SED 419/519: Teaching Mathematical Modeling in STEM

**Instructor:** Dr. Eric Weber  
**Meetings:** This class meets twice per week for 80 minutes per session.  
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**Phone:** 541-737-1305

**Prerequisites:** Participants should be a prospective pre-service teacher at any level, a K-12 teacher, (a) free-choice learning educator, (or) have access to an educational setting.

**Course Description:** Provides students an overview of the content requirements in the Common Core Standards for Mathematics and the teaching practices that are central to those standards with a focus on the role of mathematical modeling. Students experience content lessons and lessons focused on supporting students in developing understanding of that content.

**Course Objectives:** Upon completion of this course, you will have-

1. Gained an understanding of the content requirements of mathematical modeling in the Common Core Mathematics standards for students.
2. Developed an understanding of how mathematical modeling fits within the Common Core Mathematics Standards.
3. Gained an understanding of the practices associated with the Common Core Standards for Mathematics with a particular focus on students’ modeling.
4. Developed proficiency at understanding how to use the practices to support students’ understanding of the content in the Common Core Mathematics Standards.
5. Developed lesson plans consisting of content and practices that support students’ understanding of content for each strand in the Common Core Mathematics Standards.

**Course Content**

**Articles and Readings**


### Course Schedule

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topic</th>
<th>Weeks</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Understanding the Structure and Practices in the Common Core Standards</td>
<td>1</td>
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<tr>
<td>2</td>
<td>What is a Learning Environment?</td>
<td>1</td>
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<tr>
<td>3</td>
<td>Understanding Modeling in the Classroom and in Research</td>
<td>1</td>
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<tr>
<td>4</td>
<td>Content Area 1: Proportionality</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Content Area 2: Rate of Change</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Content Area 3: Functions</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Applied Lab: Construction of Lessons and Learning Environments</td>
<td>1</td>
</tr>
</tbody>
</table>

### Student Learning Outcomes

For students enrolled in SED 412:
a) Increased content knowledge about functions, rate of change, and proportionality.
b) Increased knowledge about effective practices in designing learning environments for students.
c) Experience with understanding the Common Core Standards’ mathematical practice suggestions.
d) Experience with understanding the role of modeling in the Common Core Standards.
e) The ability to construct effective learning environments for students by focusing on modeling.

For students enrolled in SED 512, the outcomes in 412 are expected in addition to the following learning outcomes:

a) Experience in leading groups of prospective teachers in both using cutting edge technology and implementing it into the classroom.
b) Experience in implementing a technology lesson in an actual classroom of middle or high school students and using that experience to refine the lesson.
c) Completion of all assignments at graduate level competence.

**Assignments**

1. 10% In-class performance
2. 20% Content Exams (2)
3. 20% Lesson Plans (2)
4. 20% Modeling assignments
5. 30% Final project

**1. In class performance:** A large part of this class will be spent on in-class discussion. There are many ways to make the discussion productive. For example, take notes while you read the textbook or other reading materials and bring them to class. It is useful to record page numbers of certain contents to make references during discussion. Your performance in class will be observed and evaluated. Some artifacts produced in class may be collected for evaluation.

**2. Content Exams:** Content knowledge is foundational to your ability to design effective learning environments to support students in developing ways of thinking about mathematics. These two content exams evaluate basic knowledge necessary for mathematical modeling. The first exam covers areas such as quantitative reasoning and functions. The second exam covers areas such as proportionality and rate of change. These exams may appear in any order depending on the expertise of the students in the course. Together, the exams comprise an evaluation of foundational content knowledge for mathematical modeling.

**3. Lesson Plans:** The core of the course is your transition from mastering content knowledge to developing learning environments to support students’ ways of thinking about those same ideas. In this pursuit, you will design two lesson plans, each centered on a way of thinking you want students to develop. The way of thinking must be central to the Common Core Standards, and must address mathematical modeling in some way. The lesson plan will demonstrate all aspects of the learning environment you intend to use (e.g. demonstrations, calculators), moves you anticipate making in the
classroom (e.g. forming students into groups), and how you will evaluate if students are thinking in the ways you anticipate. You will build on one of these two lessons to create your final project, which consists of a number of lessons linked together.

4. Modeling Assignments: You will be presented with a new problem (or two) to model. You are required to make your best attempt at solving the problem(s) in class. Following class, you are required to do a formal lab write-up of your model. To help you, you may use any thinking tools you could conceivably use in a middle school classroom (calculators, computers, graphs, tables and formulas, etc.). Most importantly, you must analyze your own thinking process in coming up with your solution. Your analysis must address the following points:

1. A description of the relationship you are attempting to model
2. A description of the methods you used to model the relationship
3. The problem solution presented in a general form (e.g., a rule, procedure, or symbolization).
4. An analysis of why your problem solution is correct (e.g., the logical structure behind the rule, procedure, or symbolization that you could use to solve new, similar problems).
5. Any difficulties you had in conceptualizing the problem, collecting and analyzing data, or coming up with a solution.

These analyses are due the following class meeting.

5. Final Project: This project has two parts:

a) A conceptual analysis consists of proposing a particular mathematical or scientific idea, and describing the understandings and ways of thinking that allow a student to think about that idea in a coherent way. You will select an idea in mathematics or science. Be sure to run the idea by me to make sure it is at an appropriate grain level for this project. You will describe the idea and the ways of thinking that a student would need to have to think about it in a coherent way. This portion of the project is crucial. Be sure that you carefully think about the ways of thinking you propose. I suggest you consult other members of the class for help, and if you have further questions, please talk to me.

b) The second part of the project consists of designing a lesson that must include a technology component. This lesson (or set of lessons) will focus on supporting students in developing the ways of thinking you proposed in your conceptual analysis. The lesson must be detailed enough that another teacher could recreate it without needing to consult you. You must explain how the use of technology in the lesson facilitates a productive learning environment. Think back to your vignette: Which type of lesson are you creating, and how does the use of technology support the development of particular ways of thinking for your students?

Evaluation for SED 419

Professional Attitudes: You are expected to exhibit professional attitudes by:
1. Attending all class sessions for full length of course and being on time. Those who attend all class sessions make significant contributions in class, and turn in all assignments on time will receive the benefit of doubt for borderline grades. Contact the instructor in case of illness or emergencies that preclude attending class sessions.

2. Completing all assignments and turn them in on time. All assignments must be submitted on or before the due date. Unless other arrangements are made ahead of time, late assignments are not accepted.

3. Putting the maximum amount of effort into the class. Please discuss conflicts with the instructor.

4. Demonstrating academic integrity: You are responsible for making yourself aware of OSU Academic Regulations (http://catalog.oregonstate.edu/ChapterDetail.aspx?key=75#Section2883) that pertain to Academic Integrity (AR 15. Honesty in academic work). Academic dishonesty includes cheating, fabrication, falsification and forgery, multiple submission, plagiarism, complicity and computer misuse.

Grades: “The grading system consists of twelve basic grades, A, A-, B+, B, B-, C+, C, C-, D+, D, D-, and F” (AR 17). Letter grades will be weighted as listed below. The following are brief definitions I attach to letter grades.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Percentage Range</th>
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<tbody>
<tr>
<td>A</td>
<td>exceptional performance (89.5 percent or greater)</td>
<td>(89.5 percent or greater)</td>
</tr>
<tr>
<td>B</td>
<td>above average performance (80 to 89.4 percent)</td>
<td>(80 to 89.4 percent)</td>
</tr>
<tr>
<td>C</td>
<td>average performance (69.5 percent to 79.4 percent)</td>
<td>(69.5 percent to 79.4 percent)</td>
</tr>
<tr>
<td>D</td>
<td>serious deficiencies, but work completed (59.5 percent to 69.4 percent)</td>
<td>(59.5 percent to 69.4 percent)</td>
</tr>
<tr>
<td>F</td>
<td>work not completed (less than 59.5 percent)</td>
<td>(less than 59.5 percent)</td>
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Extensions: Students may request an extension or an incomplete because of illness or extenuating circumstances if they have been doing acceptable work prior to the request. The instructor will define the requirements and timelines to complete the course. Note: Instructors are not obligated to give extensions.

Withdrawal: The OSU policy for students’ withdrawal requests is governed by OSU policies that you can find at http://oregonstate.edu/registrar/dropwithdraw-course

**Evaluation for SED 519**

To complete the course, students in SED 519 must also demonstrate that they have completed the following two items with a grade of “passing”.

1) Experience in leading groups of prospective teachers in both using cutting edge technology and implementing it into the classroom. The SED 519 students will document at least two activities in which they led groups of prospective teachers in using technology in the classroom. At least one of these activities must occur outside of Oregon State University.
2) Experience in implementing a technology lesson in an actual classroom of middle or high school students and using that experience to refine the lesson. The cooperating teacher will provide documentation that the lesson was completed in satisfactory manner.

The expectations for professional attitudes are the same as required for SED 419 students. The grading system reflects the increased standards expected of students in SED 519.

**Grades:** “The grading system consists of twelve basic grades, A, A-, B+, B, B-, C+, C, C-, D+, D, D-, and F” (AR 17). Letter grades will be weighted as listed bellow. The following are brief definitions I attach to letter grades.

- **A** exceptional performance (93 percent or greater)
- **B** above average performance (83 to 92.9 percent)
- **C** average performance (73 percent to 82.9 percent)
- **D** serious deficiencies, but work completed (63 percent to 72.9 percent)
- **F** work not completed (less than 63 percent)

**Learning Resources**

- Global Climate Change: [http://climate.nasa.gov/](http://climate.nasa.gov/)
Google Scholar: http://scholar.google.com/schhp?hl=en&tab=ws To search for resources relevant to a topic of interest or by a particular author, type keyword or author’s name into the search box and click on “search” (See also electronic databases under Oregon State University Library)


National Council of Teachers of Mathematics (NCTM): http://www.nctm.org


National Science Teachers Association: http://www.nsta.org

National Weather Service: http://www.weather.gov/

NOAA Education: http://www.education.noaa.gov/tweather.html

Oregon Academy of Science: http://www.oas.pdx.edu/

Oregon Council of Teachers of Mathematics: http://www.octm.org

Oregon Science Teachers Association: http://www.oregonscience.org

Oregon State Department of Education Standards for Mathematics: http://www.ode.state.or.us/search/results/?id=20

Oregon State Department of Education Standards for Science: http://www.ode.state.or.us/search/results/?id=22

Science Education Resource Center: http://serc.carleton.edu/index.html

The National Science Digital Library: http://nsdl.org/

The State of Technology: http://www.thestateoftech.org/

**Important Notices**

**Academic Integrity:** Students are expected to comply with all regulations pertaining to academic honesty, defined as: An intentional act of deception in which a student seeks to claim credit for the work or effort of another person or uses unauthorized materials or fabricated information in any academic work. For further information, visit Avoiding Academic Honesty, or contact the office of Student Conduct and Media at 541-737-3656.
Plagiarism and Expectations for Student Conduct: You are expected to submit your own work in all your assignments, postings to the discussion board, and other communications, and to clearly give credit to the work of others when you use it. Academic dishonesty will result in a grade of “F.” Any student whose work indicates a violation of the OSU Academic Misconduct Policy (cheating, plagiarism), can expect penalties described in the Dean of Students’ website http://oregonstate.edu/admin/stucon/achon.htm

The following link provides information on writing in general and specific guidance on proper citation techniques. http://cwl.oregonstate.edu

Student with Disabilities: Accommodations are collaborative efforts between students, faculty and Disability Access Services (DAS). Students with accommodations approved through DAS are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through DAS should contact DAS immediately at 737-4098. http://oregonstate.edu/dept/budgets/genupol/gupdissu.htm

Expectations for Student Conduct: http://oregonstate.edu/admin/stucon/achon.htm