

## **TMM001 Quantitative Reasoning Expectations**

While the TMM011 guidelines provide a complete description of a quantitative reasoning course, it might be beneficial to summarize the intentions of the course. This quantitative reasoning course has been developed to teach students to logically analyze situations involving measurements, whether they be quantities or rates. Students learn to describe situations through measurements and relationships between those measurements. Students learn to hypothesize on details or consequences of conditions. Students learn to make decisions, formulate and execute plans, and interpret and judge results. Finally, students learn to communicate their analyses and discuss their conclusions. This knowledge should be the target of course assessment. Can students operate independently inside a quantitative situation?

While calculational skills are necessary in every facet of this endeavor, they are not the course objective. This course exists because incoming students struggle with the reasoning. Therefore, it might be appropriate to start with basic situations requiring the application of fundamental numerical reasoning concepts such as doubling and percentages, emphasizing pertinent calculations, and generally offer more direction toward the beginning of the course. However, as the course continues, it is desired that assessment become dominated by more complex situational descriptions and stated goals. It is also desired that assessments ask students to make decisions, explain their choices, implement their plan, describe their results, judge their applicability, and communicate their reasoning and any conclusions.

Assessments must transform throughout the course to reflect an intentional effort to help students become independent thinkers in unfamiliar situations. We hope that students will take this reasoning knowledge with them as they explore future subjects in their college careers. To accomplish this, it is also preferable to include novel situations on assessments. To assess student reasoning, it is necessary to observe how they approach situations which the course has not previously visited. Assessments should become less dependent on calculational questions, more inclusive of unprompted decisions, and capable of placing students inside innovative situations.

## College Algebra Expectations

The Ohio Mathematics Initiative was formed in response to a growing concern that our mathematics pathway was not serving our students' academic goals.

*The Ohio Mathematics Initiative (OMI) is a collaborative effort of mathematics faculty members from the state's public colleges and universities and Ohio high schools that is revisiting and rethinking mathematics courses and curricula and the relationship of mathematics to other disciplines.*

*One catalyst for the initiative is the need to better align course options to students' academic and career goals.*

Part of the OMI's attention has been drawn to college-level entry courses where College Algebra has long been the default course for beginning students regardless of program or degree. This bottleneck has two significant consequences.

First, non-STEM students are asked to learn concepts and skills tailored for a STEM degree. While the larger ambitions of critical thinking and reasoning can be gleaned from these activities, investigating the details of elementary functions has not been an effective conduit for non-STEM students. These lofty aspirations for reasoning are obscured from non-STEM students by the struggle to learn procedures and implementation. Thus, College Algebra has experienced constant transformation to accommodate these students and their goals. Secondly, by accommodating other audiences, goals, and motivations, STEM students have not received the level of preparation they need for Calculus. Now that a Quantitative Reasoning course is a viable alternative for a critical thinking and reasoning education, the OMI can finalize the revision of College Algebra and Trigonometry as a sequence solely dedicated to Calculus preparation.

## Subgroup 2 : Quantitative Reasoning Proposal

Quantitative Reasoning (QR) courses are an essential component of Mathematics Pathways outside the STEM fields. Many institutions have adopted and agreed to the common set of Learning Outcomes described in TMM011 of the OTM. This course, in similar format and in all instances, satisfies a QR component of general education programs.

The purpose of a QR course is to engage students in intellectual processes that exemplify a critical evaluation of quantified information encountered in everyday life. These processes revolve around reasoning rather than manipulative skills or procedures. Students are expected to decipher information, make decisions, create models, conduct investigations, deduce conclusions, notice connections between similar situations, and communicate their thought processes at every step. It is expected that these processes result in logical analyses of commonplace situations involving measurement. The computational skills required from the students for this purpose are, for the most, learned in middle school and early high school, so the “college level” component must be carefully considered as the reasoning and communication aspects of the course. This is not easy.

Developing and teaching these type of courses is labor intensive. It requires instructors to constantly update materials, critically assess students’ written work, and provide continuous feedback. Most importantly, instructors must minimize the traditional type of assessments - items that mostly measure memorization and procedural skills - on quizzes and test. Reasoning skills, communication skills, and cooperative approaches to work are important outcomes that must be assessed and should weigh heavily in the evaluation of the student performance.

There are several published textbooks available for QR courses, but in general the homework-delivery systems attached to these textbooks are designed to measure memorization and basic procedural skill levels, leaving out of the assessment process the most important outcomes of the course – the reasoning. In addition, the relevance and dated nature of the problem situations and projects presented in these texts can also be an issue that affects the quality of the course. Finally, national educational organizations such as Carnegie and the Dana Center, providers of resources, materials, and faculty training for QR courses, are now either transferring publishing rights to corporations or, due to increased enrollments, becoming very expensive for both students and institutions.

We propose to assist faculty in maintaining and improving the quality of QR courses taught in Ohio institutions, and lower educational costs to the students.

Group 2 of the OMI proposes:

1. To update and promote the use of the QR project library. Create a community of QR faculty to share activities, projects, ideas, classroom implementation, and assessment practices.
2. To develop and maintain a free-access computerized skill-questions bank available to all institutions.
3. To develop flexible starter-kits, some of which carry field-related threads.