses (Math or Teac). The program is designed for online delivery to accommodate existing, certified mathematic teachers. The goal is to strengthen skills in content and pedagogy, much like the goal of the proposed MSM degree.

Required Courses	
COURSE	CREDIT HOURS
<b>Required Courses (15 credit hours)</b>	
<b>Core Courses</b>	<b>9 credit hours</b>
<ul style="list-style-type: none"> <li>▪ Math 810T: Algebra for Algebra Teachers</li> <li>▪ Math 811T: Functions for High School Teachers (pre-calculus content)</li> <li>▪ Math 812T: Geometry for Geometry Teachers</li> </ul>	
3 credit hours selected from:	3 credit hours
<ul style="list-style-type: none"> <li>▪ Math 807: Capstone course - Mathematics for Teachers I</li> <li>▪ Math 808: Capstone course - Mathematics for Teachers II</li> <li>▪ Math 809: Mathematical Modeling for High School Teachers</li> </ul>	
3 credit hours selected from:	3 credit hours
<ul style="list-style-type: none"> <li>▪ Math 804T: Experimentation, Conjecture &amp; Reasoning</li> <li>▪ Math 805T: Discrete Math for Secondary Teachers</li> <li>▪ Math 806T: Number Theory &amp; Cryptography for Secondary Teachers</li> </ul>	
<b>Elective Courses</b>	<b>21 credit hours</b>

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Required Courses	
COURSE	CREDIT HOURS
Electives in Mathematics	9 credit hours min.
<ul style="list-style-type: none"> <li>▪ Math 804T: Experimentation, Conjecture &amp; Reasoning</li> <li>▪ Math 805T: Discrete Math for Secondary Teachers</li> <li>▪ Math 806T: Number Theory and Cryptography for Secondary Teachers</li> <li>▪ Math 807T: Using Math to Understand Our World</li> <li>▪ Math 808T: Concepts of Calculus</li> <li>▪ Math 807: Capstone course - Mathematics for Teachers I</li> <li>▪ Math 808: Capstone course - Mathematics for Teachers II</li> <li>▪ Math 809: Mathematical Modeling for High School Teachers</li> <li>▪ STAT 812T: Statistics for High School Teachers</li> </ul>	
Electives in Education	6 credit hours min.
<ul style="list-style-type: none"> <li>▪ EDPS 991: Cognition and Motivation</li> <li>▪ TEAC 800: Inquiry Into Teaching and Learning</li> <li>▪ TEAC 801: Curriculum Inquiry</li> <li>▪ TEAC 892: Integrating Geometry Teaching &amp; Learning</li> <li>▪ TEAC 892: Integrating Mathematics Teaching &amp; Learning (pre-calculus content)</li> <li>▪ TEAC 892: Teaching High School Statistics</li> <li>▪ TEAC 892: Teacher Learning about Reasoning &amp; Sensemaking in Secondary Classrooms</li> <li>▪ TEAC 949A: Trends and Issue in Mathematics Teaching &amp; Learning</li> </ul>	

*Select Course Descriptions:*

**MATH 802T.** Functions, Algebra, and Geometry for Middle Level Teachers. 3 credits. Use of functions in problem solving. Theory of measurement, especially length, area, and volume. Geometric modeling in algebra. Graphs, inverse functions, linear and quadratic functions, the fundamental theorem of arithmetic, modular arithmetic, congruence and similarity. Ways these concepts develop across the middle level curriculum.

**MATH 804T.** Experimentation, Conjecture and Reasoning. 3 credits. Problem solving, reasoning and proof, and communicating mathematics. Development of problem solving skills through the extensive resources of the American Mathematics Competitions. Concepts of logical reasoning in the context of geometry, number patterns, probability and statistics MATH 804T is intended for middle-level mathematics teachers.

**MATH 805T.** Discrete Mathematics for Middle Level Teachers. 3 credits. Prerequisites: Admission to the MAT or MScT program in mathematics or to a graduate program in the College of Education and Human Sciences Concepts of discrete mathematics, as opposed to continuous mathematics, which extend in directions beyond, but related to, topics covered in middle-level curricula. Problems which build upon middle-level mathematics experiences. Logic, mathematical reasoning, induction, recursion, combinatorics, matrices, and graph theory. MATH \*805T is intended for midlevel mathematics teachers.

**MATH 807T.** Using Mathematics to Understand Our World. 3 credits. The mathematics underlying several socially-relevant questions from a variety of academic disciplines. Construct mathematical models of the problems and study them using concepts developed from algebra, linear and exponential functions, statistics and probability. Original documentation, such as government data, reports and research papers, in order to provide a sense of the role mathematics plays in society, both past and present. MATH 807T is intended for middle-level mathematics teachers.

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**MATH 807.** Mathematics for High School Teachers I. 3 credits. Analysis of the connections between college mathematics and high school algebra and precalculus.

**MATH 808.** Mathematics for High School Teachers II. 3 credits. Analysis of the connections between college mathematics and high school algebra and geometry.

**MATH 810T.** Algebra for Algebra Teachers. 3 credits. Prerequisites: Admission to the MAT or MScT program in mathematics or to a graduate program in the College of Education and Human Sciences. The integers. The Euclidean algorithm, the Fundamental Theorem of Arithmetics, and the integers mod  $n$ . Polynomials with coefficients in a field. The division algorithm, the Euclidean algorithm, the unique factorization theorem, and its applications. Polynomials whose coefficients are rational, real or complex. Polynomial interpolation. The habits of mind of a mathematical thinker. The conceptual underpinnings of school algebra.

**MATH 811T.** Functions for High School Teachers. 3 credits. Course examines mathematics underlying pre-calculus material through problem solving. Connections to other topics in mathematics, including algebra, geometry and advanced mathematics are highlighted.

**MATH 812T.** Geometry for Geometry Teachers. 3 credits. Prerequisites: A valid secondary mathematics teaching certificate. Course examines mathematics underlying high school geometry through problem solving. Topics include Spherical, Euclidean and Hyperbolic geometry, introduction to Neutral geometry, Platonic and Archimedean solids and projective geometry.

**TEAC 800.** Inquiry into Teaching and Learning. 3 credits. Contemporary educational research from multiple theoretical perspectives.

**TEAC 801.** Curriculum Inquiry. 3 credits. The relationship between curriculum theory and/or research to educational practices.

Provided below is information collected from University of Texas Arlington.

In the two Master's programs, M.Ed. C&I – Science Education, and M.Ed. C&I – Math Education, students take six (6) education courses (EDUC) focused on science and mathematics education and six (6) science education (SCED) OR six (6) mathematics education (MAED) courses emphasizing discipline-specific subject matter in their respective program (science or math), integrated with pedagogy/curriculum topics for teaching the subject to K-12 students. These science and/or math courses engage students in active inquiry and problem solving experiences that dually promote the following:

- Learning of important science and mathematics concepts aligned with national and state standards to strengthen content and process understanding, and
- Understanding and skill in transforming relevant content learned into meaningful, inquiry-based science and math teaching curricula for students in grades K-12 by experiencing such curricula in each course.

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*Select Course Descriptions:*

**M.Ed. in Science Education and M.Ed. in Mathematics Education - Both Programs EDUC  
 - Education Courses, Science/Math Education Focused**

**EDUC 5305: Curriculum Design, Implementation, and Evaluation**

This course engages students in an examination of theory and research in curriculum development, implementation, and evaluation. Emphasis is on current trends in the content areas.

**EDUC 5309: Advanced Instructional Strategies**

This course engages students in a study of advanced models of teaching and learning such as concept attainment, inductive thinking, inquiry, problem-based learning, role play, simulation games and other models, with an analysis of research on the effectiveness of these models. Emphasis is on current trends in the content areas.

**EDUC 5380: Diversity in Educational Settings**

Effective leadership, instruction, and management strategies for work in diverse educational settings. Designed to provide increased self-awareness and insight into issues of diversity such as culture, ethnicity, exceptionality, gender, language, religion, and socioeconomic status. Demographic issues along with urban and suburban educational settings will also be addressed.

**EDUC 5394: Understanding Classroom Research**

In this course, students gain an understanding of educational research and critically analyze resources of research, such as professional journals, Internet sites, technical reports, ERIC (Education Resources Information Center) documents, and reports of professional organizations. The students will examine historical trends and themes in education and how they have changed and progressed to newer, cutting-edge educational research that informs classroom instruction. Students will analyze research data and reports of research with the purposes of, gaining understanding of sound educational research techniques; evaluating research designs including issues of validity and reliability; gaining knowledge of both quantitative and qualitative data collection procedures; interpreting the results and implications of research; and learning the form of technical, scholarly writing. Through course experiences, students will be prepared to write meaningful research questions and design methodologies for conducting their own classroom research projects. Students will also learn to be effective consumers of research, equipped with skills needed to make sense of classroom, district, state, national, and international educational research studies. This course is to be taken after at least 9 hours of graduate course work and preceding EDUC 5395 and EDUC 5397.

**EDUC 5395: Designing Classroom Research**

In this course, students will develop their own classroom educational research project. Their designed study will be based in the literature in their educational field and focus on classroom research questions and problems that will inform teaching practices. In this course, students will develop an individual research problem statement, argue the significance of the problem, complete a written literature review and logical chain of reasoning related to the stated problem, write specific research questions to investigate the problem in educational settings, and design a research study (methodology) that will effectively investigate their research questions. Students design a research study that shows promise for improving education, written as the first three chapters of a scholarly classroom action research project. Prerequisite: EDUC 5394. This course is to be taken in the semester just prior to the final semester of the masters' degree program, and in the semester immediately preceding EDUC 5397.

**EDUC 5397: Implementing and Disseminating Classroom Research**

In this course, students will implement the classroom research designed and written in EDUC 5395, collect data from this research, and interpret results. Students will prepare a final, written research report that presents the investigation and its results in a 5-chapter professional format, such as would be prepared as a paper for presentation at a professional conference and/or publication in an educational journal. At the conclusion of this course, students will submit a copy of their research project report to the course instructor and present the completed project as their final Capstone Experience for the Master's degree in education. Prerequisites: EDUC 5394 and EDUC 5395. This course is to be taken in the final semester of the M.Ed. and in the semester immediately following EDUC 5395.

**Northern State University**  
**Intent to Plan: Master of Science in Mathematics for Teachers**

**M.Ed. in Mathematics Education Program Only**  
**MAED – Mathematics Education Courses**

**MAED 5351: Whole Numbers, Rational Numbers, and Operations**

In this course students engage in activities and problem solving on concepts related to whole numbers, rational numbers and operations. Students in the course will learn to utilize research based problem-based teaching methods to promote K-12 student understanding. Students will experience how K-12 students learn these concepts as they themselves engage in computation and problem solving activities transferrable to classroom practice. In this course, students will engage in experiences to learn and teach their K-12 students on using numbers, number systems and their structure, operations and algorithms, quantitative reasoning, and technology.

**MAED 5352: Rational Numbers and Operations**

The focus of this course is on rational numbers and operation concepts. Students will experience how students learn these concepts as they themselves engage in computation and problem solving activities transferrable to classroom practice.

**MAED 5353: Probability and Statistics**

In this course students will engage in learning experiences and readily usable curricula for teaching K-12 students concepts of probability and statistics, their applications, and technology. Students will examine K-12 student learning and research-based practices that best help them understand these mathematical concepts and that will promote their development of probabilistic reasoning abilities.

**MAED 5354: Problem Solving**

In this course, students experience and practice innovative curricula for teaching and learning problem solving. Students engage in hands-on activities and apply various problem solving techniques, using mathematical processes to reason mathematically, to solve mathematical problems, to make mathematical connections within and outside of mathematics, and to communicate mathematically. Students learn to identify relevant and irrelevant variables in problems and work through problems to arrive at meaningful solutions. Students examine research on ways to help K-12 students become effective problem solvers as transferrable to other mathematics topics and subjects across the curriculum.

**MAED 5355: Conceptual Geometry**

In this course students will experience and incorporate active learning curricula that utilize a variety of manipulative materials, diagrams, models, and pictures to study geometry and spatial reasoning. The students will learn effective, research-based practices for teaching geometry and examine ways to best help K-12 students build geometric and spatial understandings as a foundation for later, more complex abstract visualizations.

**MAED 5356: Measurement**

This course focuses on inquiry-based, problem-based curricula that help K-12 students learn concepts of measurement including units of measure, standardization, and error. Students will learn to use teaching techniques that will promote K-12 students' understanding as well as the application of measurement concepts to other subjects and to everyday life experiences.

**Appendix A.** Anecdotal testimonials were provided by professionals in education and/or math fields. These individuals on numerous occasions stressed the importance of having adequately trained teachers with strong math backgrounds. Below are example comments of such testimonies.

**Northern State University****Intent to Plan: Master of Science in Mathematics for Teachers**

"School districts are always looking for high quality professional development opportunities for staff. A structured Master's program in the areas of math (and science) would strengthen existing high school course offerings and provide exemplary opportunities for students."

- Dr. Becky Guffin, Aberdeen School District Superintendent

"With both the new mathematics core standards and the eventual new state science standards both promoting STEM skills in our students, our K-12 science and math teachers will need to find ways to adapt. This course will give practicing teachers those skills necessary to help their students achieve those standards."

- Ms. Jacki Omlund, Master Teacher of Physics and Astronomy

Schools districts participating in the Rising Scholar program, such as Mitchell, Huron, and Aberdeen, have teachers interested in this program. We solicited these teachers for input on program recommendations, and all unanimously stated their interest and support for said program. Many comments were as follows:

"...I am interested. I really like the idea that is would be geared towards content delivery.

- Aberdeen School District

"This is great!...I am just so excited by this opportunity. Frequently Master level programs spend too much time on content without regard to the pedagogy that truly impacts the student and the professional."

- Mitchell School District

"Yes, I have interest!!!! I just need more information."

- Huron School District

**Appendix B.** Northern State University's tentative MSMT program provides 30 graduate credits, with 21 credits in math content and 9 credits in education/delivery. Coursework will be taken online in which cohorts of students are established to form math networks among teachers. Further, one summer will be designated to the delivery of content knowledge. Appropriate workshops and courses will be held during this summer to help enhance teachers with the pedagogical aspect of math education.

**Masters of Science in Mathematics for Teachers**30 credit hours*Required Core Courses (9cr):*

Math 713 Advanced Algebra I, 3cr

Math 5xx Advanced Geometry and Trigonometry (NEW course), 3cr

Math 725 Advanced Calculus I, 3cr

*Required Curricular Courses (18cr):*

Math 5xx Statistics and Data Analysis (NEW course), 3cr

Math 512 Advanced Linear Algebra, 3cr

Math 5xx Real Analysis (NEW course), 3cr

**Northern State University**  
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Math 735 Mathematical Modeling, 3cr

EPSY 741- Psychology of Learning (course offered by NSU Dept of Ed), 3cr

EDFN 752- Research Based Curriculum & Instruction (course offered by NSU Dept of Ed), 3cr

*Required End Course (3cr):*

EDER 761- Graduate Research and Design (course offered by NSU Dept of Ed), 3cr

Course Descriptions

MATH 713 – Advanced Algebra I

A graduate level survey of Algebra: groups, rings, fields, modules, and Galois theory.

MATH 5xx – Advanced Geometry and Trigonometry

This course reviews Euclidean Geometry. The parallel axiom and its equivalents are explored. Congruence and similarity are developed. Emphasis is given to the Side Splitter Theorems in preparation for the triangular definition of the trigonometric functions. The circular definition of the trigonometric functions is developed as well as are several important trigonometric identities. The history of Euclid's Fifth Postulate and the development of Non-Euclidean Geometry are explored. An introduction to Hyperbolic Trigonometry is given.

MATH 725 – Advanced Calculus I

Topics will include set theory; point set topology in  $R^n$  and in metric spaces; limits and continuity; infinite series; sequences of functions.

MATH 5xx – Statistics and Data Analysis

The modern sciences are fundamentally data-driven; this course focuses on making sense of data, both quantitatively and conceptually. Topics include methods to describe data, inferential statistical methods, sampling and experimental design, simple and multiple linear regression, logistic regression and an in-depth examination of modeling. The course uses statistical software to do much of the computational and graphical work so students can focus on interpretation.

MATH 512 – Advanced Linear Algebra

A graduate level study of vector spaces, linear transformations, matrices, inner products, eigenvalues, eigenvectors, the methods of solution of systems of linear equations, and applications.

MATH 5xx – Real Analysis

This course proceeds from the historical and axiomatic development of the real number system to the analysis of real-valued functions of a real variable. The Algebra of Functions is defined. Rigorous definitions of limits are given and used to prove the basic limit theorems. Continuity of functions is defined and the basic continuity theorems proved. The Intermediate Value Theorem and the Extreme Value Theorem are proved and applied. Derivatives are defined and the function algebra rules are proved from the definition. Several theorems are discussed and/or proved -e.g. the Mean Value Theorem. Definite Integrals are defined and several applications are constructed. Sequences and series are developed and various convergence theorems are proved.

**Northern State University****Intent to Plan: Master of Science in Mathematics for Teachers****MATH 735 – Mathematical Modeling**

Formulation of models for situations in the social, economic, and physical sciences, dimensional analysis, the Buckingham Pi Theorem, scaling curve fitting, testing hypothesis and predictions.

**EPSY 741- Psychology of Learning**

An intensive study of the nature of human learning based on traditional and current learning theories, information processing theory, and current research for their implications for curriculum and instruction. Also addressed are the variables influencing individual differences, cultural aspects of the learner and motivation.

**EDFN 752- Research Based Curriculum and Instruction**

This course addresses the design, implementation, and evaluation of a curriculum that meets state and national standards and fully accommodates learners' diverse needs; also addressed are the principles of effective instruction and the application of best practices for student learning.

**EDER 761- Graduate Research and Design**

An introduction to the methods and skills important to the conduct and consumption of research.