

GRSC 7770: A Field Guide to Teaching MATH 1113

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Fall, 2018

Last updated June 23, 2019.
The latest version is online [here](#).

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1 Introduction

1.1 Daily discussions

Looking at the syllabus, you'll see that most days have a "daily discussion" component. This means:

- Each week, one of the groups of students will lead the discussion on last week's reading.
- They should spend 5-7 minutes at the board, outlining and summarizing the reading.
- Then they should lead the class discussion for another 5-7 minutes.
- This activity counts whether they are "present" or not.

Things to keep in mind:

- This is a *student* seminar; so the students should be doing the "work". Asking questions, making presentations, etc.

2 Week 1

2.1 Preparing for your first day as GRSC instructor

Congratulations! You've been chosen to teach GRSC 7770! Hopefully this guide will serve you well. Of course, feel free to upgrade it to your liking. The most important things to do before your first class are the following:

1. You'll need to rent a camera from the CTL.
2. You should email the people you intend to give lectures throughout the semester.
3. You should email your GRSC class with a syllabus and welcome email.
1. Check your room before the first day of class.

2.2 Introduction to GRSC 7770

2.3 Covering the syllabus

You should cover the syllabus on the first day. You may have a few students from other departments, and its important for them to know that this course is geared primarily towards the mathematics department. Important features of the course are:

- Attendance is mandatory.
- You are expected to complete all assignments. Late assignments will not be accepted and will count as an absence.
- The textbook is free online.
- Should include additional resources like the CTL.

2.4 Data driven teaching strategies

3 Week 2

3.1 Discussion: A declaration of values

This week's discussion will be led by you (the GRSC instructor). You are to set the tone for how these discussions should go.

3.2 How to write a syllabus

Today's activity is to start writing a syllabus. You should provide them with the materials given out by the current MATH 1113 coordinator. This should include:

- the MATH 1113 calendar.
- additional external resources (e.g. Toyin's YouTube channel and Kelly Sappington's YouTube information).

3.3 Key functions and components of a syllabus

A syllabus has several functions. The first function is to invite students to your course to inform them of the objectives of the course and to provide a sense of what the course will be like. The second function is to provide a kind of contract between instructors and students to document expectations for assignments and grade allocations. The third function is to provide a guiding reference resource to which students and instructional staff can refer for logistical information such as the schedule for the course and office hours, as well as rationale for the pedagogy and course content.

Generally, a syllabus should include the following information:

- **Learning Objectives.** What students will gain or take away from your course. Why these objectives are the most important skills/knowledge for the course (helpful if objectives are included for each topic/session).
- **Goal/Rationale.** How the course relates to primary concepts and principles of the discipline (where it fits into the overall intellectual area). Type of knowledge and abilities that will be emphasized. How and why the course is organized in a particular sequence.
- **Basic Information.** Course name and number, meeting time and place, instructor name, contact information, office hours, instructional support staff information.
- **Course Content.** Schedule, outline, meeting dates and holidays, major topics and sub-topics preferably with rationale for inclusion.
- **Student Responsibilities.** Particulars and rationale for homework, projects, quizzes, exams, reading requirements, participation, due dates, etc. Policies on lateness, missed work, extra credit, etc.
- **Grading Method.** Clear, explicit statement of assessment process and measurements. Materials and Access. Required texts and readings, course packs. How to get materials including relevant instructional technologies. Additional resources such as study groups, etc.
- **Teaching Philosophy.** Pedagogical approach including rationale for why students will benefit from it.

4 Week 3

Have students bring questions for Philip Griffeth.

5 Week 4

5.1 Grading the syllabus

Have students exchange syllabi and grade each other's according to the guidelines.

5.2 Discussion: Introduction to active learning

Active learning strategies come in many varieties, most of which can be grafted into existing courses without costly revisions. One of the simplest and most elegant exercises, called Think-pair-share, could easily be written into almost any lecture. In this exercise, students are given a minute to think about and perhaps respond in writing to a question on their own. Students next exchange ideas with a partner. Finally, some students share with the entire class. A think-pair-share engages every student, and also encourages more participation than simply asking for volunteers to respond to a question.

Other active learning exercises include:

- **Case studies:** In a case study, students apply their knowledge to real life scenarios, requiring them to synthesize a variety of information and make recommendations.
- **Collaborative note taking:** The instructor pauses during class and asks students to take a few minutes to summarize in writing what they have just learned and/or consolidate their notes. Students then exchange notes with a partner to compare; this can highlight key ideas that a student might have missed or misunderstood.
- **Concept map:** This activity helps students understand the relationship between concepts. Typically, students are provided with a list of terms. They arrange the terms on paper and draw arrows between related concepts, labeling each arrow to explain the relationship.
- **Group work:** Whether solving problems or discussing a prompt, working in small groups can be an effective method of engaging students. In some cases, all groups work on or discuss the same question; in other cases, the instructor might assign different topics to different groups. The groups task should be purposeful, and should be structured in such a way that there is an obvious advantage to working as a team rather than individually. It is useful for groups to share their ideas with the rest of the class whether by writing answers on the board, raising key points that were discussed, or sharing a poster they created.
- **Jigsaw:** Small groups of students each discuss a different, but related topic. Students are then shuffled such that new groups are comprised of one student from each of the original groups. In these new groups, each student is responsible for sharing key aspects of their original discussion. The second group must synthesize and use all of the ideas from the first set of discussions in order to complete a new or more advanced task. A nice feature of a jigsaw is that every student in the original group must fully understand the key ideas so that they can teach their classmates in the second group.
- **Minute paper, or quick write:** Students write a short answer in response to a prompt during class, requiring students to articulate their knowledge or apply it to a new situation. NB: A minute paper can also be used as a reflection at the end of class. The instructor might ask students to write down the most important concept that they learned that day, as well as something they found confusing. Targeted questions can also provide feedback to the instructor about students' experience in the class.
- **Statement correction, or intentional mistakes:** The instructor provides statements, readings, proofs, or other material that contains errors. The students are charged with finding and correcting the errors. Concepts that students commonly misunderstand are well suited for this activity.
- **Strip sequence, or sequence reconstruction:** The goal of this activity is for students to order a set of items, such as steps in a biological process or a series of historical events. As one strategy, the instructor provides students with a list of items written on strips of paper for the students to sort. Removable labels with printed items also work well for this activity.

- **Polling:** During class, the instructor asks a multiple-choice question. Students can respond in a variety of ways. Possibilities include applications such as PollEverywhere or Learning Catalytics. In some courses, each student uses a handheld clicker, or personal response device, to record their answers through software such as TurningPoint or iClicker. Alternatively, students can respond to a multiple-choice question by raising the appropriate number of fingers or by holding up a colored card, where colors correspond to the different answers. A particularly effective strategy is to ask each student to first respond to the poll independently, then discuss the question with a neighbor, and then re-vote.

6 Week 5

6.1 Problem solving in STEM

6.1.1 How do I decide which problems to cover in section or class?

In-class problem solving should reinforce the major concepts from the class and provide the opportunity for theoretical concepts to become more concrete. If students have a problem set for homework, then in-class problem solving should prepare students for the types of problems that they will see on their homework. You may wish to include some simpler problems both in the interest of time and to help students gain confidence, but it is ideal if the complexity of at least some of the in-class problems mirrors the level of difficulty of the homework. You may also want to ask your students ahead of time which skills or concepts they find confusing, and include some problems that are directly targeted to their concerns.

6.1.2 You have given your class some problems to solve

Try to give your students a chance to grapple with the problems as much as possible. Offering them the chance to do the problem themselves allows them to learn from their mistakes in the presence of your expertise as their teacher. (If time is limited, they may not be able to get all the way through multi-step problems, in which case it can help to prioritize giving them a chance to tackle the most challenging steps.) When you do want to teach by solving the problem yourself at the board, talk through the logic of how you choose to apply certain approaches to solve certain problems. This way you can externalize the type of thinking you hope your students internalize when they solve similar problems themselves. Start by setting up the problem on the board (e.g you might write down key variables and equations; draw a figure illustrating the question). Ask students to start solving the problem, either independently or in small groups. As they are working on the problem, walk around to hear what they are saying and see what they are writing down. If several students seem stuck, it might be a good to collect the whole class again to clarify any confusion. After students have made progress, bring the everyone back together and have students guide you as to what to write on the board. It can help to first ask students to work on the problem by themselves for a minute, and then get into small groups to work on the problem collaboratively. If you have ample board space, have students work in small groups at the board while solving the problem. That way you can monitor their progress by standing back and watching what they put up on the board. If you have several problems you would like to have the students practice, but not enough time for everyone to do all of them, you can assign different groups of students to work on different but related - problems.

6.2 When do you want students to work in groups to solve problems?

- Don't ask students to work in groups for straightforward problems that most students could solve independently in a short amount of time.
- Do have students work in groups for thought-provoking problems, where students will benefit from meaningful collaboration.
- Even in cases where you plan to have students work in groups, it can be useful to give students some time to work on their own before collaborating with others. This ensures that every student engages with the problem and is ready to contribute to a discussion.

6.3 What are some benefits of having students work in groups?

- Students bring different strengths, different knowledge, and different ideas for how to solve a problem; collaboration can help students work through problems that are more challenging than they might be able to tackle on their own.
- In working in a group, students might consider multiple ways to approach a problem, thus enriching their repertoire of strategies.

: What are some strategies for helping students to form groups?

- Students who think they understand the material will gain a deeper understanding by explaining concepts to their peers.

6.4 What are some strategies for helping students to form groups?

- Instruct students to work with the person (or people) sitting next to them.
- Count off. (e.g. 1, 2, 3, 4; all the 1s find each other and form a group, etc).
- Hand out playing cards; students need to find the person with the same number card. (There are many variants to this. For example, you can print pictures of images that go together [rain and umbrella]; each person gets a card and needs to find their partner[s].)
- Based on what you know about the students, assign groups in advance. List the groups on the board.
- Note: Always have students take the time to introduce themselves to each other in a new group.

7 Week 6

7.1 What should you do while your students are working on problems?

- Walk around and talk to students. Observing their work gives you a sense of what people understand and what they are struggling with. Answer students questions, and ask them questions that lead in a productive direction if they are stuck.
- If you discover that many people have the same question or that someone has a misunderstanding that others might have, you might stop everyone and discuss a key idea with the entire class.

7.2 After students work on a problem during class, what are strategies to have them share their answers and their thinking?

- Ask for volunteers to share answers. Depending on the nature of the problem, student might provide answers verbally or by writing on the board. As a variant, for questions where a variety of answers are relevant, ask for at least three volunteers before anyone shares their ideas.
- Use online polling software for students to respond to a multiple-choice question anonymously. If students are working in groups, assign reporters ahead of time. For example, the person with the next birthday could be responsible for sharing their groups work with the class.
- Cold call. To reduce student anxiety about cold calling, it can help to identify students who seem to have the correct answer as you were walking around the class and checking in on their progress solving the assigned problem. You may even want to warn the student ahead of time: "This is a great answer! Do you mind if I call on you when we come back together as a class?"
- Have students write an answer on a notecard that they turn in to you. If your goal is to understand whether students in general solved a problem correctly, the notecards could be submitted anonymously; if you wish to assess individual students work, you would want to ask students to put their names on their notecard.
- If you had assigned different groups to work on different problems, you can:
 - Use a jigsaw strategy, where you rearrange groups such that each new group is comprised of people who came from different initial groups and had solved different problems. Students now are responsible for teaching the other students in their new group how to solve their problem.
 - Have a representative from each group explain their problem to the class.
 - Have a representative from each group draw or write the answer on the board.

7.3 What happens if a student gives a wrong answer?

- Ask for their reasoning so that you can understand where they went wrong.
- Ask if anyone else has other ideas. You can also ask this sometimes when an answer is right.
- Cultivate an environment where its okay to be wrong. Emphasize that you are all learning together, and that you learn through making mistakes.
- Do make sure that you clarify what the correct answer is before moving on.
- Once the correct answer is given, go through some answer-checking techniques that can distinguish between correct and incorrect answers. This can help prepare students to verify their future work.

7.4 A few final notes

- Make sure that you have worked all of the problems and also thought about alternative approaches to solving them.
- Board work matters. You should have a plan beforehand of what you will write on the board, where, when, what needs to be added, and what can be erased when. If students are going to write their answers on the board, you need to also have a plan for making sure that everyone gets to the correct answer. Students will copy what is on the board and use it as their notes for later study, so correct and logical information must be written there.

8 Week 7

9 Week 8

9.1 Discussion: Making the grade

This week's reading is pages 59–63.

9.2 Activity

Today's activity is to have the GRSC students grade a quiz.

9.3 Some general principles of responding to student work

Here are the most important.

- **Know Your Goals and Name Them.** Grading allows students to know where they stand in relation to learning goals, whether they're the goals of a given assignment, a sequence of assignments, a semester-long course, or a broader course of study. Therefore, the first step in effective grading happens before students start writing a paper or sit down with a problem set: you need to decide what your learning goals are, name them, and identify what criteria will allow you to measure student progress toward those goals.
- **Be Transparent with Students.** As necessary as learning goals and concrete criteria are, the goal isn't just to have them—they need to be shared with your students. Getting students on the same page with you about why they are doing an assignment and how they're being assessed is a crucial part of making graded feedback purposeful, and the more transparent the goals and criteria are, the better. Starting with the course description and the syllabus, and extending through the prompts for assignment sequences and on through capstone projects or final exam, transparency allows the grading process to be more of a dialogue than a judgment from on high.
- **Strive for Consistency.** At some point after you've framed an assignment for yourself and your students, and after they've uploaded their assignment or put down their pencil—the time for grading will arrive. In an ideal world free of miscommunication or disciplinary foibles, the next step would simply be to block off chunks of time and apply the rubric you'd shared with your students beforehand. The world being what it is, however, challenges often arise. For instructors grading essay assignments, a common challenge is helping students see that your qualitative assessment is consistent, i.e., that it isn't just a matter of your taste or preference or mood. Anyone who's taught in the humanities or social science is likely to have stories about students who feel as though their grade on an essay assignment was just a reflection of the instructor's subjective or impressionistic response, or just a measure of how closely the essay's thesis came to the instructor's own position on some matter of academic dispute. And to be fair, in the absence of clear learning goals and a rubric that's been consistently applied, it's hard to dispel that skepticism. The question here is what it means to apply a rubric consistently, and the short answer is this:
 - Read through the lens of the criteria you've established in your prompt and rubric (thesis, identifying positions within a debate, use of secondary sources)
 - Show your priorities by focusing on those criteria in your marginal feedback (don't get bogged down with comments on style or structure if those aren't tied to your learning goals)
 - Organize your feedback letter in terms of your rubric's criteria, so that the letter itself becomes an evidence-based argument that supports your claim about how successfully the student's written product did or didn't demonstrate mastery of the skills described in the assignment's learning goals
- **Offer Context.** For instructors grading assignments that typically receive number grades and have answers on a clearer right/wrong spectrum (vocab quizzes, math problem sets, short-answer ID tests), the objectivity or consistency of the instructor is less likely to come into question. In these cases, by contrast, the challenge for instructors is moving past the idea that having an objective rubric alone

makes their grading process is meaningful or fair. A grade on a page cant speak for itself, and for it to be meaningful it needs to correspond to students learning contexts, e.g., how does the grade reflect students engagement with class time and course materials, or their preparation for the test, or their use of office hours, etc. And for a grade to be genuinely fair, it needs to correspond to pathways to future success. One effective tool for lending context to quantitative feedback is the exam wrapper, a guided set of questions students complete after receiving their graded work that asks them to identify their own areas of understanding and confusion, to reflect on how they prepared for the exam, and, often, to provide instructor feedback on how effectively the exam indeed tested mastery of the goals it set out to measure.

10 Week 9

11 Week 10

12 Week 11

13 Week 12

14 Week 13

14.1 Inclusive course design

When designing a course, each move matters. From your selection of course materials, to your teaching methods, to the ways you ask students to demonstrate their learning, your course may privilege some students while disadvantaging others. There are moves you can make during the course design phase, though, that can help you create a more equitable and inclusive learning experience.

14.2 Plan to access early and often

Assessment doesn't always have to be in the form of high-stakes midterms, exams, or papers. There are a number of low-stakes techniques that are easy to implement and that can provide quick, useful information. For example, you might collect student information using index cards or polling software. At the start of a class or a new module of material, you can ask students to write answers to brief background knowledge questions to get a sense of where they're starting from. Once or twice throughout the semester, ask students to write down and pass in their muddiest point, that is, the most confusing part of the class they've experienced thus far; ensure that their feedback remains anonymous. Providing ongoing opportunities for assessment can both inform you about how student learning is going and where it might be necessary to make adjustments, and it can allow students a chance to reflect on how well they're learning and where they might adjust their approach to your course as needed. See more on ongoing assessments.

14.3 Plan to vary teaching strategies

Planning to employ various teaching strategies can go a long way toward fostering inclusivity by validating different learning tendencies and understandings of what counts as knowledge. Some teaching strategies will work wonderfully for some, but not others. Consider using a combination of board work, slides, videos, comics, podcasts, a variety of media and activities. Rather than simply lecturing or running through problem sets, mix things up by getting students to come up with answers in small groups, or invite students to the board to show their process. For discussions, try having students talk in pairs or smaller groups before opening up to the whole group. There are many ways to mix things up.

14.4 Allow students to demonstrate their learning in various ways, when possible

Some students excel at discussing and articulating arguments in class; others may share deep insights during office hours or via online discussion platforms. Encourage students to develop in all areas and forms of expression, but also communicate your recognition that not all students demonstrate their grasp of the material in the same ways equally. If a student or group of students is having difficulty learning or communicating through a particular medium, then it can be helpful to dedicate class time to walking everyone through the purpose and process of working with that medium. For example, if students are to research and write an academic paper, then you may spend some class time clearly articulating the purpose of not just this particular paper, but academic paper writing more broadly. If you are inviting students to use a less conventional medium to complete an assignment—creating a video or podcast, for instance—then it's important to articulate how these media provide unique opportunities for demonstrating learning, and why you believe working with them is a good fit for the learning aims of the assignment. This explicit communication about how learning can be demonstrated in various ways, through various media, helps convey to students your support and openness to the differences they may experience in demonstrating what they're learning.

15 Week 14

15.1 Inclusive moves

Students should have equitable opportunities for learning, regardless of their race, ethnicity, sexual orientation, gender, religion, linguistic or socioeconomic background, ability, and more. What concrete moves can we make to foster an optimal environment for learning, which encourages engagement, authenticity, and respect?

While course design is the first step to teaching equitably, cultivating a classroom climate that fosters learning is an ongoing process. It starts on the first day of class and entails creating, communicating, and managing the classroom norms and conventions in a way that is conducive to learning. The following strategies can help instructors achieve an inclusive classroom climate.

15.2 Set the tone on your first day

Set the tone for inclusivity by providing opportunities for students to introduce themselves, learn about their classmates, and learn about you. You're all in the same classroom: what brought you to this particular classroom, at this particular time, to study this particular topic? What do you hope to learn or get out of the class? (Note: you'll have to be open to receiving a variety of answers, including ones that indicate the class is required and they're simply hoping to get some credits from it!) Clearly introduce students to the courses learning goals and any methods they should expect to engage in regularly throughout the semester. If your class primarily involves discussion, for instance, then be explicit about discussion norms and conventions from day one. You may even come up with ground rules for group interaction together as a class; these ground rules can live on an online version of the syllabus or the courses website. The first day is also a great time to articulate how you understand your course to be relevant to your students' lives.

15.3 Get to know your students

Beyond learning names, ask your students why they're taking your course and what they hope to get out of it. Beyond asking these questions, find out about your students' previous experience with your discipline and subject. You may also want to learn more about their extracurricular passions and commitments. You can collect all of this information on index cards on the first day, or you could invite students to sign-up for a brief one-on-one or small group meeting with you at the start of the semester. In any case, encourage your students to take advantage of your office hours throughout the semester. Requiring them to visit you at least once in the first month of the course—even briefly—can be a helpful signal of your availability and willingness to engage.

15.4 Build rapport among the group

Give your students regular opportunities to interact with each other and you. Start classes with an icebreaker or opening ritual or routine to help the group feel comfortable and aligned. You may ask students to take turns leading the opening exercise so that ownership over this part of the class is shared. Throughout the semester, invite students to move around and work with different partners. This movement not only prevents classroom social dynamics from getting stale, it also allows students an opportunity to get to know each other throughout the class duration. This variation is especially important for discussion-based classes, or sections that require a lot of pair work.

16 Week 15