Research on Mathematical Knowing and Learning

Course number: MATH 5624  
Hours: 3 credit hours  
Time: Monday 4-7 pm  
Place: McBryde, Room 118  
Office Hours: M 2-3, T 10-12, H 10-12

Purpose: The purpose of this course is to investigate psychological and sociological foundations of mathematics and mathematical learning, and to investigate methods for building models of students’ mathematics.

Having successfully completed this course, you will be able to:

• Compare several perspectives on the epistemological foundations of mathematics, including radical constructivism, embodied cognition, and sociocultural theory;
• Compare several approaches to modeling students’ mathematical knowledge and learning;
• Conduct research on student learning in a mathematical domain that incorporates the following methods and principles
  • Building a theoretical framework for research questions that is based in existing literature;
  • Conducting clinical interviews and teaching experiments with students and classrooms;
  • Building models of the mathematical knowledge of students, classrooms, and cultures;
  • Reporting findings in a manner suitable for publication in a scholarly journal.

Texts:

You will be provided with additional articles related to mathematical knowing and learning from several other perspectives, including embodied cognition and sociocultural theory.

Major Assignments:
Practice Preliminary Exam (10%): Because this course is part of a mathematics preliminary exam sequence, you will be expected to write a paper answering questions similar to those appearing on the exam.
Hypertext (20%): Over the course of the semester, seminar participants will build a hypertext document of contrasting theoretical frameworks and relationships between
them. The document should incorporate readings from the seminar and will use hyperlinks to expand on ideas and to provide examples.

**Annotated Bibliography (20%)**: For each week’s reading and ahead of that week’s class meeting, you should record a complete reference for the reading along with a summary of the article. This summary (annotation) should focus on ideas in the reading that are most relevant to your research interests. You will need to maintain up-to-date drafts of your annotated bibliography in Scholar. Bibliographies will be evaluated periodically.

**Research Project (50%)**: The course will culminate in the completion of individual research projects, which will be supported throughout the semester with the following activities:

- Developing a research question focused on student learning within a particular mathematical domain;
- Building an annotated bibliography of existing, related research;
- Conducting clinical interviews with students or classes, at the appropriate grade level, and sharing evidence with the class;
- Completing a final paper, suitable for a presentation or journal, that reports your findings.

**Grades**: Final grades will be computed using the assignments and percentages reported above. The standard grade scale (e.g., A- as 90-92%) will be used.

**Tentative Schedule**:

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<tr>
<th>Week</th>
<th>Topic</th>
<th>Assignments Due</th>
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<tr>
<td>Jan 26</td>
<td>The unreasonable effectiveness of mathematics</td>
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<tr>
<td>Feb 2</td>
<td>Radical Constructivism</td>
<td>Read von Glasersfeld Chapters 1-3</td>
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<td>Feb 9</td>
<td>Practice Prelim</td>
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<td>Feb 16</td>
<td>Scheme Theory and Teaching Experiments</td>
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<td>Feb 23</td>
<td>The Reorganization Hypothesis</td>
<td>Read</td>
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<td>Mar 2</td>
<td>Reflective Abstraction</td>
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<td>Mar 16</td>
<td>Hypothetical Learning Trajectories</td>
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<td>Mar 23</td>
<td>APOS Theory</td>
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<td>Mar 30</td>
<td>Embodied Cognition</td>
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<td>Apr 6</td>
<td>Educational Neuroscience</td>
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<td>Apr 13</td>
<td>Educational Neuroscience</td>
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<td>Apr 20</td>
<td>Emergent Theories</td>
<td>Hypertext due</td>
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<td>Apr 27</td>
<td>Sociocultural Theories</td>
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<td>May 4</td>
<td>Integrating perspectives</td>
<td>Research Projects due</td>
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<tr>
<td>May 11</td>
<td>Exam Day: 7:45-9:45</td>
<td>Research Presentations (15 min) due</td>
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Readings: