

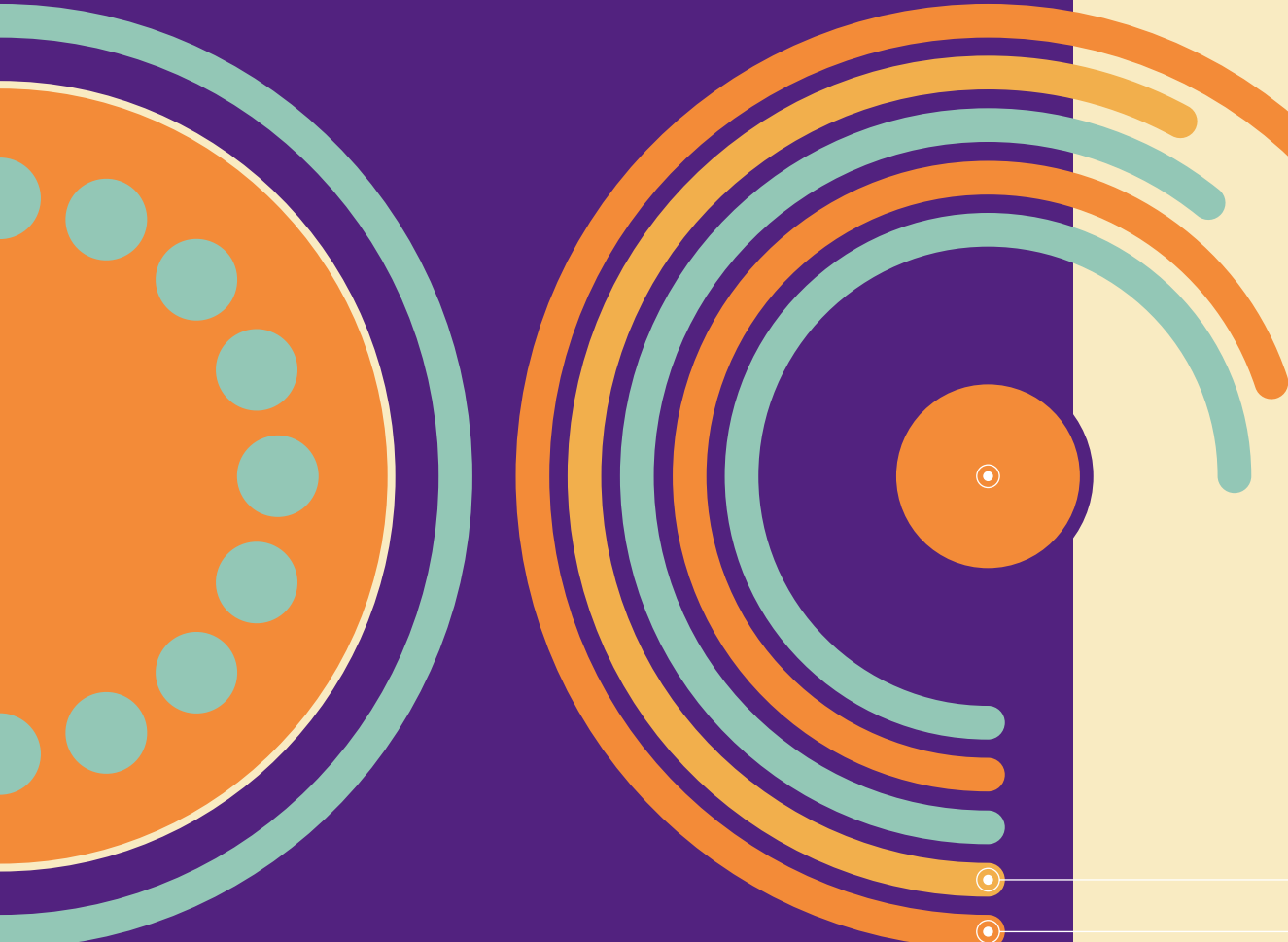
MAKING SENSE OF MATHEMATICS AND TEACHING

PROFESSIONAL DEVELOPMENT

K-8



MAKING SENSE OF MATHEMATICS AND TEACHING



Making Sense of Mathematics and Teaching professional development courses are offered through the Center for Teaching and Learning Mathematics at the University of Northern Iowa. These courses provide innovative mathematical professional development designed to directly improve teacher practice and enhance student learning.

Our courses are designed to deepen elementary and middle school teachers' understanding of mathematical concepts and to support their implementation of research-based teaching strategies. UNI faculty and mathematics consultants provide content and pedagogical expertise to further participants' growth as mathematics educators.

All courses are aligned with the Common Core State Standards for Mathematics, including both content and practice.

FOUNDATIONAL RESEARCH

Making Sense of Mathematics and Teaching courses reflect the importance of effective and innovative mathematics instruction and the positive impact felt by students who are taught by highly effective and capable teachers.

Five significant bodies of research provided the foundation for the original concept of these courses. This same research continues to guide course development. The courses are intended to improve mathematics instruction and ultimately impact student achievement:

Teacher outcomes:

- Improved mathematical content knowledge
- Improved instruction based on the Standards for Mathematical Practice
- Reflection upon beliefs about the way students learn mathematics

Student outcomes:

- Development of a deeper understanding of mathematics
- Increased use of the Standards for Mathematical Practice
- Improved achievement in mathematics

Mathematical Knowledge for Teaching (MKT) includes an emphasis on both mathematics content knowledge and pedagogical knowledge. MKT is concerned with knowing mathematics from the perspective of helping others to learn it, and includes being mathematically ready to teach an idea, method, or other aspect (Thames and Ball, 2010).

Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important processes and proficiencies with longstanding importance in mathematics education (Common Core State Standards for Mathematics, 2011).

Learning Mathematics with Understanding encompasses conceptually-based, problem-centered instruction that focuses on student thinking (Hiebert, 1997 and Van de Walle et al., 2014).

Change Theory helps our course developers, facilitators, and participants to understand that improving quality instruction requires a healthy attitude and understanding about change principles (Hall and Hord, 2006).

Iowa Professional Development Model focuses on curriculum, instruction, and assessment, as well as participative decision making, instructional leadership, and simultaneity (Iowa Department of Education, 2011).



COURSE OFFERINGS

Making Sense of Numbers (MSN) is the foundational course with content focused on the base ten structure of our number system. The implementation focus is on routines that help children develop ways to represent numbers, relationships among numbers, and number systems (Shumway, 2011, 2018).

Making Sense of Operations (MSO) focuses on the four basic operations (addition, subtraction, multiplication, and division) for whole and rational numbers. The implementation focus is on brief number talks that help students to build mental math and computation strategies (Parrish, 2014, 2016).

Making Sense of Geometry (MSG) centers on two- and three-dimensional shapes and their properties. The implementation focus is problem-based instruction using three-phase student-centered lessons (Van de Walle, et al., 2018) and orchestrating mathematical discussions (Smith and Stein, 2019).

Making Sense of Measurement (MSM) focuses on ways to measure one-, two-, and three-dimensional attributes, develop connections among them, and make sense of standard formulas. The implementation focus is on classroom discussion that supports students in reasoning mathematically and communicating that reasoning (Chapin, et al., 2013).

Making Sense of Rational Numbers (MSRN) focuses on unit fractions, equivalent fractions, and decimal notations. The implementation focus is on five formative assessment strategies with emphasis on clarifying learning goals, measuring learning goals, and eliciting evidence of learning (Wiliam, 2018).

Making Sense of Algebraic Thinking (MSAT) connects the generalization of the four basic operations to various expressions. The implementation focus is on five formative assessment strategies with emphasis on providing feedback that moves learning forward and activating learners in assessing their own and others' learning (Wiliam, 2018).

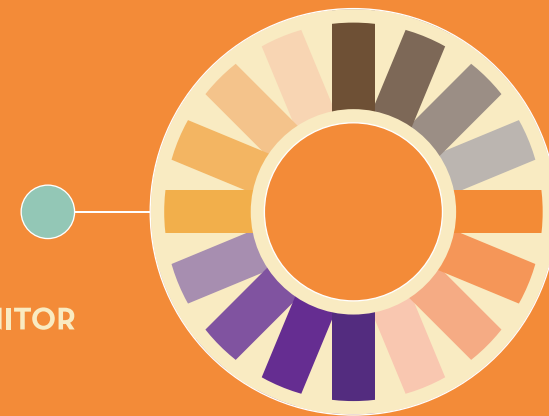
Making Sense of Data, Statistics, and Probability (MSDSP) focuses on data and statistics in the Common Core State Standards. The implementation focus is on classroom discussion with an emphasis on supporting students in making their thinking visible, and on knowing how to engage students in productive talk (Kazemi & Hintz, 2014).

Making Sense of Programming (MSP) focuses on the structure of programming and the study of several programming environments which can be used by students at a variety of ages and ability levels. The course will also include discussion of current core standards in the teaching of programming. The implementation focus is on implementing programming across the curriculum.

PARTICIPANT EXPECTATIONS

The *Making Sense of Mathematics and Teaching* courses provide hands-on professional development opportunities for teachers. To achieve the outcomes of our professional development, the following teacher actions have been strategically incorporated into the courses:

- DO** mathematics
- STUDY** theories
- EXPERIENCE** models
- REHEARSE** instruction
- IMPLEMENT** purposefully
- REFLECT** on practice
- COLLABORATE** with peers
- SELF-ASSESS** and **SELF-MONITOR**
- ANALYZE** evidence
- USE** student data



PROJECT EVALUATION

Evaluation for the *Making Sense of Mathematics and Teaching* courses is ongoing, yielding positive outcomes that directly impact teachers. Results from the Teacher Knowledge Assessment System measures reveal statistically significant increases in teacher content knowledge pre to posttest. The instructional strategies that teachers learn during the courses are implemented in the mathematics classroom. Teachers report a high level of overall satisfaction with the courses.

Course evaluation instruments include:

- Teacher Knowledge Assessment System (Hill and Ball, et al., 2007)
- Concerns-Based Adoption Model (Hall and Hord, 2006), specifically Innovation Configuration Maps
- Mathematics Teaching Efficacy Beliefs Instrument (Enochs, Smith, & Huinker, 2000)
- Course Evaluations



MAKING SENSE OF MATHEMATICS AND TEACHING MODEL FOR PROFESSIONAL DEVELOPMENT

The following model applies to the series of eight *Making Sense of Mathematics and Teaching* courses.

COURSE STRUCTURE	FOCUS	COURSEWORK	INTENDED OUTCOMES	MEASUREMENT MECHANISM
<p>36 clock hours of face-to-face instruction</p> <p>(12 half-day sessions or six full-day sessions)</p>	<ol style="list-style-type: none"> 1. Learn mathematics through the lens of Mathematics Knowledge for Teaching 2. Learn about and observe models of instructional strategies 3. Plan and rehearse effective mathematics instruction 	<ol style="list-style-type: none"> 1. Study theory (i.e. Developing Mathematical Ideas, articles, other resources) 2. Do mathematics (i.e. Routines, three-phase lessons) 3. Talk about mathematics and develop mathematical vocabulary 4. Reflect on their own thinking, student thinking, and their instruction 5. Process tasks (teachers experience mathematics as a learner and reflect on mathematics as a teacher) 	<ol style="list-style-type: none"> 1. Increased Mathematical Knowledge for Teaching 2. Increased ability to reflect upon practice 3. Deepened understanding of models of effective instruction 4. Changed teacher beliefs about the way students learn mathematics 	<ol style="list-style-type: none"> 1. Teacher Knowledge Assessment System 2. Mathematics Teaching Efficacy Beliefs Instrument 3. Course evaluation
<p>15 clock hours of online sessions and job-embedded implementation of instructional strategies</p> <p>(five online sessions with a minimum of two weeks between sessions for classroom implementation and reflection)</p>	<ol style="list-style-type: none"> 1. Implement instructional strategies 2. Reflect on implementation 3. Build professional learning communities 	<ol style="list-style-type: none"> 1. Implement effective classroom instruction 2. Self-assess instruction and self-monitor learning 3. Analyze evidence of student thinking 4. Use student data to guide instruction 5. Reflect upon the implementation of instructional strategies through online assignments and discussion boards 6. Collaborate with colleagues and other educators 	<ol style="list-style-type: none"> 1. Increased Mathematical Knowledge for Teaching 2. Increased ability to reflect upon practice 3. Deepened understanding of models of effective instruction 4. Changed teacher beliefs about the way students learn mathematics 	<ol style="list-style-type: none"> 1. Analysis of online assignments and discussion board posts 2. Analysis of video recorded lessons using an Innovation Configuration Map 3. Analysis of student achievement data

CTLM CENTER FOR TEACHING AND
LEARNING MATHEMATICS

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