M510: Problem solving for teachers

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Office Hours: Set up a time that's convenient for you at www.fapeck.com/meeting

Course webpage (Moodle): http://www.umonline.umt.edu

We are mathematicians.

We ask questions

We wonder about the world—the "real" world and the world of mathematics

We are sense-makers

We experience confusion, anxiety and joy

We create and use models, tools, and strategies to mathematize the world

We are teachers.

We approach pedagogical interactions as teacher-learners

We find the right models, tools, and strategies to help people learn

We seek to foster wonder, perplexity, and understanding

We're not afraid of a little confusion or anxiety

We treat all learners as people and promote their development as people

We are a community.
We are mathematicians.
We are teachers.

About the course

Mathematics is often conceptualized as a noun: a set of things to learn.

> In this course, we'll conceptualize mathematics as a *verb*:
> The human activity of problem solving.

We'll explore the implications of this "verb" perspective as *doers* and *teachers* of mathematics.

As *doers* of mathematics, we'll focus only on the verb. We're just going to do problem solving. There is no ulterior motive, no content to learn. Just problems to solve. This course is like desert.

As *teachers* of mathematics, we'll explore techniques for engaging students in problem solving, such that they learn mathematical content through problem solving. The focus is on practical techniques, derived from research in *real classrooms* with *real students*.

Learning outcome

The main outcome of the course is:

Participants will *develop* as mathematicians and teachers.

Development involves the acquisition of knowledgeable skill, but it's much bigger than acquiring content knowledge. Development involves *becoming* a member of a community, and thus it affects not simply what we know, but also who we are and how we see the world. Therefore, development cannot be reduced to an enumerated list of learning outcomes nor can it be standardized across participants.

We develop as members of a community as we participate in the practices of that community. Thus, rather than thinking about the course in terms of *outcomes* to be attained, it is better to think about the course in terms of *practices* to participate in. During the course, participants will:

(a) participate as a *member of a mathematical community*, including engaging in mathematical problem solving, argumentation, and critique; and

(b) participate as a *member of a teaching community*, including sharing and reflecting on your practices.

Course activities and deliverables

1. **Mathematical investigations and peer review:** The primary mathematical activity in the course will be 6 problem solving investigations. This involves:

   - Conduct an **investigation**. From a given starting point, develop and follow interesting questions. (~4 hours)
   - Produce a **write-up** of your findings that explains, to a mathematically-literate reader, what you investigated, what you found, and the mathematical reasoning behind your findings (~2 hours).
   - Provide **feedback** on a peer's investigation. Take time to understand their reasoning. Provide written feedback, including questions that you have (~2 hours).

   Notice the expectation that the investigation itself should take approximately 4 hours. These are not the typical "school-like" exercises that we expect to complete is 5-10 minutes. These are big, open landscapes that take a long time to investigate. As you engage in investigations, you should take the words on the front page of this syllabus to heart. Problem solving is a *human* activity, and thus engages all of our humanity. Don't be surprised to feel emotions like confusion, anxiety, and joy.

   More information about the expectations for investigations will be provided on the website.

   Deliverable: At the end of each module (by Sunday at midnight) you will submit your investigations to Moodle and to a peer for peer-review. You should return your peer review by the following Sunday.

2. **Portfolio**: After completing 3 investigations, you will revise your investigations in response to your peer reviews and assemble a portfolio of your two best investigations to submit for grading. Portfolio A will draw from investigations 1-3, and will be completed during Module 5. Portfolio B will draw from investigations 4-6, and will be completed during finals week.

   Deliverable: Portfolio A (over investigations 1-3) is due on Sun 11/03. Portfolio B (over investigations 4-6) is due on Fri 12/13. I will provide rubrics for portfolio grading.

3. **Pedagogical readings and discussion:** Each module contains pedagogical readings that describe techniques for teaching mathematics through problem solving. The research described in these readings is all done in real classrooms with real teachers and real students.

   You should expect approximately 30-50 pages of reading per module. We will discuss these readings on Moodle.

   Deliverable: Participate in the Moodle discussion(s) on the assigned reading

Feedback and Grading

Feedback

You should expect to receive the following feedback on your investigations:

- Peer review: Each week you will send your investigations to one peer for review. Your peer will provide feedback on your mathematical reasoning and communication. You will receive a peer review for each investigation.
- "In-progress" rating from Fred: The investigations won't be graded until they are submitted in the final portfolio. For each investigation, I'll give you an "in progress" rating, based on how the investigation meets the expectations of the final portfolio. These ratings will not be recorded as grades, but they should give you a sense for how the investigation would be graded as part of the final portfolio. I will provide detailed guidelines and rubrics for the portfolio.

Grading

You grade is based on the following:

- **Participation in mathematical practices 60%:** This will be assessed using weekly self-assessments. At the end of each week, you will complete a brief self-assessment, in which you assess the extent to which you participated in the class activities that week.

- **Evidence of problem solving 40%:** This will be assessed using your portfolios. Your portfolios should provide your best evidence of your engagement in problem solving activity throughout the course. I will provide detailed guidelines and rubrics for the portfolios.

Texts and other readings

There is no book required for the course. Readings will be posted in PDF form on Moodle.

Tentative topics and schedule

The course consists of seven modules, described below. We may adjust the content and schedule in response to ideas and issues that surface as we go through the course.

Schedule of modules

Module	Dates	Pedagogy focus	Mathematical activity
1	Mon 8/26 – Sun 9/01 (1 week)	Introduction, big ideas, research on problem solving	
2	Mon 9/2 – Sun 9/15 (2 weeks)	The conditions for problem solving: Thinking classrooms	Investigation #1
3	Mon 9/16 – Sun 9/29 (2 weeks)	Setting the stage: Norms and first days activities	Peer review #1 Investigation #2
4	Mon 9/30 – Sun 10/13 (2 weeks)	Fostering productive group work and discourse	Peer review #2 Investigation #3
5	Mon 10/14 – Sun 11/03 (3 weeks)	Choosing good tasks	Peer review #3 Investigation #4 Portfolio A (investigations 1-3)
6	Mon 11/04 – Sun 11/17 (2 weeks)	Maintaining engagement during problem solving	Peer review #4 Investigation #5
No class - Thanksgiving	Mon 11/18 – Sun 11/24		
7	Mon 11/25 – Sun 12/08 (2 weeks, incl. finals)	Coverage	Peer review #5 Investigation #6
Finals week	Mon 12/09 – Fri 12/13		Peer review #6 (due Wed 12/11) Portfolio B (inv. 4-6; due Fri 12/13)

(note that Module 1 is one week, and consists of only reading. Module 5 is three weeks to allow for preparation of Portfolio A).

Time commitment

You should plan to spend about 6-8 hours per week on the course. I know that many of you are full-time teachers, so I tried to make the course as flexible as possible. Of course, you should be prepared to commit time to the course, but you can structure that time flexibly to fit your schedule.

Schedule *within* a module

Use the following schedule to help you plan your time

Day	**Primary activities**	**Approx. time** (6-8 hr/wk)
Week one, Mon-Sun	Mathematical activity: Complete peer review, begin investigation Pedagogy: Complete all readings, complete first posts on discussion board	2-3 hours 4 hours
Sunday of week one	*Peer review due,* *First post on discussion board(s) due*	
Week two, Mon-Sun	Mathematical activity: Continue investigation, complete write-up Pedagogy: Engage in lively discussion on discussion board. Plan to post daily, or at least every-other-day	4 hours 2-3 hours
Sunday of week two	*Upload investigation to Moodle and send to peer-review partner* *All posts due on discussion board*	

Meeting

If you would like to meet with me, with can do so via phone (406.243.4053), Skype (fredpeck1), or Zoom (https://umontana.zoom.us/j/548632179).

We can meet at a time that is convenient for you. Please schedule a meeting using the URL below:

www.fapeck.com/meeting

Other policies

Communicating: Email is the best way to reach me. UM policy states that I must use your UM email account when I correspond with you. Please email me from your UM account—that makes it easy to follow the policy! Even if you don't, I still have to reply to your UM account.

Classroom and testing accommodations: The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students. If you think you may have a disability adversely affecting your academic performance, and you have not already registered with Disability Services, please contact Disability Services in Lommasson Center 154 or 406.243.2243. I will work with you and Disability Services to provide an appropriate modification.

Academic honesty: All students need to be familiar with the Student Conduct Code. You can find it in the "A to Z Index" on the UM home page. All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University.