Learning Activity 1: Ethical Guidelines for an Undergraduate Mathematics Student

In Learning Activity 1, students collaboratively develop a set of Ethical Guidelines for Mathematics Majors. The activity starts with an introductory discussion, Discussion A, that raises awareness and sets the stage before students work in small groups to brainstorm ideas for a set of ethical guidelines. Next, the results of the group work are shared and collaboratively refined through Discussion B. Finally, the class holds a final vote on what to include in the class-wide guidelines. Each part of the activity is described in more detail below where we offer instructors guidance through implementing this activity in your class.

First, we suggest assigning the following pre-class readings to students.

- Ethical Guidelines of the American Mathematical Society[**?**]
- American Statistical Association Ethical Guidelines for Statistical Practice[**?**]
- Association for Computing Machinery Code of Ethics and Professional Conduct[**?**]
- American Academy of Actuaries Code of Professional Conduct[**?**]
- Institutional Honor Code/Student Conduct Code

The overall task of this activity is that students collaboratively develop a set of Ethical Guidelines for Mathematics Majors (aimed at their responsibilities now as students in the context of them working on the trajectory of the math major that our group is working on and knowing they will take this further along their trajectories and will in the capstone course consider ethical guidelines that will be used more broadly later in their careers). Ideally, this activity would take place in class during the first week of the semester.

- For the initial Class Discussion, the instructor will guide a whole-class conversation to raise awareness and get the students thinking of their role as math majors who work ethically during their time as students, with a hint towards an ethical framework. We aim to empower them as graduates of our mathematics program.
- Provide the *Guided Discussion Questions* to the students for the initial class discussion.
- Following the initial class discussion, assign students to random groups of 3 or 4 for 15 minutes of group work. Provide the **Directions for Group-work**.
- After 10-15 minutes of group work, pull the class together and direct an all-class share. Perhaps groups are self-reporting their three guidelines in a shared environment (such as a Google doc or discussion board thread the instructor set up beforehand, which can be especially helpful with large classes). If not, ask a student volunteer to receive these from the groups and write them on the board or a projected device for all to see. Indicate with check marks or some notation which guidelines are repeated. (This set of three guidelines is the deliverable from each group. Participation/engagement points might be assigned to this activity.)
- For the follow-up, second class discussion, the instructor might need to guide more discussion on whether the class wishes to revise any of the proposed guidelines before voting on them as a class. See the **Continued Class Discussion Questions** document for questions the instructor would pose to the students.
- Finally, it is time to have students vote on which guidelines to adopt as a class for the semester. (A potential extension would be to revisit the guidelines mid-semester to reflect, revise, and update if the students found the need for any edits.) We used a simple majority vote on this.
- As the end product, the instructor will type up the Mathematics Major Ethical Guidelines and post them in the learning management system for students' reference - a collaboratively developed set of classroom guidelines developed by one of our classes.

Guided Discussion Questions

1. *Who might be the people or entities to which a mathematician/undergraduate math major would be accountable in how a physician is accountable to their patients? (e.g., fellow students, faculty, future employer, or future students of theirs)*
2. *Do you consider yourselves stewards of the discipline of mathematics?*
3. *Is it possible to ever know all the consequences of our work and actions?*
4. *What is the difference between a law, policy, or guideline?*
5. *Are there situations where it is appropriate to make exceptions to or modify any of the ethical guidelines you reviewed in the pre-class reading?*
6. *Considering the ethical guidelines you reviewed in the pre-class reading, what is doable and what is not?*

Directions for Group-Work

Each group will:

1. *Assign group roles such as Facilitator/Manager, Recorder, Spokesperson, and Strategy Analyst [**?**].*

2. *Introduce themselves and share their math major specification (pure, applied, secondary math certification, stat/data science, actuarial science, etc.), and how they would like to be addressed (such as preferred name, pronouns, or whatever they want the group to know). As this is approximately a Class Day 2 activity, introductions are needed.*

3. *Compose three ethical guidelines for math majors to practice while they are undergraduate students and one ethical guideline for graduates from our mathematics program.*

Continued Class Discussion Questions

1. *Does anyone have questions they would like to ask another group about any of their proposed guidelines?*
2. *Are our proposed guidelines fair?*
3. *Are our proposed guidelines understandable/clear?*
4. *Are our proposed guidelines possible/reasonable to obey?*

Learning Activity 2: Vignette Analysis

In Learning Activity 2, the students apply an ethical reasoning lens to analyze vignettes. It is recommended that this activity take place mid-semester. In preparation for implementing this activity in one's class, the instructor would compile a set of vignettes linked to being an undergraduate math major (not necessarily to particular math concepts) that contain an ethical challenge. Below are four vignettes we used in our class, contact the authors for a set of real student responses for each vignette.

List of Possible Vignettes:

1. **Real Analysis Study Group**

   John, Jane, and Ted are classmates in this semester's challenging, senior-level real analysis course. They have been getting to class early and using the empty classroom to study and work together. Their first exam is next Monday. Jane suggests they meet at 10 am in the student activity center on Saturday to study together. Ted counters, suggesting they should all meet in his studio apartment instead. John and Ted agree with Ted's suggestion and dismiss Jane's.

2. **Reflection Journal**

   Dr. Kovalevsky has assigned a Reflection Journal on researching a mathematician and briefly writing their biography. You use ChatGPT to compose the biography of your mathematician because you are a mathematics major and not an English major, so you are not a competent essay writer.

3. **Simulation Lab Report**

   Paul is a mathematics major intending to apply for graduate school. He is the oldest son in his family. His parents expect him to excel always. This numerical analysis course is really hard. Their first simulation lab write-up is due tomorrow. He knows he is just not getting reasonable data out of his simulations. The professor wants the students to submit a summary report of their work, data, and interpreted results. Paul adjusts his data to be more reasonable than they actually are and completes his report on time.

4. **Course Heroine** You have just completed Mathematics 123, your last math class ever. You are graduating this weekend with a job offer overseas beginning next month. Within the Mathematics 123 syllabus, the professor states, "No materials used in this class, including, but not limited to, lecture hand-outs, videos, assessments (quizzes, exams, papers, projects, homework assignments), in-class materials, review sheets, and additional problem sets, may be shared online or with anyone outside of the class without explicit, written permission of the instructor." Course Heroine offers you $250 to share all your graded Mathematics 123 assignments with them.

- In class, this activity begins with the instructor assigning students to groups of 3-4 and distributing a different vignette to each group. Next, the instructor provides the following **Vignette Group Instructions**.
- After 10-15 minutes of group work, pull the class together and direct an all-class share. Perhaps groups are self-reporting their vignette analysis in a shared environment (such as a Google doc or discussion board thread the instructor set up beforehand).(Participation/engagement points might be assigned to this activity.)

Vignette Group Instructions

Each group will:

1. *Assign group roles as suggested in Learning Activity 1.*
2. *Identify the ethical challenge in the vignette.*
3. *Identify which elements of our Mathematics Major Ethical Guidelines (created in Activity 1) pertain to the vignette.*
4. *Identify who are the affected parties in this scenario.*
5. *Analyze a vignette's harms, benefits, and consequences to/for/on affected parties.*
6. *How did our guidelines work as you used them to analyze this vignette? Should we change them in any way?*

Learning Activity 3: Personal Reflection

Learning Activity 3 would be an end-of-semester follow-up assignment done individually in which students apply the mathematics major ethical guidelines collaboratively developed at the beginning of the semester to their own lived experiences as mathematics majors. In an individual assignment, ask each student to return to the guidelines from the beginning of the semester and write a personal reflection guided by the following suggested writing prompts. Example student responses are available from the corresponding author.

Some students may think they do not have an ethical challenge experience to reflect on in this assignment. If so, the instructor might invite such students to come talk one-on-one. The instructor might prepare a few examples to share with students if needed. It could be an ethical challenge this student faced themselves or saw a fellow student or even an instructor face.

Personal Reflection

- *Reflect on your work in this or another STEM class in which you are concurrently enrolled using the lens of our Mathematics Major Ethical Guidelines.*
- *Consider an ethical challenge(s) that you as a student witnessed in this class or another STEM class this semester or in another academic setting (high school or college class or student organization).*
- *Which elements of our Mathematics Major Ethical Guidelines applied to this challenge(s)?*
- *What were the harms, benefits, and other consequences of this ethical challenge(s) to/for/on affected parties?*
- *How well did our Mathematics Major Ethical Guidelines function as you applied them to this ethical challenge(s)?*
- *Where did our Mathematics Major Ethical Guidelines fall short? What are your suggested revisions to our Mathematics Major Ethical Guidelines at the end of this semester?*

As a last resort, if you cannot find a personal ethical challenge you experienced and/or witnessed, you may complete this assignment as follows.

*Choose at least one of the four levels of ethical engagement shared below and share how this resonates with you at this early stage of your career as a mathematician. In their November 2018 SIAM News article 'Mathematicians and Ethical Engagement,' Maurice Chiodo and Dennis Müller [**?**] pose four levels of ethical engagement that mathematicians can demonstrate:*

- *The first level is the fundamental understanding that the practice of mathematics is not ethics-free. (This will be new information for many colleagues and students.)*
- *Mathematicians should speak out to other mathematicians to raise awareness of ethical issues among their peers.*
- *Mathematicians should learn/be taught to take a seat at the tables of power.*
- *Mathematicians are responsible for calling out the bad mathematics of others by acting upon instances where mathematics has "gone wrong" or has been misused.*