CAPSTONE ON TEACHING & LEARNING MATHEMATICS FOR SECONDARY TEACHERS

Dr. Douglas A. Lapp

Instructor Info

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Office Hours:
TTh 2:00-3:00 pm (PE 222)
& by appointment.
I also maintain an Open Door policy. If my door is open, feel free to drop in. If my door is closed, please take no offense. I am probably hiding because I have some deadline to meet. (Please Feel Free To Call or E-mail! I don't bite.)

Attendance

Class attendance is required. Attendance will be taken each class period. More than 2 unexcused absences will cause your grade to be lowered a third of a letter grade for each occurrence beyond the first 2 (e.g. 3 missed classes would change a B to a B-, 4 missed classes would change a B to a C+)..

About the Course

This Capstone course is designed to integrate the subject content knowledge gained in the first three courses of the program (Math 261, 362, and 363) with both pedagogical & curricular content knowledge. In this course we will build on your experiences from the previous courses that were specific to subject matter content in algebra, geometry, probability, and statistics; however, now we will focus attention on the scientific study of the teaching and learning of mathematics. We will use vignettes, written cases, and video excerpts to analyze both teacher actions and student activity as they interact in classroom situations. In addition, we will address the practical issues of lesson and unit planning as well as curriculum design.

This course also requires 40 hours of field-based work in the secondary schools. This field-based work constitutes your "Pre-Student Teaching" experience for CMU's teacher education program. You will receive your placement during the first or second week of class.

Instructional Methods

We will take an active learning approach and so you will be expected to engage in discussions and work with your fellow classmates to discover key concepts. Technology will allow us to explore mathematical ideas and pedagogy with deeper discussions where *your ideas matter*. Be willing to share your thoughts with the class. Keep in mind that the only dumb question is a question unasked.

The TI-Nspire CX II CAS™ or TI-Nspire CX CAS™ calculator will be your primary tool for exploring Calculus. You may need to spend a little extra time initially familiarizing yourself with the calculator, but once you have become proficient with these machines I am sure you will find their use invaluable. I will be assigning an introductory activity using videos to help you become familiar with basic functionality of the device. Watching and following along with these video clips will be important and you will turn in an electronic file the first week of class.

As we know from research, mathematics is best learned by engaging students in exploration and justification of conjectures. Therefore, this course will model pedagogical methods set forth by organizations such

Grading

Your grade will be based on the following breakdown:

Pre-Student Teaching	10%
Readings	5%
Pedagogical Reflections	10%
Quizzes	10%
Midterm	10%
Curriculum Design	5%
Mini-teaching	5%
Projects/Labs	10%
Flipgrid	5%
Lesson Plans	10%
Unit Plan	20%
Total	100%

Your grade will then be figured on the following percent scale.

Scale:
[92, 100]A
[90, 92) A-
[87, 90) B+
[82, 87) B
[80, 82) B-
[77, 80) C+
[72, 77) C
[70, 72) C-
[67, 70) D+
[62, 67) D
[60, 62) D-
[0, 60)   E

Academic Integrity

To promote integrity and deter dishonest academic work, it is assumed that you will conduct yourself within the University's expectations. For more information, visit the Office of Student Conduct's web page. For more information, click here.

as the National Council of Teachers of Mathematics and the Mathematical Association of America.

Materials

One item you may find handy is a small (6 inch or so) tripod for your phone. This will allow recording of yourself for class assignments.

Text & Technology

Text: Liljedahl, P. (2020). *Building thinking classrooms in mathematics, grades K-12: 14 teaching practices for enhancing learning*. Corwin Press.

Technology: For Math 462, you will need a graphing calculator with a Computer Algebra System (CAS) that will also work with our wireless calculator network. A computer algebra system is simply a device that will do symbolic manipulations such as finding symbolic derivatives or integrals, expanding algebraic expressions, working with matrices, or solving equations exactly. For this purpose, you will need a TI-Nspire CX CAS or TI-Nspire CX II CAS that can be used with the wireless network. Be careful NOT to get the regular TI-Nspire CX or CX II since they do NOT have a computer algebra system. Make sure it is the TI-Nspire CX CAS. If it does not say both "CX" and "CAS" in the name, it is not the right one. Please bring it to every class meeting and make sure it has a sufficient charge. **When you purchase your calculator, it comes with computer software, so be careful not to throw away the activation code with the packaging.**

Other Materials/Requirements: You will also need a small or mini tripod for your cell phone. We will be making several videos in class with your phones. In addition, you will need to get a membership in the National Council of Teachers of Mathematics (NCTM). For membership information, visit www.nctm.org and select the student membership option. This is a reduced price for dues and journals.

Student Learning Outcomes

The major goal of this course is to increase students' understanding of the teaching and learning of mathematics. The information you learn here will be relevant to your future as a teacher, whether it is related to the mathematics you will teacher or the pedagogy you will use. For example, we will discuss issues related to learning trajectories for specific mathematical content as well as the psychology of how students learn it. Both mathematical content knowledge and pedagogical content knowledge are essential for planning good lessons. The learning objectives cover both content standards and standards for mathematical practice. We will organize these into four main categories with the

Course Withdrawal

Students must DROP a course if they plan to stop attending before the course starts or prior to the second meeting time for face-to-face courses to get a refund. Dropping later than this will incur varying rates of refund (or none at all). For details, see the Drop and Withdrawal Chart. A drop removes the course from your record if done early enough. If you drop after the designated deadline, you may receive a W, but keep in mind that there is date after which you cannot drop. Again, details are given on the Registrar's webpage.

Instructional Video

In order to encourage discourse about mathematics, we will use MS Teams as a way to work together outside of class. My intention is for this to be your place in cyberspace to work collaboratively. **Microsoft Teams** provides a nice platform for this purpose. Our Teams class allows me to post video clips of my computer screen so that if some folks are struggling with a concept, I can help illustrate ideas in video form. I can also use it to help you learn some functionality of the TI-Nspire CX CAS, especially at the beginning of the course. I will organize the instructional video under the Files tab in MS Teams by topics.

specific mathematics content falling into each. Below is a graphic that summarizes the mathematical practices of the student learning outcomes for the course.
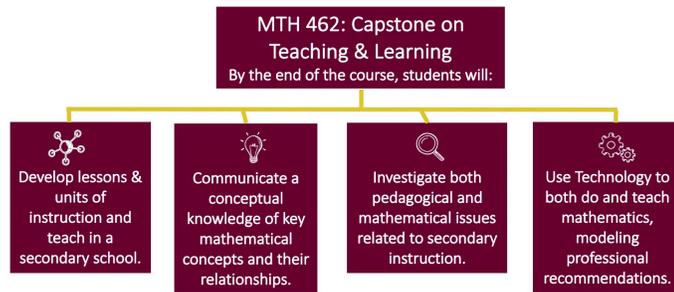
Pre-Student Teaching Fieldwork

In addition to your time in class, you will also be expected to spend 40 hours working in a secondary school setting. During these experiences, you will be required to teach lessons and work with your host teacher. You will receive more information about your field placement and responsibilities during the first two weeks of the course.

Journal Readings

Some of the assignments will involve searching the current Mathematics Education journals for articles on the teaching and learning of mathematics concepts. These assignments will involve reading journal articles and reacting to those articles from the perspective of both teacher and student. The library has many fine journals specifically for mathematics education such as *Mathematics Teacher: Learning & Teaching*, *Journal for Research in Mathematics Education*, *School Science and Mathematics*, and the NCTM Yearbooks to name only a few. Many other journals are also acceptable. In addition, I may give you articles as handouts and then expect you to respond to prompts related to the readings.

Pedagogical Reflections

Throughout the course you will be expected to write about your thoughts related to classroom situations as presented by sample student work, written cases, vignettes, or video excerpts. We will use some of the video from various sources as well as the text for the course to stimulate discussion. We will also draw on your experiences in the schools to motivate our analysis of the teaching and learning of mathematics. Be prepared to share your thoughts as your ideas matter. Keep in mind that there are no definitive answers when it come to teaching and learning (although we do know some things don't work), so

Assessment

In order to allow for diversity in student learning styles and achievement measures, you will be assessed using several methods. Since one of our objectives is to be able to continually learn new technologies and apply both mathematics content and learning theory to your classroom long after you leave "formal education", we want you to be able to learn on your own. For this reason projects will constitute a large portion of your grade. You will have reading assignments, pedagogical reflections & classroom episode analyses, quizzes, creation of curriculum materials, laboratory assignments conducted in cooperative groups, lesson plans, and a unit plan. Some of these assignments will require significant time outside of class. In addition, you will have one in-class midterm exam.

Flipgrid

As another method of formative assessment, from time to time you will be expected to respond to questions using FlipGrid. FlipGrid is a video platform where people can submit short (1 to 10 minute) video responses to posed questions via a smartphone, tablet, or computer (I usually try to limit it to 90 seconds). This will give you the opportunity to explain your thinking and understanding that goes beyond simple procedural knowledge.

sharing perspectives gives us a way to be thoughtful about our teaching.

Quizzes

The quizzes will be over basic mathematics and pedagogical topics related to the course materials. You will also be expected to use basic functionality of the technology used in various explorations. The quizzes will test your ability to apply what has been discussed in the course in an on-demand setting. You will be given mathematical investigations as well as pedagogical questions where you must analyze students' mathematical work or classroom situations. The quizzes will give an individual assessment of your ability to deal with both technological use and application of mathematical and pedagogical ideas in the learning and teaching of mathematics. **Your lowest quiz will be dropped and thus there will be no make-ups for quizzes.**

Midterm Exam

There will one midterm exam to test your ability to apply what we have discussed in class. The exam will ask you to analyze both mathematical and pedagogical ideas and test you on basic learning theory.

Curriculum Design

Another important aspect of teaching is the ability to create classroom-ready curriculum materials. In this course you will be expected to design student-centered activities that guide students to discover key mathematical ideas or concepts. These activities will include both a student handout as well as a teacher guide for its use in the classroom. Details for these assignments will be given in class.

Projects & Lab Assignments

Throughout the semester you will participate in lab activities designed to help you make connections between the undergraduate and secondary mathematics curricula. I think that you will not only find these labs helpful in generating ideas for your future teaching, but you will also find that concepts you were taught through memorization during your own school experience will begin to actually make sense. The use of technology in the mathematics classroom can foster an atmosphere of conjecture and proof. Students will be able to explore patterns that they could not before—this is one advantage of technology use and we will model this environment in the course.

You will also be expected to explore concepts using the computer and software such as TI-Nspire CX CAS™ and GeoGebra, as well as hand-

Recording of Class

In order to protect the intellectual property interests of the instructor, the privacy interests of student members of the class, and to encourage an open and fair exposition of all student views in the classroom without fear that student views expressed will be recorded and possibly posted in another forum, recording (video or audio) of classroom activity (or live video stream) and conversations is not permissible without the expressed, prior written consent of the instructor. Unauthorized recording of classroom activity shall be considered a violation of the CMU Student Code of Rights, Responsibilities, and Disciplinary Procedures as disruptive of a student's right to learn under 3.2.3 Disruption of Learning. While it is expected that students will attend live classes whether face-to-face or virtually, I will record the streamed class in MS Teams where it will be posted. It is important to note that only members of the class will be able to view these videos within Teams and sharing them outside this environment will constitute a violation of the CMU Student Code of Rights, Responsibilities, and Disciplinary Procedures as described above. Recording class sessions via other means (e.g. screen-casting software) is not permitted. Please remember that these recordings are not meant to replace class attendance, but rather as a means to study and reflect on course material.

held technology such as the TI-Nspire CX CAS™ hand-held with data collection sensors, and the CBR2™.

Since part of the reason for working in cooperative groups is to promote discourse among students on mathematical ideas, it is impossible to make up such an experience. **Therefore, there will be no make-ups for missed labs or activities**.

As stated above regarding labs and projects, each group will be asked to present its findings from time to time to the rest of the class. Since the person presenting is selected at random, your participation is expected, and it is in the group's interest to make sure all members have a solid grasp of the ideas developed by the group. In order to facilitate group work outside of class, I will create open groups in MS Teams so that you can work together virtually via video channels in Teams.

Collaborative Groups

You will be placed in random collaborative groups every week or so (at natural breaks in activity). This will allow you to work with a variety of people throughout the semester. To accomplish this, when you are asked to form or change groups, you will draw a random card from a deck when you enter the classroom and then sit at the assigned table corresponding to your group card (e.g. 2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A). You will work and sit in this location until the groups get rearranged again. As stated earlier, there will also be groups in MS Teams corresponding to these group names as well so that you can collaborate with each other outside of class.

Within each group, roles will also be randomly assigned. Another aspect of group work to help promote an equitable environment is requiring students to take on different roles within the group from time to time so that everyone develops team skills and shares the workload. While there are many good roles that can be used depending on the type of group work, the roles we will use for this course will be: Facilitator, Recorder/Reporter, Resource Manager, and Understanding Coordinator. These roles should suffice to cover most of the needs of the group while exploring mathematics. So that over time, group members will take on a variety of roles, your role for each "shuffling" of the groups will be given by the suit of your card (♣,♦,♥,♠).

♣ Facilitator/Resource Manager: Obtains needed materials and keeps the group on track. Monitors time to make sure the group is ready to participate in class discussions when the class is brought together to share results. Makes sure all group members share during discussions.

♦ Recorder: Keeps a record of the group's discussion and develops the

final write-up for submission.

♥ <u>Reporter</u>: Provides explanations of the group's findings to the larger class during discussion. The Reporter will rely on the Recorder's notes and written summaries (often displayed on whiteboards or via calculator screen).

♠ <u>Understanding Coordinator</u>: Makes sure all members of the group participate and understand what is being said by members of the group. The Understanding Coordinator may ask group members to re-voice the contributions of others to make sure the meaning is clear.

Since each group will generally hand in only one report, as you list the names of the group members at the top, please also list the role they played in the lab or project. Keep in mind that you may at times be placed into a group of size 3 rather than 4. If this happens, one member of your group may be called on to fulfill two roles. More details for what each role entails will be discussed in class.

Lesson Plans

One of the most important parts of classroom instruction involves a well thought out lesson plan. In this course, you will develop lessons that are grounded in research-based practice and are influenced by our analysis of classroom episodes found in both written and video formats. A detailed structure for these lessons will be discussed in class.

Mini-teaching

From time to time you will be expected to deliver a portion of lesson plans to your classmates as if you were teaching middle or high school students. If time allows, we will do it in class and then provide feedback to each other. If class time becomes an issue, some of these experiences may be done using Flipgrid and you will watch and respond outside of class. Remember, this is a time to grow as a teacher, so when you receive feedback, take it as a chance to hone your skills as a teacher. When you provide feedback, do it in a constructive way and be mindful of your tone so as to not come across as harsh. We are all growing together and so focusing on a growth mindset is the start of a successful career where you will be able to collaborate with colleagues in a positive manner.

Unit Plan

There will be no final exam. The final Unit Plan grade will take the place of the final exam. A unit plan is a document that unifies several lesson plans into a single, coherent learning experience that takes place over multiple class sessions within the secondary school schedule. Units will

Accommodations

CMU provides students with disabilities reasonable accommodations to participate in educational programs, activities or services. Students with disabilities requiring accommodations to participate in class activities or meet course requirements should register for services through Student Disability Services, 120 Park Library, 989-774-3018, <u>www.cmich.edu/ess/ studentaffairs/SDS/</u>.

Name, Gender Identity, and/or Gender Expression

Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name and/or pronoun. Please let me know about any differences as soon as possible so that I may make the appropriate changes to my records. For more information regarding CMU's commitment to making campus a safe space for people of all sexualities and gender identities, visit the <u>Office of LGBTQ Services</u> (Bovee University Center 108).

Comments

You and I are part of a team. If we work together I think we will both come away from this course having learned a great deal. You have the potential to teach me as well. Feel free to share your ideas about mathematics with the class and with me. As was illustrated in the video I showed on the first day of class from Fred Rogers, making mistakes is part of learning and we should not be afraid of making mistakes. We actually learn more from our mistakes than we do our successes. Please feel comfortable contributing to class discussions. Our class is a Safe Zone where we are able to support each other. If you need help, come see me. It is important to get help as soon as possible to avoid falling behind. Call me if you need to see me. I won't bite—I promise. To encourage you to actually read this syllabus, within the first week of classes, when you get to this sentence, email me a picture of Spock from Star Trek and I will add 2 bonus points to your quiz category if you do so prior to the second week of class.

typically cover 2-3 weeks of content. The way in which you weave lessons together can have a significant impact on how students come to understand the mathematical concepts involved. Therefore, this experience of creating a unit plan is a culminating event for this course and will pull together all aspects of the course into one final assignment. Although there is no in-class final exam for this course, our class will meet during the scheduled final exam time to discuss your unit plans.

Face Covering and Social Distancing

Face coverings, such as masks, are optional. If you need to wear a mask, please feel free to do so. As every person's situation is different, we will all respect each others' choices for personal protection and be sensitive to the needs of our classmates. Should the situation change and CMU decides to change policy, please refer to the COVID-19 Resources page at https://www.cmich.edu/about/covid-19-information-and-resources.

Expectations for Students and Instructor

CMU understands the benefits of pluralism and embracing diversity and is committed to cultivating an "irresistible culture of inclusion." Therefore, CMU faculty strives to create safe and inclusive learning environments in which students can respect and celebrate diversity through inclusive and mutually respectful language. CMU is committed to transforming as an institution to respond to support enlightened change around ever-evolving attitudes of inclusion.

Student Expectations	Instructor Expectations
Actively participate in whole-class and groups discussions.	Have fun sharing how cool mathematics is.
Be respectful of the ideas and contributions of others.	Encourage students to share their views and show respect as they share.
Share your ideas (even if you think you might be wrong).	Reinforce to students that they are capable of understanding mathematics.
Complete all assignments.	Be prepared for class.
Turn off your cell phones unless needed for class activities.	Respond swiftly and effectively to student concerns.
Come to class on time, as we often begin with a quiz or opening warm-up.	Grade objectively, consistently, and promptly.
Discuss class concerns with me either after class or during designated office hours.	Assure students that making mistakes is OK and part of the learning process.
Come prepared for class by completing readings or pre-activity investigations prior to class.	Accommodate differences in students' learning.
	Provide time in class for students to engage with the instructor and classmates about course ideas.