Diversity & Inclusion Plan (DIP): Math Department 2017-2018

Report to CATL, Spring 2018

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Phase III, the Assessment & Sharing Phase: Diversity and Inclusion Plan

Implemented Course: MTH 151, Calculus I

Fall 2018: Yokley, Beuerle, Trocki
Spring: Mays

Project Summary

The objective addressed in this Diversity and Inclusion Plan (DIP) was to meet the needs of diverse learners represented in Calculus I courses. Addressing this objective aligned with the Mathematics and Statistics Department's larger goal to, "gather and identify research to breaking down obstacles for diverse groups entering Elon and MTH/STS." An obstacle identified by our group was the limited opportunities for diverse learners to participate during Calculus I instruction. Specifically, discourse in this course offering was often dominated by a handful of students leaving little to no room for all students' contributions to be recognized and included. In phase one of our DIP we researched evidence-based pedagogies to overcome this obstacle and drafted an implementation plan. Three of us implemented the plan in four courses in fall 2017. One of us who did not teach that course in the fall, implemented the plan in their section of Calculus in spring 2018.

The particular goal of our project was to increase the participation of diverse learners in Calculus I through implementing evidence-based pedagogies. We anticipated three byproducts of meeting this goal: 1) increased access to mathematical content; 2) increased agency, authority, and identity; and 3) flexible instruction that responds to students' needs and thinking (Schoenfeld, 2016). We anticipated that students who have not had an academic background that reflects being asked to share their ideas in class would benefit from experiencing pedagogies that aligned with our project goal. A guiding directive of our work was appreciating the imperative to honor the thoughts and contributions of all mathematics learners in Calculus I as Elon strives to produce citizens for a just and equitable society.

Our team identified and implemented three avenues through which to include evidence-based pedagogies to meet our goal: to increase the participation of diverse learners in Calculus I. The first was to begin the semester with getting to know each student. We thought that doing so would provide a foundation to contextualize the subsequent learning as recommended by the Center for Research on Education, Diversity, and Excellence (CREDE). Two of the indicators provided in reference to CREDE's contextualization standard are paraphrased in the following: 1) making connections between school and their personal experiences; 2) helping to reach a

deeper understanding of the academic material through deeper personal connections. The second avenue was to use warm ups at the beginning of lessons as a way to formatively assess the students' progress in attaining learning goals and to provide a forum for students from diverse backgrounds to participate and share their thinking with their peers. The third avenue was to implement the discourse promoting strategy, think-pair-share, to provide additional opportunities for students from diverse backgrounds to share their thinking in both a small group setting and with the larger class. Before the fall semester began and during the semester we discussed our plan and progress focusing on ways that guarantee that all students' thinking will be shared and honored.

Our group assessed the effectiveness of our DIP in three ways. Students completed a pre-course and post-course written questionnaire to gather information on their perceptions of participating in learning mathematics. This questionnaire focused on the areas of access, agency, authority, and identity. Second, each professor completed a number of reflections to record their perceptions on how well the DIP was executed with specific attention to the efficacy of the strategies employed. Finally, professors gathered student work samples as a representation of the learning that took place under certain evidence-based pedagogies (e.g. warm-ups). We secured Institutional Review Board (IRB) approval for all data collected. We met in late fall 2017 and discussed our progress and shared successes and challenges. One on our team implanted these strategies and collected data in their Calculus I course this spring of 2018.

Assessment Results

Findings relevant to the goals of our DIP are provided below.

Pre-Course Questionnaire Results Summary

Question	Summary
1) How well do you think you will do in this course concerning your anticipated grade? Provide evidence for your response (e.g. I'm a dedicated student, I struggle in math classes, etc.). A, A-, B+, B, B-, C+, C, C-, D+, D, D-	Summary response reported as average GPA **3.41**
2) What do you expect to learn?	Sample summarizing statements • A better understanding of Calculus and the concepts that go along with it, like: limits, integrals, derivatives, trigonometry, and theorems • How to use Calculus in the real world • Expanding my knowledge from Pre-Calculus or other Calculus classes taken in high school
3) List the top three activities that you believe will help you learn the content in this course. For example, you may indicate that preparing for tests, taking notes, or watching online videos, etc. will help you learn the content in this course.	Top three reported activities • Taking notes • Watching videos • Tutoring
4) Please indicate your level of agreement with the following statement by circling the best descriptor. In previous math classes I have taken, I have been actively engaged in learning the math content during class sessions.	Summarizing average reported on scale from 1 to 5. 1 Corresponds to 'Strongly Agree' and 5 corresponds to 'Strongly Disagree.' **1.79**

Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree	**(90 Responded)**
5) Please indicate your level of agreement with the following statement by circling the best descriptor. In previous math classes I have taken, I feel that all students had opportunities to verbally participate during class sessions. Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree	Summarizing average reported on scale from 1 to 5. 1 Corresponds to 'Strongly Agree' and 5 corresponds to 'Strongly Disagree.' **1.89** **(90 Responded)**
6) Please indicate your level of agreement with the following statement by circling the best descriptor. In previous math classes I have taken, I feel that the instructor adjusted their instruction appropriately based on the learning needs of students. Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree	Summarizing average reported on scale from 1 to 5. 1 Corresponds to 'Strongly Agree' and 5 corresponds to 'Strongly Disagree.' **2.58** **(90 Responded)**
7) Please indicate your level of agreement with the following statement by circling the best descriptor. In previous math classes, I feel that the instructor cared about my progress in the class. Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree	Summarizing average reported on scale from 1 to 5. 1 Corresponds to 'Strongly Agree' and 5 corresponds to 'Strongly Disagree.' **1.94** **(90 Responded)**
8) How many hours per week do you anticipate working with others outside of class on learning the content in this course?	Reported Average **4.67 hours per student** **(90 Responded)**

Post-Course Questionnaire Results Summary

Question	Summary
1) How well do you think you did in this course concerning your current grade? Provide evidence for your response (e.g. I was a dedicated student, I struggled in math class, etc.). A, A-, B+, B, B-, C+, C, C-, D+, D, D-	Summary Response reported as average GPA **3.26**
2) Did you learn what you expected to learn?	Sample summarizing statements • Yes, covered all units and concepts on the basis of Calculus • Built a lot off of high school calculus classes
3) List the top three activities that you believe helped you learn the content in this course. For example, you may indicate that preparing for tests, taking notes, or watching online videos, etc. helped you learn the content in this course.	Top three reported activities • Went to tutoring and office hours for help • Taking notes • Looking at online videos
4) Please indicate your level of agreement with the following statement by circling the best descriptor. In this math class (Calculus I), I have been actively engaged in learning the math content during class sessions. Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree	Summarizing average reported on scale from 1 to 5. 1 Corresponds to 'Strongly Agree' and 5 corresponds to 'Strongly Disagree.' **1.81** **(117 Responded)**
5) Please indicate your level of agreement with the following statement by circling the best descriptor. In this math class (Calculus I), I feel that all students had	Summarizing average reported on scale from 1 to 5. 1 Corresponds to 'Strongly Agree' and 5 corresponds to 'Strongly Disagree.'

opportunities to verbally participate during class sessions. Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree	**1.58** **(117 Responded)**
6) Please indicate your level of agreement with the following statement by circling the best descriptor. In this math class (Calculus I), I feel that the instructor adjusted their instruction appropriately based on the learning needs of students. Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree	Summarizing average reported on scale from 1 to 5. 1 Corresponds to 'Strongly Agree' and 5 corresponds to 'Strongly Disagree.' **2.33** **(117 Responded)**
7) Please indicate your level of agreement with the following statement by circling the best descriptor. In this math class (Calculus I), I feel that the instructor cared about my progress in the class. Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree	Summarizing average reported on scale from 1 to 5. 1 Corresponds to 'Strongly Agree' and 5 corresponds to 'Strongly Disagree.' **1.74** **(117 Responded)**
8) How many hours per week did you spend working with others outside of class learning the content in this course?	Reported Average **3.94 hours per student** **(117 Responded)**

On item one, students predicted that they would earn a GPA of 3.41, but indicated that they would earn a GPA of 3.26 at the end of the semester. This is likely due to the difficulty level typically experienced in a college level Calculus I course. Commonalities in student responses to item two were having a better understanding of calculus, using calculus in the real world, and expanding on what was learned in previous classes. On the post-questionnaire, commonalities were covering all units and concepts on the basis or foundations of calculus and expanding on what was learned in high school calculus. Responses to item two revealed a partial alignment between what students expected and what they experienced. Responses to item three on the pre-questionnaire showed that students thought taking notes, watching videos, and tutoring would help them succeed in the course. Responses on the post-questionnaire revealed the same findings but in a different order as based on frequency of response.

Items four through seven required student responses ranked from one to five with one being 'strongly agree' and five being 'strongly disagree.' Student responses revealed no significant difference between pre and post averages and therefore no significant effects from the strategy implementation as based on these particular questions. However, this finding may speak to the need for more refined questions or data gathering techniques. For instance, student interviews may reveal more nuanced reactions to the strategies and the way instruction was approached in their Calculus I course. On the pre-questionnaire student responses were averaged to reveal a prediction of 4.67 hours per week spent studying outside of calculus class. On the post-questionnaire student responses were averaged to reveal a markedly lower average of 3.94 hours per week.

Professor Feedback

The three professors who participated in fall 2017 provided feedback in the following form: 1) three professor reflections (early, middle, and late in semester); and 2) list of warm-ups and think-pair-shares we each have used during the semester. Our team felt that this documentation would provide us and others a list of how two of our implemented strategies were incorporated into instruction. Furthermore, we expected that the reflections would serve as a gauge on how well the implementation played out and what we learned about implementation as the semester progressed. See below for a summary each of the three professors reflecting on their experiences using these strategies.

Professor One Reflections

In general, I felt that the class that responded better to class discussion was the class that performed better on assignments. I did feel a larger percentage of the class asked questions or contributed (in both of my two sections) than I have typically seen in other semesters. I believe I was able to reinforce material in a more deliberate way through warm-ups, and the think-pair-share activities resulting in students interacting more with their peers (during these and other activities). I think students felt more comfortable approaching me because of the effort to learn more about them. Using warm-ups as transitions helped me articulate connections and the "big picture" of calculus better than I believe I have in any previous semester.

The drawback of the warm-ups and think-pair-share activities might be considered a loss of class time, but I felt the time was used more wisely than before (for the most part). The primary drawback of all the strategies (think-pair-shares, warm-ups, getting to know students) was the level of energy and planning required. I found myself exhausted at the end of the semester, and my teaching load was not as heavy as some semesters. If the strategies are completely new to a professor, I would suggest deliberately implementing "getting-to-know you" approaches in one semester before adding the warm-ups/think-pair-shares (or vice versa).

Professor Two Reflections

The beginning of the semester (first few weeks) had a few challenges that were expected

- Students were unsure of how to collaborate/comment on math questions
- Mainly worked independently and then swapped notes with no constrictive comments

After the first few weeks but before the midterm the students were in full swing of expectations

- Students expected to have a warmup on the screen when they walked in
- Many students did not need instructions to get started on the warmups
- Much more "in the moment" collaboration on the TPS

The Second half of the semester was used to produce student driven ideas at a deeper level

- Introduced new concepts/extension in the warmups
- Had students write an outline of how to think about problems

Much more student driven at this point in time (some "heated" debates on solutions occurred)

Professor Three Reflections

The semester of Calculus I went very well and the strategies seemed to benefit the students for a number of reasons. It took about two and a half weeks for me to learn the name of each student. I had students make name tents on card stock and they displayed their name tent until I was able to name each student with no hints. Students seemed to appreciate the fact that I learned and used each of their names. They even applauded when I correctly named each student. One potential drawback was the time and effort it took me to learn each name. I believe the benefits outweigh the drawbacks.

The warm-ups and think-pair-shares held students accountable for their learning. This represents a change from some previous semesters where students seemed to go through the motions during class time and remain passive. I typically used warm-ups to remind students of a previously addressed concept. This gave them practice in applying what we had covered in the previous class. These informal assessments gave students a chance to monitor their own understanding and the chance for me to formatively assess whether or not students were understanding. If I felt that they needed more help with a concept after the warm-up, I would take a little class time to review in light of specific questions. I used think-pair-shares in conjunction with each warm-up and in the middle of notes if I wanted to give students immediate practice with a new idea. One challenge was that of monitoring how much class time we spent on these strategies. As the semester progressed, I got much better at giving a specific time window to complete a warm-up and/or think-pair-share.

I suggest that others try these strategies, but begin with one at a time. Possibly try to get to know each student and their name at the beginning while using some warm-ups. If you see benefits to you and your students, then try to incorporate other strategies more frequently. I will continue to use these strategies in my subsequent course offerings.

Conclusion

Recall that the objective addressed in this DIP was to meet the needs of diverse learners represented in Calculus I courses. Addressing this objective aligned with the Mathematics and Statistics Department's larger goal to, "gather and identify research to breaking down obstacles for diverse groups entering Elon and MTH/STS." The particular goal of our project was to increase the participation of diverse learners in Calculus I through implementing evidence-based pedagogies. We anticipated three byproducts of meeting this goal: 1) increased access to mathematical content; 2) increased agency, authority, and identity; and 3) flexible instruction that responds to students' needs and thinking (Schoenfeld, 2016). Based on summarized findings, we found that the pedagogical strategies implemented and studied showed promise for meeting the overall DIP objective and specific goals. Undergraduate educators are encouraged to consider implementing these strategies for the betterment of all learners.

Dissemination

Our team has presented our study and findings with the Department of Mathematics and Statistics during our faculty meeting on April 4th, 2018. This presentation was well received, and

members of the department seemed to benefit from our shared work. Additionally, we submitted an abstract to present our work and findings at the Mathematical Association of America's Annual MathFest Meeting in Denver in August of 2018. We eagerly await the proposal reviewers' decision. Finally, we look forward to discussing the possibility of crafting a paper to share our research story and findings for a practitioner journal such as the Mathematical Association of America's Focus Journal.

References

National Council of Teachers of Mathematics. (2014). *Access and Equity in Mathematics Education Position Statement.* Retrieved from http://www.nctm.org/Standards-and-Positions/Position-Statements/Access-and-Equity-in-Mathematics-Education/

> Creating, supporting, and sustaining a culture of access and equity require being responsive to students' backgrounds, experiences, cultural perspectives, traditions, and knowledge when designing and implementing a mathematics program and assessing its effectiveness. Acknowledging and addressing factors that contribute to differential outcomes among groups of students are critical to ensuring that all students routinely have opportunities to experience high-quality mathematics instruction, learn challenging mathematics content, and receive the support necessary to be successful. Addressing equity and access includes both ensuring that all students attain mathematics proficiency and increasing the numbers of students from all racial, ethnic, linguistic, gender, and socioeconomic groups who attain the highest levels of mathematics achievement.

Schoenfeld, A. (2016). What makes powerful classrooms—and what can we do, now that we know? *Mathematical Association of America Focus, 36*(2), 11-14.

> If you could focus on five aspects of mathematics instruction in order to improve mathematics teaching, what would they be? Those five things should (a) have students emerge from the course as powerful thinkers and problem solvers when they are well implemented; and (b) have a coherent way to implement. The article introduces a framework with five dimensions: (1) The Mathematics; (2) Cognitive Demand; (3) Access to Mathematical Content; (4) Agency, Authority, and Identity; and (5) Formative Assessment.

Steele, C. M. (2010). *Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do.* New York: W. W. Norton and Company.

> Claude M. Steele, who has been called "one of the few great social psychologists," offers a vivid first-person account of the research that supports his groundbreaking conclusions on stereotypes and identity. He sheds new light on American social phenomena from racial and gender gaps in test scores to the belief in the superior athletic prowess of black men, and lays out a plan for mitigating these "stereotype threats" and reshaping American identities. (from amazon.com)

Appendix

1) Getting to Know Students at Beginning of Semester (Faculty Resource)
Begin semester with learning about each student's background and expectations (3x5 Card may be best option for gathering this knowledge). Use an ice-breaker activity of your choice (see resources below).

From Wright (2012): *Research on the first day of class by Knefelkamp showed there was a real desire on the part of both students and teachers for connectedness, but neither group realized the other shared that desire. If the participants on both sides don't understand how to develop their relationships, learning will be diminished. If you have experienced some anxiety about this meeting, planning some specific steps can not only reduce that feeling, but can get students to share in the sense of purpose you hold for the class.*

Minimal information to attain from each student (first four may be shared with the class during ice-breaker, the last three are for the professor only)

A. Name
B. Year in college
C. Where they are from
D. List one or two things that are important in your life
E. Last math course taken
F. What are your expectations for learning in this course?
G. What would you like me to know about your individual experiences learning math?

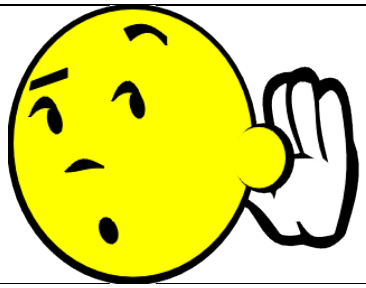
Resource One: The Most Important Day: Starting Well (by Delivee L. Wright). Includes list of ice-breakers.
http://www.honolulu.hawaii.edu/facdev/guidebk/teachtip/dayone.htm

Resource Two: Strategies for Getting to Know Your Students.
http://www.unl.edu/gradstudies/current/teaching/names

Resource Three: Strategies for Building Rapport with All Students.
http://www.unl.edu/gtahandbook/building-rapport

2) Best Practices for Discussing Mathematics (Handout)

Practices for Discussing Mathematics

1) Respect each other by actively **listening** to each other's contributions.	
2) **Analyze** and **evaluate** the mathematical thinking and strategies of others (NCTM).	
3) **Construct** viable arguments (CCSS-M): a. **make conjectures** and build a logical progression of statements to explore the truth of conjectures; b. **justify conclusions**, communicate them to others, and respond to the arguments of others.	
4) **Revoice** others' verbal contributions ("I hear you say…").	
5) **Believe** that we, "learn to speak and act mathematically by participating in mathematical discussion and solving new or unfamiliar problems" (Goos, 2004).	

3) Best Practices for Writing and Conducting Mathematical Warm-Ups (Faculty Resource)

Definition: the act or an instance of warming up; *also*: a preparatory activity or procedure (Merriam-Webster).

Purpose: There numerous reasons for incorporation warm-ups into your instruction including:

A. To review a previously addressed concept or problem;
B. To provide the professor a window of formative assessment;
C. To address a pre-requisite skill or concept that provides a foundation for the class session material;
D. To spark curiosity and build anticipation for the new material of the class session.

Resource One: How to Ask Good Questions
http://www.nctm.org/Conferences-and-Professional-Development/Tips-for-Teachers/Asking-Questions-and-Promoting-Discourse/

Set up classroom norms so that everyone knows their role in the classroom.

The teacher's role includes orchestrating discourse by:

- posing questions to challenge student thinking;
- listening carefully and monitoring understanding;
- encouraging each student to participate - even if it means asking, "Who can repeat what Andrew said?" or "Who can explain in another way what Bailey did?"

The student's role includes:

- listening and responding to the teacher and one another;
- using a variety of tools to reason, make connections, solve problems;
- communicating, and make convincing arguments of particular representations, procedures, and solutions.

(From http://www.nctm.org/Conferences-and-Professional-Development/Tips-for-Teachers/Asking-Questions-and-Promoting-Discourse/)

4) Best Practices for Conducting Think-Pair-Shares (Faculty Resource)

Think-Pair-Share (Lyman, 1981) is a summarization strategy that can be used in any content area before, during, and after a lesson. The activity involves three basic steps. During the "think" stage, the teacher tells students to ponder a question or problem. This allows for wait time and helps students control the urge to impulsively shout out the first answer that comes to mind. Next, individuals are paired up and discuss their answer or solution to the problem. During this steps students may wish to revise or alter their original ideas. Finally, students are called upon to share with the rest of the class. There is also a Think-Pair-Square-Share. In this strategy, partners discuss answers with another pair before sharing with the class. This activity ensures that all students are interacting with the information. Teachers can use this activity in the formative assessment process as they walk about the room listening to student conversations. (from West Virgina Dept. of Ed.)

Ask questions that assess the students' learning. Try **Think-Pair-Share**. Call on students by name to invite them to contribute. These questions are not, "Do we all get it?" or, "Does anyone have any questions?" Rather, these questions must give the learners an opportunity to communicate their reasoning process - why they chose a particular method and how their choices made sense. Transform some of your *closed* questions, those that can be answered with one word, to *open* questions, those that require explanation.

Be careful to make this transformation gradually. Some students may not answer open-ended questions because they are only comfortable answering questions that they can be confident they know what constitutes an appropriate response. One way to encourage students to contribute to the discussion is to use the think-pair-share method. First, allow students to think alone about their solutions. Then, allow them to talk through their ideas with a partner. Next, ask two pairs of students to share their ideas with each other. Last, facilitate a whole-class discussion. (From http://www.nctm.org/Conferences-and-Professional-Development/Tips-for-Teachers/Asking-Questions-and-Promoting-Discourse/)

Consider getting each student to write down at least one sentence to document their thoughts before enacting the think-pair-share.