GES3: Solve problems using quantitative reasoning.

MATH0901, 1000, 1010, 1016, 1030

Semester: FALL 2013

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For the Fall 2013 Semester students in GE mathematics courses 1000, 1010, 1016, 1030, (0901) were assessed using the AAC&U Quantitative Literacy Value Rubric. This assessment was conducted in all sections and data was received and analyzed as follows:

Course	Number of Sections	Number of Students
Math0901	12	539
Math1000	21	407
Math1010	11	248
Math1016	11	283
Math1030	1	24
Math1054	7	140

Quantitative reasoning presents a nuanced picture at Kean university. At this time we define quantitative reasoning more specifically as: algebraic thinking (reasoning), statistical thinking (reasoning), proportional thinking (reasoning), and problem solving. Our students vary in performance levels depending on the course and the complexity of the quantitative task before them. Overall students succeeded in calculation on familiar problems (Math1010, 1000, 1016, 1030, 1054), but had more difficulty with novel contexts (Math1010, 1054). The AAC&U Quantitative Literacy Value Rubric was more difficult to use in traditionally taught courses that value procedural calculation fluency (Math1000, 1054), as opposed to those that inherently require students to explain and analyze their work (Math1016, 1010, 1030). Much reflection and consideration is required to move forward and evaluate our pedagogy and curriculum to ensure not just high levels of students' learning, but high levels of students' learning mathematical content that is both meaningful and necessary for their future professional and personal lives. We believe that reflection needs to occur not just at the micro level but also at the macro level – looking at all the relevant courses, thinking longitudinally, thinking about the different routes students might take and the needs they might have as they enter particular majors.

Math0901

Some students enter college without the basic quantitative reasoning skills necessary to enter a college level Mathematics course. In this case, they begin with an Introductory Algebra course which will allow them to build the skills they will need to be successful at the next level.

Students were assessed at the beginning of the semester using a pre-test comprised of questions from each of the areas of algebra that were tested on the placement test. At the end of the semester they were given a cumulative final exam covering the same topics to measure their progress over the course of the semester. We have measured a very positive student learning, retention and development from the pre-test scores to the final exam.

Math1000

Students in this course showed the most weakness in calculation which perhaps speaks to the basic concern about college level algebraic readiness[1]. Multiple approaches are needed to ensure satisfactory student learning (program alignment, high level of learning in Math0901, curriculum and pedagogical innovation in Math1000.)

Math1010

Students in Math1010 showed some weakness in all AAC&U Quantitative Literacy Value Rubric categories. This is not surprising as this is a freshmen level course and student may begin at very different levels of mathematical proficiency. We are increasing our expectations of analytical thinking in all aspects of real-life open-ended authentic quantitative problems and to that end enriching our curriculum with such problems and many opportunities to practice these skills.

Math1016

Students in this course showed weakness in application/analysis and Assumptions. Data is a critical component in many aspects of education, careers and life. Data helps to make decisions in the fields of psychology, sociology, criminology, economics, business, medicine, sports and education, just to name a few. In Math 1016 the student is taught the skills needed to think for themselves, the ability to communicate and how to utilize the findings in an effective and concise manner. It is important to assess the students' quantitative reasoning skills, to make sure they are able to apply them upon completing the course and entering into their careers.

Upon completing Statistics, students have learned the basic understanding and skills that will carry them into the next level of reasoning course, whether it is Research and Technology, Research, Methods for Criminal Justice or Psychology Statistics, and eventually into the Capstone course.

An effective way to assess the students' skills is through a final project. This project models what would be happening in the "real world". All aspects of quantitative reasoning are covered in this assignment. The student is encouraged to pick a topic that relates to their field of study, or is of major interest. They must create the statistical test, gather and analyze data, draw conclusions, make predictions and

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1 Kean serves predominantly urban, minority, and low socio-economic level students from New Jersey who are affected by New Jersey's highest achievement gap where these same students may graduate 3 to 4 class levels behind their white and sub-urban peers. New Jersey Capital Report, 01/12/14, Janellen Duffy and Ann Borowiec, Jerseycan.

communicate the results. All of these are the key elements of quantitative reasoning. The project is assessed using the AAC&U Quantitative Literacy Value Rubric.

Math1030

Students in Math1030 were well able to represent, interpret, calculate, analyze, and communicate their quantitative findings in portfolio problems submitted at the end of the semester. Students performed the lowest on assumption: "no student met level 3 with 75% at level 1 and 8% at level 2. Assumptions were not explicitly discussed and therefore that low score is consistent with the course context." (Math1030 report) With due caution, we can conclude that student performance reflects the course content – if you have to explain throughout the course you will get better at explaining. We must continue to develop this course and ensure mathematical rigor within its all-encompassing structure.

Math1054

Students in Math1054 appeared to perform 'equally bad and good', i.e. in a binomial distribution on the AAC&U Quantitative Literacy Value Rubric. Considerations of pedagogy and curriculum should be planned. Perhaps some students need conceptual understanding to perform procedurally and vice-versa. Additionally, longitudinal studies will be planned that explore student preparation in pre-requisite Courses (Math0901, 1000).

In General

The students in Math 1016, Math 1010, Math 1030, and Math 1000, were assessed at this introductory level using the AAC&U Quantitative Literacy Value Rubric for the first time and on different types of assignments (embedded exam questions, project papers, portfolios).

At the intermediate level, a pilot study assessed 8 sections of Research and Technology was performed identifying it as the intermediate level for the assessment on quantitative reasoning. In this course, assessment was done on the students' final research project with the rubric. This project continues to have students apply Quantitative Reasoning across the curriculum at a more advanced level by having not only designing methodology and perform experimentation but also explain results and discuss them with published literature.

At this initial phase it was impossible to track the same student through all of their courses. What can be compared are the means of the rubric. The results are positive and show a slight improvement in students' reasoning abilities as they proceed through these levels. In order to truly see if the course progression is working, two things must happen. First, math must be taken prior to Research and Technology, however, since Statistics and Research and Technology are so connected, it may be interesting to pilot a paired course in Fall 2014 and compare to other data. Secondly, it is imperative to track every student through their academic career.

The 1000 level Mathematics courses each emphasize different strands of quantitative reasoning. It would be useful to look what the next level of Math the student will be taking for their major, by doing so it will allow us to tailor the course to a student's individual needs. Incorporating this minor change we can increase the likelihood of student success, emphasize relevant concepts and better prepare them for the next level. The data supports the possibility of separating the students by major and

designing two developmental courses with different trajectories. Students who will be heading into Math 1000 need to master certain more complex concepts than students headed to Math 1010 and 1016. This will allow us to give the student a more individualized education experience and insure greater success at the next level.

For the long term, we would like to look at the needs of each major and map the appropriate math course to each major. This would allow for a structured and disciplined major specific math road-map that will best prepare the students to successfully pass the courses and apply quantitative reasoning throughout their education across the curriculum.