BINGHAMTON UNIVERSITY

ASSESSMENT OF STUDENT LEARNING OUTCOMES
IN GENERAL EDUCATION REPORT
ACADEMIC YEAR 2016–2017

SUBMITTED BY

University Undergraduate Curriculum Committee

Assessment Category: Mathematics/Reasoning
Date: Fall 2017
Introduction: The assessment subcommittee was asked to review 24 course portfolios collected since the Fall 2011 semester. Recommendations are underlined in the main report and summarized at the end.

I. Student Learning Outcome(s)

The General Education Learning Outcomes for Mathematics/Reasoning (M) courses state:

Students in M courses will demonstrate competence in an area such as calculus, symbolic logic, the logic of computers, the logic of deductive and inductive reasoning, or probability and statistical inference.

The University Bulletin states that the courses meeting the M requirement include any course in the Mathematics Department numbered 130 or above, any of several designated statistics courses, or any of several designated logic courses. An Advanced Placement score of 3 or better in Calculus or Statistics may be used to satisfy this requirement.

Students at Binghamton are offered a standard range of calculus and probability and statistics courses from the Mathematics Department that fulfill the GenEd M requirement. There are also probability and statistics courses taught in majors that normally apply those methods. The Philosophy Department also teaches courses in Logic and Reasoning.

II. Plan/Methods/Measures Used in this Assessment

The M requirement lists calculus, logic, or probability and statistics. Calculus courses assessed students in the topics of the calculus curriculum at the appropriate level of the course, statistics classes assessed students in probability and statistical inference to the expected extent, according to the level of the course, and the logic courses assessed students in the principles and techniques of logic and inductive reasoning.

The portfolios submitted for assessment normally include a course syllabus, a written explanation of how the course fulfills the Learning Outcomes, and a reflective statement discussing students’ achievement of the Learning Outcomes, and most provide a tabular Outcomes Assessment Report. The earlier reports provide relevant assignments given to students and sample work, but sample work and specific assignments are not included in the more recent portfolios as they are no longer required.
For each round of portfolio collection, this committee takes a simple random sample of six sections of courses that fulfill the Gen Ed M requirement. Instructors whose courses have been sampled within the previous three years are ineligible for selection during a given academic year. Two courses that did not submit portfolios with the relevant data were trimmed from the sample for the purposes of quantitative analysis. This generated a sample consisting of 18 courses in the Math Department, two courses in the Philosophy Department, one course in the Economics Department, and one course in Computer and Quantitative Skills in the School of Management.

III. Findings

All courses examined include more than adequate material related to the M Learning Outcomes. However, some courses reported large percentages, sometimes 25-30%, of students failing to meet the Learning Outcomes. It was not clear if such students failed the course. Also, some instructors counted students that withdrew from the class as failing to meet the learning outcomes, while other instructors based their analyses only on students still enrolled at the end of the semester. Instructors often state that failing to meet the expected level corresponded to students not attending class and not completing homework assignments. It was also observed that student performance was negatively impacted because of missing background skills, expected from high school, in algebra and, for calculus, trigonometry.

A common theme across many reflective statements was that most students become proficient with the techniques or “mechanics” of the mathematical theory they are studying in the course but only a minority understand how the theory is applied to solve real problems. Some instructors felt they had gone some way in teaching students how to turn the description of a problem into a mathematical formulation but it takes time and depends on commitment from the students.
While there was a significant gap in the collection of data (there was no data for the 2014-15 and 2015-16 academic years), the data suggests an increase in the percentage of students that at least met the learning outcomes between the 2011-12 and 2016-17 academic years. However, student performance sometimes varies greatly, and it is difficult to discern whether this trend is due to chance. The Math Department introduced a new design for calculus courses in Fall 2015, which may have produced the improvement. The change is summarized at the end of Section VI. More assessment data in future semesters will be needed to draw a conclusion.
There was no statistically significant difference (p >.05) between 100 and 200 level courses in the percentage of students that meet the learning outcomes in a given course. However, when broken into all four performance levels, analysis reveals a statistically significant difference (p <.05) between courses at the 100 level and 200 level in the percentages of students that only approached the learning outcomes and the percentage of students that met but did not exceed the learning outcomes. In both cases, the mean for 200 level courses was higher than the mean for 100 level courses. While a larger sample would lend greater certainty, this suggests that the performance of students in 200 level courses has a greater tendency to cluster around moderate performance levels more than it does in 100 level courses. However, when combined, the percentages of students at the extreme levels of achievement (failed and did not approach; exceeded) did not show a statistically significant difference between the 100 and 200 level courses.

IV. Course Syllabi

The math department appears to use a common syllabus for every section of certain courses. However, the common syllabi do not seem to address the Gen Ed M learning outcomes explicitly, although they do state their own learning objectives. Since the learning outcomes, as stated, seem to be fulfilled just by participation in a qualified math course, it is not clear whether or not this is a problem. Of the courses in the department where instructors had their own syllabi, only one explicitly addressed the Gen Ed.

Outside the Math department, only two out of five syllabi explicitly addressed the Gen Ed M learning outcomes. This means that, effectively, only three courses explicitly addressed the Gen Ed M learning outcomes. In some cases, the syllabi linked to a web page that had the verbatim M requirement listed at the end, but the requirement was inconspicuous as a result.

V. Discussion of Strengths and Weaknesses of the Assessment

There is some variation in the M course offerings from year to year. For example, the Economics course sampled was not offered in the 2017-18 academic year. However, using 2017-2018 as a baseline, it appears that the sample might not be as representative of M courses as it could be. For instance, the Psychology Department was noticeable in its absence from the sample. During the 2017-2018 academic year, 20% of the students in Gen Ed M courses were in a psychology course. The Mathematics Department was overrepresented in the sample: although 60% of students in the 2017-18 academic year in Gen Ed M courses took them in that department, it comprised 82% of the sample for this assessment cycle. Although a majority of students in Gen Ed M courses take them in the Math Department, these results should be interpreted with an understanding that the department with the second-highest portion of students in Gen Ed M courses is completely absent from the sample.

A small number of students (< 2% of students in Gen Ed M courses) took courses in the Anthropology and Biology departments during the 2017-18 academic year. It is worth noting that these departments were not represented in the sample.

Submission of the requested portfolio materials was uniformly high: 24 out of 24 courses sampled submitted a description of how the course fulfills the general education requirements, 23 out of 24 submitted a
reflective statement, and 22 out of 24 courses submitted a syllabus. Due to some variation in the way portfolios were compiled, two courses had to be trimmed from the quantitative analyses presented in this report.

In the tabular assessment results, it was not clear which of the four areas of the M requirement -- (i) calculus, (ii) symbolic logic and deductive and inductive reasoning, (iii) logic of computation or (iv) probability and statistical inference -- were being assessed. Only references to certain exams or assignments were listed without explanation. Many instructors were unable to build a bridge from the M Learning Outcome to what knowledge possessed by their students was being assessed beyond listing problem sets or exams. In many cases the courses are overseen by small faculty groups and perhaps contact between the assessment team and those faculty members could be the most productive.

VI. Evidence of Improvements since Last Assessment Cycle

Since only two portfolios were submitted in the last assessment cycle, this committee cannot make strong claims about the success rates in students in Gen Ed M courses during this cycle as compared to the last one. However, over the course of the assessment cycle, there was a distinct positive trend in success rates across academic years. Since the population size of Gen Ed M courses is small each academic year (approximately 22-23 sections), we can be reasonably certain that the success rates demonstrated each academic year were representative of the overall success rate.

The previous committee recommended:

1. The Registrar establish an automated mechanism to enforce prerequisite standings.

During the last Gen Ed M assessment cycle, students enrolled in CS 140 (when it carried the M) without the announced prerequisites. As of the 2006 academic year, CS 140 no longer fulfills the M requirement. Automated enforcement of prerequisites has only recently been implemented and assessment of its overall effect has been undertaken.

2. The request for portfolios be made early in the semester.

This committee makes requests for Gen Ed assessment portfolios before the start of the semester. In addition, the committee now holds a semesterly workshop in order to help instructors compile portfolios that are complete. During this assessment cycle, we received 24 completed portfolios. Although it is not clear how much of this trend is due to the intervention, given the increased response rate for this assessment cycle, this committee sees no need for further intervention in order to increase the response rate.

Changes to the Calculus Curriculum.

The Mathematics Department undertook an initiative to redesign the first two semesters of calculus by changing Calculus I (Math 221, 4 credits) into Differential Calculus (Math 224, 2 credits) and Integral Calculus (Math 225, 2 credits) and Calculus II (Math 222, 4 credits) into Integration Techniques and Applications (Math 226, 2 credits) and Infinite Series (Math 227, 2 credits). Each 2-credit unit is taught in
a half semester, allowing students that fail or withdraw an opportunity to repeat a unit in the same semester or in a subsequent winter or summer term. Students in majors that need Calculus are given a way to meet their requirements in a timely fashion even if they encounter difficulties adjusting to the material initially.

VII. Recommendations:

1. With the change from Math 221 Calculus I and Math 222 Calculus II to the sequences Math 224/225 in Fall 2015 and Math 226/227 in Spring 2016, it seems that meeting the 4 credit requirement for M in the Math Department should be explained more clearly since all of Math 224 through Math 227 are 2 credit courses.

2. The listing of four different areas that can meet the M requirement in the statement of the requirement discourages the use of the requirement verbatim in course syllabi. Likewise, it makes the mapping of assessment measurements to the M requirement difficult for instructors. If instructors are to be asked to include the verbatim Learning Outcomes in the syllabus of every M course, they should understand this is an explanation of the goals of the Gen Ed program, not of the class itself. To achieve uniformity, instructors and the Departments where courses are taught with a common syllabus, should be requested to include the M requirement verbatim on the first page, followed by the specific learning outcomes of the course itself.

3. The UUCC is discussing a change the assessment process from a portfolio-based approach to a survey-based one, impacting recommendations 4 and 5 below. A survey would allow for the collection of more consistent data and larger samples from which the committee can draw information. At the time of this writing, the change in assessment process has yet to be approved by all of the relevant stakeholders. If the UUCC’s revisions of the assessment process are approved, recommendation 4 will be inapplicable, since the change is likely to sufficiently address the issues which that recommendation is intended to address, and recommendation 5 would be reduced to the general information sessions that the UUCC has begun for other areas of Gen Ed in the assessment year.

4. If the assessment process is not changed, instructors should be provided with the more structured assessment instruments with the Learning Outcomes already filled in, possibly broken down into component parts where relevant. This might apply to all Gen Ed Categories. For Mathematics/Reasoning, it would be helpful for instructors to be provided sample tabular assessment formats, individualized for each of the four general areas: calculus, logic and reasoning, computational logic, or probability and statistics. In that way instructors could clarify which assessments are used for different parts of their course; for example, a course on probability and statistics could break the assessment down into testing of ability to compute probabilities, testing knowledge of statistical measures, and testing of the ability to apply statistical inference.

5. In year of assessment UUCC should arrange more interaction with faculty teaching M courses about the learning outcomes and the assessment process. For the M Gen Ed, it seems an initial meeting with the Mathematics faculty coordinating the calculus sequence and elementary statistics courses would establish better guidelines. Based on those changes, workshops held at the beginning of each semester for instructors preparing portfolios (as have recently been offered for other Gen Eds) are a good first step, but if the assessment process is not changed as described in recommendation 3, an additional consultation (in a meeting or by email) while the portfolio is being
drafted may be helpful. The goals would be to improve the quality of portfolios while also saving instructors and assessors time and effort by making the process more transparent.

Chief Academic Officer: _______________________________ Date: 1-8-19