Ohio | Department of Higher Education

Mike DeWine, Governor
Randy Gardner, Chancellor

Ohio Mathematics Initiative
Subgroup 2 – OTM Revision Panel
February 8, 2019
10:00 am to 2:00 p.m.
Northside Library
1423 N High Street, Columbus, OH 43201

Present: Trefor Bazzet, Terry Calvert, Irina Chernikova, Patrick Dowling, Blerta Ereditario, Katharine Fisher, Steven Gubkin, Karl Hess, Bill Husen, Pramod Kanwar, Ricardo Moena, David Stott, Lee Wayand, Michelle Younker, Paul Zachlin

ODHE/OATN Staff: Jessi Spencer

I. **Welcome**

Dr. Richard Moena of the University of Cincinnati welcomed the group and thanked all of the participants for joining. He explained that the group was meeting to reflect on last year's discussions and on this year's projects. He reinstated that last year work was done to refine calculus learning objectives and rewrite them in such a way to inspire faculty to be more proactive when teaching calculus. He also mentioned that learning objectives were being crafted for elementary mathematics.

II. Updates from Subcommittees

The meeting began with updates on the Calculus Project. Dr. Lee Wayand of Columbus State Community College explained the group's shift in focus from subjects, contents, sequences, and courses to a more student-focused mindset that thinks explicitly in terms of benefitting students. Although thinking in this new mindset was a challenge, it has opened doors to creating new opportunities and thinking in different ways, especially in respect to the quantitative reasoning (QR) course. However, this only brings the group to the starting line. The group is prepared to do what it has wanted from the beginning, which is to refine a STEM pathway.

Because the current calculus sequence has not shown to be as effective as desired, there was discussion of "re-inventing the wheel" in regards to the calculus sequence. A new picture develops when different populations of students are addressed with different calculus needs. One representative proposed providing faculty with a comprehensive list of mathematics topics and having them designate via a survey which topics they believed to be most critical to student learning of calculus. The survey results could help delineate which topics have been addressed and which areas need more attention.

The group discussed which populations of students would be included in STEM, including chemistry, physics, biology, biochemistry, pharmacology, and environmental sciences. The group questioned whether engineering should be included in the same group as these other science majors or whether it would have its own separate mathematics requirements. Representatives wondered whether it would be wise to develop several different "flavors" of calculus to fit the needs of different populations of students. For example, at Sinclair Community College, biology and business administration are overwhelmingly the largest majors on campus. To the Sinclair representative, it would make sense to construct calculus classes tailored for their needs. However, it was noted that only institutions that could enroll students in large enough numbers in these tailored classes would be able to offer them. For smaller institutions, perhaps courses could be combined if small numbers of students were enrolled in courses.

However, one representative pointed out that if institutions offer a variety of types of calculus, some students might be better prepared than others down the line while others may need to retake a course to cover content they did not thoroughly learn before. It was suggested that a regional point of view might work best if several flavors of calculus were offered. On the other hand, a course providing a general survey of mathematics could also be an option. The group agreed, though, that it is difficult to create just one course to serve all students' needs.

The discussion then focused on ways to best prepare students for calculus. Students who start college by taking college algebra or pre-calculus often do not finish calculus II, which indicates that these courses are not adequately preparing students for calculus. In college algebra for non-STEM students, there are currently components that are only included in the course curriculum to make the course passable. One representative suggested that these elements should be dissipated and replaced with material that will sufficiently prepare students for further math courses.

One representative supported the previous claim that college algebra does not adequately prepare students for calculus. Students are most successful in calculus if they enter calculus from right after high school, rather than if they enter college algebra first. Another representative explained that many elements of college algebra are redundant with high school algebra II. Many other elements of college algebra are trigonometry-focused. Perhaps this could be constructed as a pre-calculus course and could serve as a better preparation for calculus than college algebra currently is.

The group also explored the feasibility of requiring only two semesters of calculus for engineering majors instead of three. It was noted that this would be difficult given the large amount of calculus needed for engineering. However, not all students are required

to take a multivariate calculus course. The mechanical engineering accreditor does require a multivariate course for mechanical engineering majors, but other engineering majors only require a single variable course, as well as linear algebra and differential equations. The group agreed that all schools have different requirements to meet the accreditor's requirements. It was suggested that engineering faculty are invited to voice their opinions on requiring only two semesters of calculus. A survey should be sent to obtain feedback from engineering faculty and to collect information on various institution calculus requirements.

The group then turned their attention to the elementary education major pathway. Currently, statistics demonstrate that education majors score lower on math placement exams than any other major. This is especially true for elementary education majors. One professor spoke of the importance of teaching these students that math is not scary. Rather, it is something they can reason about and that it is natural for humans to engage in it. This attitude shift can lead to miraculous changes in students. In addition, it is important that education majors are adequately prepared to teach math in their future careers.

The current landscape of the mathematics courses required by education majors is diverse in terms of the number of courses required, the number of credit hours required, and the textbooks used to aid in learning. For instance, The Ohio State University requires two courses at 5 credit hours each. Meanwhile, Cleveland State University offers 3 courses at 3 credit hours each. Bowling Green State University, on the other side of the spectrum, only requires one course at 3 credit hours. Furthermore, the manner in which students are being taught these courses varies significantly, with some professors utilizing a more lecture-based format with PowerPoints. Some faculty have also never taught courses such as these before. A representative suggested there be a list of standardized desired outcomes for these courses and a vision statement on how the courses should be taught. This could help build a foundation for someone who has never taught these courses before.

The ways in which math courses are taught for middle school level education majors are especially inconsistent. Some institutions teach middle school level courses alone, while others combine these courses with elementary school level or high school level courses. Thus, the content of courses changes from institution to institution. The good news, though, is that several national organizations like the College Board of Mathematical Sciences have specified recommendations for what these future educators should be learning in their mathematics coursework. These organizations are largely in agreement about these recommendations and these can be used as a launching point.

Presently, the biggest disconnect in progression is from the middle school level to the high school level. There is currently a low enrollment rate for middle school education majors. Raising the mathematics requirements for this level would obliterate the already-low enrollment rate because many middle school level education majors do not wish to take higher level math courses. To exacerbate the situation, the licensure system is changing within the next year or two. Currently, the teaching licenses are for grades K-3, 4-9, and 7-12. Soon it will change to K-5, 4-9, and 7-12, leaving grade 6 as the only uniquely middle school grade. It is reasonable to assume that even fewer people would enroll in the middle school education level if there are other licenses that cover many middle school level grades plus a few more of interest. The group suggested that perhaps we look at other states that match Ohio laws and examine how they teach mathematics to education majors. Perhaps doing so would help the group find uniformity to model. The silver lining is that we are working on our changes with the changing licensure in mind.

III. New Projects

The group then discussed Calculus for the Life Sciences. It was suggested that this course would initially be offered to biology majors with other life sciences majors following suit afterwards. One representative believed that using active learning techniques would be beneficial to this population of students, with meaningful examples customized for these students' needs. The group discussed the fact that statistics is almost a universal requirement for majors in the life sciences. Most institutions have a two-course math sequence for life sciences majors where statistics is one of the courses. Other institutions, though, weave statistics into both math courses. Again, it was brought up that every institution organizes their requirements differently and that this is impeding transferability.

Mathematics requirements for business majors were then discussed. One suggestion was that business majors take a terminal quantitative reasoning course with an algebra flavor. Other suggestions included adding contextualization for business majors and adding a focus on probability. One representative explained how quantitative reasoning can provide a viable alternative to college algebra for these students because it has the capability of teaching them logical thinking skills. According to this viewpoint, many programs state that they want a college algebra course when really they want students to develop particular skills which could also be developed in a more relevant course like QR. The goal would be to make people aware that QR can do this. Another representative, however, believed that college algebra is fine how it currently is, but that its emphasis is what matters. In another point of view, a legitimate four-hour pre-calculus course focused on functions and the necessary pieces of college algebra and

trigonometry could be created. This would eliminate the requirement for college algebra and would keep students from having to take college algebra just to fulfill a general education requirement.

The discussion then focused on technical mathematics. One representative wondered what percentage of students were enrolled in these programs and Jessi Spencer from the Ohio Articulation and Transfer Network (OATN) stated that OATN could try to find this information. At one institution, technical mathematics courses are struggling to stay afloat because enrollment numbers are quite low. Skilled trade students inquire about this class the most, since college algebra and statistics do not fit their needs and their institution does not offer a QR course. One suggestion was to create a math course that addresses QR but has a flavor of whatever the institution needs.

There has recently been a lot of movement regarding quantitative reasoning (QR) courses. 10 QR courses are currently approved at institutions and 1 is pending approval. The group decided a reminder should be sent to institutions who have not already done so to submit a QR course. It was also suggested that institutions who have approved QR courses should be contacted to see if they would share some of their projects so other institutions can reference them in creating their own QR course. Ms. Spencer said that OATN can help with this effort.

The group discussed the importance in modifying the methods in which QR courses are currently taught and in which students are assessed. Rather than exams, which do not allow students to build arguments around their data, more projects should be incorporated into the course. Several institutions indicated that it would likely not be difficult to get their department to support this change. The group expressed interest in developing an expectation statement regarding QR teaching methods, which perhaps could also be included in the TMM. Additionally, several representatives were interested in discussing this issue at the Strong Start to Finish spring convention on March 1st because much attention is currently being given to this event. Roundtable discussions might be an adequate stage for this discussion.

IV. Lunch

The attendees took a break for lunch.

V. New Projects - Continued

The group discussion then centered around mathematics requirements for nursing majors. Typically, the mathematics requirement for nurses is statistics. However, groups like the Nurse Advocacy Association (NAA) and the Dana Center have been analyzing

national trends in mathematics requirements for nursing and are observing changes. The group agreed that a survey should be sent to institutions to collect information on mathematics requirements for nurses and whether they are satisfied with their requirements. There was discussion on how to best modify mathematics courses to fit nursing needs, which is what the NAA is proposing. Some suggestions included requiring a course where students practice calculating dosages of medications or requiring a QR course that has some statistics components and is contextualized for nursing students.

Several representatives agreed that it would be beneficial and appealing to students to combine requirements and cut down on credit hours wherever possible. The group suggested sending a survey to nurses (rather than mathematicians) to explore their opinions on national trends in nursing major mathematics requirements. The survey results could help this group determine whether this is a project they would like to focus on, and a smaller task force could be created for this project. Additionally, one representative noted that some LA health programs often follow suit with nursing programs. It may be of interest to include a few people from LA health in these discussions as well.

VI. For the Good of the Order

The group expressed interest in distributing several surveys to various populations of faculty to obtain their opinions on mathematics requirements for their students. A survey containing a comprehensive list of one hundred mathematics topics will be distributed to mathematics faculty so they can designate which topics would be most critical to student learning of calculus. Another survey will be sent to engineering faculty to collect information about their institution's mathematics requirements for engineering students. Additionally, this survey will explore engineering faculty opinions of requiring two versus three semesters of calculus. Additionally, a survey will be sent to institutions to collect information on mathematics requirements for nurses. Nurse faculty interest on national trends in math requirements for nursing students will also be gathered. After these results are collected, a smaller task force could be created to focus on mathematics requirements for nurses. Finally, a survey will be distributed to institutions without approved QR courses to see whether they are in the process of developing and/or submitting a QR course for approval. Institutions who have an approved QR course will be contacted to see if they would be interested in sharing some of their projects as a reference.

Additionally, the Ohio Articulation and Transfer Network (OATN) will conduct research in several areas to promote this group's mission. OATN will analyze national trends in mathematics requirements for early and middle childhood education majors. OATN will also analyze the numbers of students graduating in these areas. Additionally, OATN will

conduct research to discover what percentage of students at each institution are enrolled in a technical mathematics course. Technical mathematics syllabi will also be collected from institutions.

Finally, teaching methods for QR courses should be discussed at the Strong Start to Finish spring convention on March 1st, perhaps at the roundtable discussions. No other questions arose regarding any of the content discussed, and the meeting was adjourned.