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MATHEMATICS EDUCATION (MAED)

MAED262. K-12 FIELD EXPERIENCE AND BUILDING STUDENT RELATIONSHIPS. 1.0 Semester Hr.

This course is designed to provide Mines students with opportunities to participate in, analyze, and reflect on issues in a mathematics or computer science K-12 school classroom setting. The overall goal is for Mines students to understand who their students are, build relationships, and begin exploring learner development and learner differences. Specifically, the course will focus on developing Mines students? ability to identify and practice basic classroom management, differentiate instruction, ask probing questions, mathematics or computer science content preconceptions, language/activities that promote a growth mindset, and professional language. Furthermore, Mines students will begin exploring the factors that shape school norms and culture. In addition to an on-campus seminar, there is a 25-hour field experience requirement in the student?s assigned partner school.

Course Learning Outcomes

- · · identify and provide examples of differentiated instruction.
- identify and provide examples of formative-assessment techniques used to evaluate what students are thinking during classroom activities
- · articulate the value of reflecting on their practice.
- explain different levels of questioning and how to ask probing questions as well as provide examples of how to use these types of questioning.
- • articulate reasons for, ways to, and examples of how they built relationships with each and every student in their classroom.
- articulate and document the mathematics or computer science content specific preconceptions that they observed students demonstrate during the field placement.
- • identify the school policies and practices of their field placement.
- identify factors that shaped the culture and norms of the school they experienced.
- communicate effectively, model appropriate use of language (e.g., use of proper grammar, use of professional language, and use of discipline-specific vocabulary), and identify unprofessional language.
- articulate the critical role of high ethical standards, including a belief in being committed to displaying ethical conduct towards students, performance and the profession, colleagues, and parents and the community.
- recognize that with quality instruction and hard work, all students are capable of learning science and mathematics; use language, activities and feedback that is consistent with a growth mindset.

MAED405. MATHEMATICAL PRACTICES AND THE SOCIAL CONTEXT OF MATHEMATICS. 3.0 Semester Hrs.

This course provides teacher candidates an opportunity to develop the skills to promote students mathematical identity and their understanding of mathematical practices and processes - mathematics is a community of inquiry-as articulated in the Colorado Academic Standards and Common Core. These skills will be modeled, practiced and mastered in the context of authentic mathematical practices (eg. the formation of the quadratic equation through maximization of orange production). Teacher candidates will engage as learners, reflect as practitioners, and finally develop their own 3-day mini-unit. To promote candidates awareness of

the social context of mathematics, candidates will explore the historical development of content and perspectives from diverse cultures. In addition this course will prepare students to be able to communicate effectively in a variety of mediums (written, oral, and digital) as educators about mathematical processes and practices.

Course Learning Outcomes

- nurture development of mathematical processes and practices. They
 anticipate how students' use of mathematical practices will look and
 sound within specific grade-band mathematical topics, knowing that
 over years of experience, their knowledge of students' ways of using
 mathematical practices will expand to more mathematical topics.
- identify, adapt, or develop lessons that explicitly teach mathematical process and practices demonstrating these as tools use to solve problems and communicate ideas.
- demonstrate that doing mathematics is a sense-making activity that promotes perseverance, problem posing, and problem solving.
- provide examples and connections for students to see that mathematics is a human endeavor that is practice in and out of school, across many facets of life.
- integrate the history of mathematics into content and share contributions from people with different gender and cultural, linguistic, religious, and racial/ethnic backgrounds.
- articulate how mathematics is based on constructed conventions and agreements about the meanings of words and symbols, and these conventions vary; algorithms considered as standard in the United States different from algorithms used in other countries.
- cultivate their students' mathematical identity by helping students realize the usefulness of mathematics by providing connections to students' everyday lives and building their students mathematics self-efficacy by encouraging hard work from every student and demonstrating the belief that every student is capable of learning and using mathematics
- identify and implement practices that draw on students' mathematical, cultural, and linguistic resources/strengths and challenge practices grounded in deficit-based thinking.
- select, adapt, or develop lessons that explicitly engage students the mathematical practices defined in the Colorado Academic Standards and Common Core in mathematics.
- identify, adapt, or develop lessons that reflect the interconnectedness of content areas/disciplines to help erase the disciplinary lines and reflect authentic situations.
- create a mini-unit (3 days or more) that explicitly teaches some aspect of mathematical practices or the social context of mathematics.
- clearly articulate their mathematical ideas in writing. o analyze text based on occasion, audience, form and function. o compose one page reflections with an awareness about introductions, conclusions and topic sentences. o articulate the process of and compose with an awareness about the composing process which is an iterative process of formulation, composition and revision. o incorporate and cite correctly all evidence used to support a text's claim/s.
- clearly articulate their mathematical ideas verbally. o delineate effective characteristics of multi-media presentations. o articulate mathematical practices in a way that secondary students can understand and be motivated to explore these practices. o collaborate with others towards giving and receiving feedback on both oral and written work about teaching mathematics as a community of inquiry.

MAED425. PRE-ALGEBRA AND ALGEBRA TEACHING TECHNIQUES. 3.0 Semester Hrs.

In this course teacher candidates will be exposed to evidence-based instructional practices to support students learning of pre-algebra and algebra and model meaningful learning opportunities, common misconceptions and ways of thinking, and students learning progressions (i.e., content trajectory). The goal of this course is for teacher candidates is to develop an awareness of 1) the common misconceptions and learning progressions associated with pre-algebra and algebra; 2) students learning progressions in pre-algebra and algebra, and 3) evidence-based and meaningful instructional strategies for pre-algebra and algebra. The teacher candidate analyzes conceptual algebra underpinnings, common misconceptions, and students' ways of thinking to create opportunities to learn.

- plan at least the first month of instruction for a middle or high school pre-algebra or algebra course using standards-based lessons experienced in this course.
- • construct and evaluate mathematical conjectures and argument to validate one's own mathematical thinking.
- identify and develop lessons that are designed to build students knowledge as defined in the Colorado Academic Standards in mathematics and literacy. Candidates will be able to
- • articulate the scope of the above standards related to the content knowledge necessary for teaching 7-12 students.
- • describe mathematical ideas, using every day and mathematical language, in both verbal and written formats.

MAED464. CAPSTONE CURRICULUM DESIGN I. 6-12 Semester Hr.

This course provides Mines students an intensive teaching experience in a K-12 mathematics or computer science classroom. The goal of this course is for the student to develop and demonstrate competencies in the areas of planning, instructional methods, assessments, creating effective learning environments for all learners, classroom management and organization, content knowledge, and professionalism. In addition to a total of 15 hours of seminars (on campus and teacher professional development), there is a 100-hour field experience requirement in the students assigned partner school. During this semester, the student will be responsible for planning and teaching at least five periods of classroom instruction as well as participate in other school related professional roles and will develop a mini-work sample (min-unit of instruction including: description of setting, learning objectives, three class periods or more of standards-based lesson plans, pre/post assessment, and reflection). Prerequisite: Completed/concurrent 3 credits of SCED 262; completed/concurrent with MAED 405 or MAED 425. Corequisite: Completed/concurrent 3 credits of SCED 262; completed/ concurrent with MAED 405 or MAED 425.

Course Learning Outcomes

- utilize research-based instructional techniques that have been shown to be effective across context, including pairing graphics with words, linking abstract concepts with concrete representations, asking probing questions, repeatedly alternating solved and unsolved problems, distributed practice and assessment to boost retention.
- identify, adapt, or develop lessons using a core set of pedagogical practices that are effective for developing students' meaningful learning of mathematics which include establishing goals, promoting reasoning and problem solving, connecting mathematical representations, meaningful discourse, purposeful questions, procedural fluency based on conceptual understanding, and

productive struggle. While planning lessons program completers will also anticipate and attend to students' prior knowledge, problem solving approaches, mathematical practices, dispositions, mathematical identity, and mathematical communication.

- use formative-assessment techniques (10 or more) to evaluate students' thinking during classroom activities and assess students' progress towards mastery of the learning outcomes in each lesson; reflect on implemented lessons and provide suggestions to improve future implementations to address gaps or needs identified from the formative assessment data, including but not limited to determining appropriate delivery of instruction based on identified student need; and to select appropriate tasks to reinforce and promote students' development of concepts and skills.
- apply evidence-based classroom management techniques (e.g., establishing rules and routines, utilizing praise and rewards, consistently disciplining misbehavior, and engaging students) to create a positive learning environment (e.g., acceptable learning behaviors and maximizing time on task.).
- create engaging learning environments that are effective for all students by providing access, support, and challenge for every student as well as differentiating instruction to meet the needs of all students.
- identify lessons that are well designed to build students' reading, writing, speaking and listening with science or mathematics classes.
- engage in professional behavior expected of new teachers including o appropriate dress, o attendance and professional commitments, o teacher presence/appropriate boundaries (specifically, can describe the difference between being a student's teacher and being their friend), o respectful collaboration (even if do not agree), o professional initiative, and o student confidentiality related to both academic performance and personal lives.
- learn about their individual school context, policies and practices and through reflection on prior field experiences have an appreciation for different school cultures and understand that these are shaped by the school's teachers, administrators, parents, students and community in which it is situated.
- provide proactive, clear and constructive feedback to families about student progress and develop a library of mechanisms to work collaboratively with the families and significant adults in the lives of their students.
- • reflect on their practice and use this reflection to set goals for further growth.
- write standards-based lesson plans that include measurable learning objectives, applicable Colorado Content Standards, required materials, safety considerations, an outline of the lesson scaffolded with the five E's (engage, explore, explain, elaborate and evaluate) or other learning cycle model, accommodations, formative assessment and subject integration.

MAED465. CAPSTONE CURRICULUM DESIGN II. 6-12 Semester Hr.

This course provides Mines students an intensive teaching experience in a K-12 mathematics or computer science classroom. The goal of this course is for the student to develop and demonstrate competencies in the areas of planning, instructional methods, assessments, creating effective learning environments for all learners, classroom management and organization, content knowledge, and professionalism. In addition to a total of 15 hours of seminars (on campus and teacher professional development), there is a 32-hour per credit hour enrolled field experience requirement in the students assigned partner school. During this semester, the student will be responsible for planning and teaching at least five periods of classroom instruction for each 3 credit hours enrolled as well as participate in other school related professional roles and will develop a mini-work sample (min-unit of instruction including: description of setting, learning objectives, three class periods or more of standardsbased lesson plans, pre/post assessment, and reflection). Prerequisite: Completed MAED 464; completed/concurrent with SCED 333, SCED 363, MAED 405, and MAED 425. Corequisite: Completed/concurrent with SCED 333, SCED 363, MAED 405, and MAED 425.

Course Learning Outcomes

- · utilize research-based instructional techniques that have been shown to be effective across context, including pairing graphics with words, linking abstract concepts with concrete representations, asking probing questions, repeatedly alternating solved and unsolved problems, distributed practice and assessment to boost retention.
- • identify, adapt, or develop lessons using a core set of pedagogical practices that are effective for developing students' meaningful learning of mathematics or computer science which include establishing goals, promoting reasoning and problem solving, connecting mathematical representations, meaningful discourse, purposeful questions, procedural fluency based on conceptual understanding, and productive struggle. While planning lessons program completers will also anticipate and attend to students' prior knowledge, problem solving approaches, mathematical practices, dispositions, mathematical identity, and mathematical communication.
- · use formative-assessment techniques (10 or more) to evaluate students' thinking during classroom activities and assess students' progress towards mastery of the learning outcomes in each lesson; reflect on implemented lessons and provide suggestions to improve future implementations to address gaps or needs identified from the formative assessment data, including but not limited to determining appropriate delivery of instruction based on identified student need; and to select appropriate tasks to reinforce and promote students' development of concepts and skills.
- • apply evidence-based classroom management techniques (e.g., establishing rules and routines, utilizing praise and rewards, consistently disciplining misbehavior, and engaging students) to create a positive learning environment (e.g., acceptable learning behaviors and maximizing time on task.).
- · · create engaging learning environments that are effective for all students by providing access, support, and challenge for every student as well as differentiating instruction to meet the needs of all students.
- · · identify lessons that are well designed to build students' reading, writing, speaking and listening with science or mathematics classes.
- engage in professional behavior expected of new teachers including o appropriate dress, o attendance and professional commitments, o teacher presence/appropriate boundaries (specifically, can describe the difference between being a student's teacher and being their friend), o respectful collaboration (even if do not agree), o professional initiative, and o student confidentiality related to both academic performance and personal lives.
- · · learn about their individual school context, policies and practices and through reflection on prior field experiences have an appreciation for different school cultures and understand that these are shaped by the school's teachers, administrators, parents, students and community in which it is situated.
- · · provide proactive, clear and constructive feedback to families about student progress and develop a library of mechanisms to work

collaboratively with the families and significant adults in the lives of their students.

MAED505. MATHEMATICAL PRACTICES AND THE SOCIAL **CONTEXT OF MATHEMATICS. 3.0 Semester Hrs.** n/a.

Course Learning Outcomes

- nurture development of mathematical processes and practices. They anticipate how students' use of mathematical practices will look and sound within specific grade-band mathematical topics, knowing that over years of experience, their knowledge of students' ways of using mathematical practices will expand to more mathematical topics.
- · identify, adapt, or develop lessons that explicitly teach mathematical process and practices demonstrating these as tools use to solve problems and communicate ideas.
- · demonstrate that doing mathematics is a sense-making activity that promotes perseverance, problem posing, and problem solving.
- · provide examples and connections for students to see that mathematics is a human endeavor that is practice in and out of school, across many facets of life.
- integrate the history of mathematics into content and share contributions from people with different gender and cultural, linguistic, religious, and racial/ethnic backgrounds.
- articulate how mathematics is based on constructed conventions and agreements about the meanings of words and symbols, and these conventions vary; algorithms considered as standard in the United States different from algorithms used in other countries.
- cultivate their students' mathematical identity by helping students realize the usefulness of mathematics by providing connections to students' everyday lives and building their students mathematics self-efficacy by encouraging hard work from every student and demonstrating the belief that every student is capable of learning and using mathematics
- · identify and implement practices that draw on students' mathematical, cultural, and linguistic resources/strengths and challenge practices grounded in deficit-based thinking.
- select, adapt, or develop lessons that explicitly engage students the mathematical practices defined in the Colorado Academic Standards and Common Core in mathematics.
- identify, adapt, or develop lessons that reflect the interconnectedness of content areas/disciplines to help erase the disciplinary lines and reflect authentic situations.
- · create a mini-unit (3 days or more) that explicitly teaches some aspect of mathematical practices or the social context of mathematics.
- · clearly articulate their mathematical ideas in writing. o analyze text based on occasion, audience, form and function. o compose one page reflections with an awareness about introductions, conclusions and topic sentences. o articulate the process of and compose with an awareness about the composing process which is an iterative process of formulation, composition and revision. o incorporate and cite correctly all evidence used to support a text's claim/s.
- clearly articulate their mathematical ideas verbally. o delineate effective characteristics of multi-media presentations. o articulate mathematical practices in a way that secondary students can understand and be motivated to explore these practices. o collaborate with others towards giving and receiving feedback on both

oral and written work about teaching mathematics as a community of inquiry.

MAED525. PRE-ALGEBRA AND ALGEBRA TEACHING TECHNIQUES. 3.0 Semester Hrs.

In this course teacher candidates will be exposed to evidencebased instructional practices to support students? learning of prealgebra and algebra and model meaningful learning opportunities, common misconceptions and ways of thinking, and students? learning progressions (i.e., content trajectory). The goal of this course is for teacher candidates is to develop an awareness of 1) the common misconceptions and learning progressions associated with pre-algebra and algebra; 2) students learning progressions in pre-algebra and algebra, and 3) evidence-based and meaningful instructional strategies for pre-algebra and algebra. The teacher candidate analyzes conceptual algebra underpinnings, common misconceptions, and students' ways of thinking to create opportunities to learn.

Course Learning Outcomes

- plan at least the first month of instruction for a middle or high school pre-algebra or algebra course using standards-based lessons experienced in this course.
- construct and evaluate mathematical conjectures and argument to validate one's own mathematical thinking.
- identify and develop lessons that are designed to build students knowledge as defined in the Colorado Academic Standards in mathematics and literacy. Candidates will be able to articulate the scope of the above standards related to the content knowledge necessary for teaching 7-12 students.
- describe mathematical ideas, using every day and mathematical language, in both verbal and written formats.

MAED562. K-12 FIELD EXPERIENCE AND BUILDING STUDENT RELATIONSHIPS. 1-3 Semester Hr.

This course is designed to provide Mines students with opportunities to participate in, analyze, and reflect on issues in a mathematics or computer science K-12 school classroom setting. The overall goal is for Mines students to understand who their students are, build relationships, and begin exploring learner development and learner differences. Specifically, the course will focus on developing Mines students? ability to identify and practice basic classroom management, differentiate instruction, ask probing questions, mathematics or computer science content preconceptions, language/activities that promote a growth mindset, and professional language. Furthermore, Mines students will begin exploring the factors that shape school norms and culture. In addition to an on-campus seminar, there is a 25-hour field experience requirement in the student?s assigned partner school. **Course Learning Outcomes**

- identify and provide examples of differentiated instruction.
- identify and provide examples of formative-assessment techniques used to evaluate what students are thinking during classroom activities
- articulate the value of reflecting on their practice.
- explain different levels of questioning and how to ask probing questions as well as provide examples of how to use these types of questioning.
- articulate reasons for, ways to, and examples of how they built relationships with each and every student in their classroom.

- articulate and document the mathematics or computer science content specific preconceptions that they observed students demonstrate during the field placement.
- · identify the school policies and practices of their field placement.
- identify factors that shaped the culture and norms of the school they experienced.
- communicate effectively, model appropriate use of language (e.g., use of proper grammar, use of professional language, and use of discipline-specific vocabulary), and identify unprofessional language.
- articulate the critical role of high ethical standards, including a belief in being committed to displaying ethical conduct towards students, performance and the profession, colleagues, and parents and the community.
- recognize that with quality instruction and hard work, all students are capable of learning science and mathematics; use language, activities and feedback that is consistent with a growth mindset.

MAED564. CAPSTONE CURRICULUM DESIGN I. 3.0 Semester Hrs.

This course provides Mines students an intensive teaching experience in a K-12 mathematics or computer science classroom. The goal of this course is for the student to develop and demonstrate competencies in the areas of planning, instructional methods, assessments, creating effective learning environments for all learners, classroom management and organization, content knowledge, and professionalism. In addition to a total of 15 hours of seminars (on campus and teacher professional development), there is an approximately 6 hours per week (100-hours total) field experience requirement in the student?s assigned partner school. During this semester, the student will be responsible for planning and teaching at least five periods of classroom instruction as well as participate in other school related professional roles and will develop a mini-work sample (min-unit of instruction including: description of setting, learning objectives, three class periods or more of standardsbased lesson plans, pre/post assessment, and reflection).. Prerequisites: Completed/concurrent 3 credits of SCED 562; completed/concurrent with MAED 505 or MAED 525. Corequisites: Completed/concurrent 3 credits of SCED 562; completed/concurrent with MAED 505 or MAED 525. **Course Learning Outcomes**

- utilize research-based instructional techniques that have been shown to be effective across context, including pairing graphics with words, linking abstract concepts with concrete representations, asking probing questions, repeatedly alternating solved and unsolved problems, distributed practice and assessment to boost retention.
- identify, adapt, or develop lessons using a core set of pedagogical practices that are effective for developing students' meaningful learning of mathematics which include establishing goals, promoting reasoning and problem solving, connecting mathematical representations, meaningful discourse, purposeful questions, procedural fluency based on conceptual understanding, and productive struggle. While planning lessons program completers will also anticipate and attend to students' prior knowledge, problem solving approaches, mathematical practices, dispositions, mathematical identity, and mathematical communication.
- use formative-assessment techniques (10 or more) to evaluate students' thinking during classroom activities and assess students' progress towards mastery of the learning outcomes in each lesson; reflect on implemented lessons and provide suggestions to improve future implementations to address gaps or needs identified from the formative assessment data, including but not limited to determining appropriate delivery of instruction based on identified student need;

and to select appropriate tasks to reinforce and promote students' development of concepts and skills.

- apply evidence-based classroom management techniques (e.g., establishing rules and routines, utilizing praise and rewards, consistently disciplining misbehavior, and engaging students) to create a positive learning environment (e.g., acceptable learning behaviors and maximizing time on task.).
- create engaging learning environments that are effective for all students by providing access, support, and challenge for every student as well as differentiating instruction to meet the needs of all students.
- identify lessons that are well designed to build students' reading, writing, speaking and listening with science or mathematics classes.
- engage in professional behavior expected of new teachers including o appropriate dress, o attendance and professional commitments, o teacher presence/appropriate boundaries (specifically, can describe the difference between being a student's teacher and being their friend), o respectful collaboration (even if do not agree), o professional initiative, and o student confidentiality related to both academic performance and personal lives.
- learn about their individual school context, policies and practices and through reflection on prior field experiences have an appreciation for different school cultures and understand that these are shaped by the school's teachers, administrators, parents, students and community in which it is situated.
- provide proactive, clear and constructive feedback to families about student progress and develop a library of mechanisms to work collaboratively with the families and significant adults in the lives of their students.
- reflect on their practice and use this reflection to set goals for further growth.
- write standards-based lesson plans that include measurable learning objectives, applicable Colorado Content Standards, required materials, safety considerations, an outline of the lesson scaffolded with the five E's (engage, explore, explain, elaborate and evaluate) or other learning cycle model, accommodations, formative assessment and subject integration.

MAED565. CAPSTONE CURRICULUM DESIGN II. 6-12 Semester Hr.

This course provides Mines students an intensive teaching experience in a K-12 mathematics or computer science classroom. The goal of this course is for the student to develop and demonstrate competencies in the areas of planning, instructional methods, assessments, creating effective learning environments for all learners, classroom management and organization, content knowledge, and professionalism. In addition to a total of 15 hours of seminars (on campus and teacher professional development), there is a 2 hours per week (32-hours total) per credit hour enrolled field experience requirement in the student?s assigned partner school. During this semester, the student will be responsible for planning and teaching at least five periods of classroom instruction for each 3 credit hours enrolled as well as participate in other school related professional roles and will develop a mini-work sample (minunit of instruction including: description of setting, learning objectives, three class periods or more of standards-based lesson plans, pre/post assessment, and reflection). Prerequisites: Completed MAED 564; completed/concurrent with SCED 333, SCED 363, MAED 505, and MAED 425. Corequisites: Completed/concurrent with SCED 333, SCED 363. MAED 505. and MAED 425.

Course Learning Outcomes

- utilize research-based instructional techniques that have been shown to be effective across context, including pairing graphics with words, linking abstract concepts with concrete representations, asking probing questions, repeatedly alternating solved and unsolved problems, distributed practice and assessment to boost retention.
- identify, adapt, or develop lessons using a core set of pedagogical practices that are effective for developing students' meaningful learning of mathematics or computer science which include establishing goals, promoting reasoning and problem solving, connecting mathematical representations, meaningful discourse, purposeful questions, procedural fluency based on conceptual understanding, and productive struggle. While planning lessons program completers will also anticipate and attend to students' prior knowledge, problem solving approaches, mathematical practices, dispositions, mathematical identity, and mathematical communication.
- use formative-assessment techniques (10 or more) to evaluate students' thinking during classroom activities and assess students' progress towards mastery of the learning outcomes in each lesson; reflect on implemented lessons and provide suggestions to improve future implementations to address gaps or needs identified from the formative assessment data, including but not limited to determining appropriate delivery of instruction based on identified student need; and to select appropriate tasks to reinforce and promote students' development of concepts and skills.
- apply evidence-based classroom management techniques (e.g., establishing rules and routines, utilizing praise and rewards, consistently disciplining misbehavior, and engaging students) to create a positive learning environment (e.g., acceptable learning behaviors and maximizing time on task.).
- create engaging learning environments that are effective for all students by providing access, support, and challenge for every student as well as differentiating instruction to meet the needs of all students.
- identify lessons that are well designed to build students' reading, writing, speaking and listening with science or mathematics classes.
- engage in professional behavior expected of new teachers including o appropriate dress, o attendance and professional commitments, o teacher presence/appropriate boundaries (specifically, can describe the difference between being a student's teacher and being their friend), o respectful collaboration (even if do not agree), o professional initiative, and o student confidentiality related to both academic performance and personal lives.
- learn about their individual school context, policies and practices and through reflection on prior field experiences have an appreciation for different school cultures and understand that these are shaped by the school's teachers, administrators, parents, students and community in which it is situated.
- provide proactive, clear and constructive feedback to families about student progress and develop a library of mechanisms to work collaboratively with the families and significant adults in the lives of their students.