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Pittsburg State University

Math Task Force Report

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Math Task Force Recommendations

Introduction

The charge given to the Math Task Force by the Provost was as follows:

1. To examine the existing mathematics requirements as they address needs of the diversity of majors at PSU.
2. To propose a means of ongoing assessment of student learning in mathematics in its general education function.
3. To propose effective changes to this instruction that are in keeping with our institutional goals of quality education linked to effective, formative assessment.

In order to carry out this charge, the Math Task Force met weekly from October to May. This process has been dynamic. The Task Force, composed of faculty and administration representing every college of the University, sought out input from faculty and students, researched literature regarding best practices, and studied the practices of other universities of similar size and mission.

This information was gathered and discussed by the task force. These discussions were synthesized by members of the committee into a common vision that became the starting point for discussion in campus-wide focus groups. The insights gained from these focus groups are incorporated in this report.

Existing Requirements and Current Needs

Requirements

The current course options for completing the mathematics requirement of general education are: College Algebra with Review, College Algebra, Quantitative Reasoning, Elementary Statistics, Mathematics for Education 1, or Calculus [18, p48]. This system is motivated by the fact that mathematical skills are needed by students in a variety of areas on the PSU campus that can be characterized as follows:

1. Technology Programs and the Natural Sciences;
2. Elementary Education;
3. Secondary Education and the Social Sciences;
4. Business.

The needs of each of these units, as the respective departments determine them, is reflected in the general education options under the mathematics heading.

Technology and the Natural Sciences each require Calculus. Consequently, College Algebra is an appropriate choice for students in these areas as it is preparatory for calculus.

Elementary Education requires Mathematics for Education I as a content mathematics course. This is then an appropriate choice for those majors.

Secondary Education and the Social Sciences need Elementary Statistics, so this course is an appropriate option.

Business students need both College Algebra and Elementary Statistics in their curriculum. Therefore, they are well covered by our general education requirements.

Students in programs that do not require a particular mathematics course already may take the Quantitative Reasoning Course, which is neither a prerequisite for any course nor required by any major.

This gives the mathematics portion of the general education requirements a rather cafeteria-esque quality. Pittsburg State University is by no means unique in this, as a survey by the Task Force of 20 other universities of similar size and mission across the country shows in Appendix D. Though sometimes disguised by clever course number, pressing service courses into the function of general education courses was the mode. In general, the universities surveyed had one special general education course designated for those in the Arts and Humanities, but the rest of the courses offered were chosen for their applicability in various programs.

In addition to surveying other universities, the Task Force examined the literature regarding best practices for general education mathematics. The CUPM Curriculum Guide, published by the Mathematical Association of America, the leading professional organization in collegiate mathematics, repeatedly states that general education mathematics should be a set of courses designed so that students can take a course best meeting their individual needs [7, p28].

Most importantly, the Task Force sought input from PSU's faculty and students to see if the current system for general education mathematics met their needs. When asked if the number of choices for general education math courses is appropriate, 71.7% of the faculty, of the 118 responding to the survey, agreed. When asked if the current offerings satisfied the needs of their graduates, 67.4% agreed. There did appear to be a dichotomy in the survey results regarding requiring one common course in contrast to letting individual departments decide which course meets the needs of their students. Faculty expressed this with 82.3% agreeing that each department should decide what course their students should take for general education mathematics and 75.5% agreeing that all students should reach a basic level of math proficiency by taking a common course. The results of the student surveys were similar. The Task Force brought this dichotomy to the faculty at the focus groups. The faculty clarified this for us by stressing that all students should have a basic level of mathematical proficiency, but should not be required to take a common course. As a side note 82.3% of the students responding to the survey thought they learned what they needed from their math courses at PSU.

See Appendix B for the complete results of the surveys.

The ubiquity of universities offering many courses to satisfy the mathematics component of general education is caused by the utility of mathematics in the technical disciplines and the

pressure to reduce hours caused by heavy general education requirements and equally heavy major requirements. However, the core general education values (as outlined in the attached rubric in Appendix A) are found in all of these technical courses.

Our committee has carefully discussed the difference between the sorts of specialized technical skills needed by particular disciplines and the broader skills needed by the typical college educated student that we desire to be an ambassador of Pittsburg State University. We believe that all current math general education offerings combine these skills, except Quantitative Reasoning, which is the embodiment of the latter.

To meet our general education values in a single course would be extremely challenging due to the diversity of PSU's student population. Moreover, such a course would serve no student well. Furthermore, requiring such a course would effectively require increasing the general education load of the technical disciplines by three credit hours. This broaches questions that are beyond the charge of this Task Force, but some ideas will be shared in the Changes section below.

Needs

Applications

As has been observed, the utility of mathematics in various academic areas is the reason for the current situation of pressing service courses to function as general education. The word "utility" as used here is a synonym for "applicability." The Task Force's survey of faculty on campus reveals that this applicability of mathematics is widely valued as a general education outcome. When faculty were asked what one thing would they change about the mathematics component of general education the number one response was to include more applications. This is also consistent with goals and objectives in our mathematics general education courses.

It is therefore somewhat ironic that College Algebra, which has in some sense been the default general education mathematics course, is not applications focused. Being preparation for the calculus sequence, it is oriented toward mathematical techniques and not the application of those techniques. Additionally, the already rigorous pace of the course does not make it open to the addition of even more topics.

Articulation

Discussions, both within the Task Force itself and between the Task Force and the Focus groups, reveal the need and the desire for greater and more regular communication between the Department of Mathematics and those it serves. This desire for communication across academic units is not new. We currently lack, however, any sort of formal structure in place to facilitate this communication.

Currently, a structure of similar purpose on the PSU campus exists in the form of the Writing Across the Curriculum Center. It is now recognized that the Department of English, though it does serve the function of teaching the basics of writing to our students, cannot and should not

teach the particular writing needs of each of the disciplines on campus. It is simply impossible. The particular writing needs for each of the disciplines must be taught within those disciplines. The Writing Across the Curriculum Center helps faculty in each of these disciplines as they themselves learn to teach writing.

With appropriate additional resources, this model could be copied to aid in a similar way the teaching and learning of mathematics on a campus-wide basis. Just as it is impossible for the English Department to teach writing in all of the disciplinary styles, it is impossible for the Department of Mathematics to teach all of the mathematical applications in every discipline. It could be possible, however, for a center of Mathematics Across Campus (MAC) to teach professors in the various disciplines how to teach mathematics.

In our survey, we found some support for MAC but not a mandate. Specifically, 64.7% of faculty members responded they were in favor of some sort of MAC. However, when asked at the focus groups opinions were quite mixed and no consensus was heard.

Means of On-Going Assessment

Given the current variety of general education offerings, devising means of assessment is something of a challenge. Fortunately, research by the Math Task Force has discovered a suitable tool: a rubric from the American Association of Colleges and Universities (AAC&U) [20]. This appears to be based on a list of values published by the Mathematical Association of America (MAA) in their report *“Quantitative Reasoning for College Graduates,”* [21]. The national scope of these two documents would be sufficient reason to recommend their common merit.

The Task Force has taken the rubric of the AAC&U and made minor modifications that put it more in line with the general education goals and objectives of Pittsburg State University. This grid-style rubric [see attached] has rows that represent aspects of mathematics that are valued, columns that display levels of accomplishment, and cells that contain descriptions of what constitutes achievement at a particular level for a particular value. It meshes nicely with PSU's Goals and Objectives for general education and is quite similar to one developed independently at the University of Arkansas, a fact we discovered when consulting Dr. Bernard Madison, an expert in mathematics assessment. See Appendix E for further details about Dr. Madison, his experience, and his recommendations.

The Task Force recognizes that the nature of artifacts produced by mathematical activity is diverse and that no one artifact can exemplify all of the values listed in the rubric, but a small collection of artifacts would suffice to capture the breadth represented within the rubric.

A gold standard for the assessment of student work would be to apply the above rubric appropriately to each and every mathematical artifact produced by every student over the course of that student's career. In the future, content management systems such as LiveText and other technological innovations will no doubt allow progress toward that gold standard.

In the meantime, the university should develop a system of assessment that will allow the university to gauge the mathematical formation of our students on a regular basis. This assessment is to be done using the given rubric.

We recommend that University Assessment Committee oversee this process and be accountable for its completion. They should work in conjunction with the General Education Committee of Faculty Senate and the Mathematics Department to design or obtain assessment instruments within the guidelines provided by the rubric.

For this to be a sustainable activity, we recommend a new position: Director of Center for Math Across Campus (MAC) and Math Department Assessment Coordinator. The new MAC position should work with a standing Math Department Assessment Committee. Other resources will be needed as adequate assessment would also require training of the faculty involved as well as a burden on the OOE.

We have outlined a roadmap for the University Assessment Committee to proceed with implementing the rubric. Our proposed plan of action for year one is detailed in the following table.

Tasks	Entity Responsible	Deadline
Define student learning outcomes to match values	New MAC position + Math Dept Assessment Committee in consultation with Gen Ed committee of faculty senate	Sept. 2011
Create measures for those outcomes	New MAC position + Math Dept Assessment Committee	Nov. 2011
Embed measures in appropriate ways	New MAC position + Math Dept Assessment Committee	Spring 2012
Collect data	Math Dept. given to University Assessment Committee	Spring 2012 (firm deadline)
Analyze data and propose changes to improve student learning	Math Dept. given to University Assessment Committee	Every year at first for baseline and then every 3rd year
*Repeat for other courses		

*We recommend assessing Quantitative Reasoning in year one, Elementary Statistics in year two, and College Algebra and Math for Education I in year three.

Changes

As applications are a common value found among the campus at large, modifications of the general education requirement should be made to reflect this. Though certain general education courses now offered already provide applications, others are less application oriented.

In order to incorporate more applications of mathematics into the general education curriculum, the university could utilize follow-up courses (called Q-courses) that apply and reinforce the mathematics of the general education course. Were this to happen, it would require the integration of these Q-courses into our general education requirements in a way similar (but not slavishly so) to what is done with Writing to Learn courses. For this to be done correctly, the creation of a Mathematics Across Campus program like the one mentioned above would need to be implemented. At this point, the Task Force fails to see a campus-wide mandate, though our survey did indicate some support for this notion.

We recognize that for a variety of reasons College Algebra has historically been the default general education mathematics course. PSU moved away from this model in 2004. However this fundamental change of philosophy is not consistent throughout campus. Therefore, we recommend the following to make the PSU community more aware of all the general education options so that individual students, working with their respective advisors, can make a choice in their best interest.

1. Create a greater awareness of mathematics general education options by informing those involved in the advisement of first- and second-year students of it.
2. Use placement instruments to advise students needing College Algebra (or Calculus) which course in the College Algebra sequence matches their level of preparation: Intermediate Algebra, College Algebra with Review, College Algebra, Pre-Calculus, or Calculus. To do otherwise sets up many students to fail.
3. We recognize that many students will change their major from one not requiring College Algebra to one that does. Therefore, those who have the responsibility of initially advising students should make discerning this likelihood a priority in the advisement process.
4. It is recognized that College Algebra is a course that attracts students with a wide variety of preparation, i.e. there are students in the class who have not been able to learn the material after multiple attempts in the secondary educational experience and there are students in the course who've had high school calculus. Using the placement instruments described above, attempts should be made to create a more homogeneous class.

In addition,

1. The Department of Mathematics should partner with the Center for Student Success in order to appropriately aid those having difficulty with the subject. Such aid should include help with study-skills as well as mathematical skills.

2. Pittsburg State University should continue to support efforts in the state to move toward an integrated curriculum that prepares high school students for the rigor of college while preserving that rigor.
 - a. This should be done in cooperation with other K-16 efforts and should certainly be done in the light of the Common Core Standards that were recently adopted by the Kansas State Board of Education for K-12 mathematics.
 - b. We recommend that the PSU Mathematics Department continues its participation in the GAP Analysis Working Group and the Governor's P-20 Council to develop a plan for improving communication between high school and college faculty regarding what students need to succeed both in college and in the workplace and to maintain alignment in the P-20 educational system.
3. The Task Force encourages the Department of Mathematics to continue its efforts to improve student success in College Algebra. We recognize that the creation, implementation, and success of College Algebra with Review was a good step in this direction. The Department should not be afraid to experiment in other ways.
4. The Department of Mathematics should consider offering more sections of the various general education courses, especially MATH 133, Quantitative Reasoning.
5. The Department of Mathematics should consider developing courses in algebra and calculus that emphasize the applications of mathematics.

Summary of Proposed Changes

Proposed Change	Entity Responsible	Campus Support	Additional Resources Necessary
Implement a placement instrument into the College Algebra sequence	Math Dept committee nominated by chair	Strong	Annual funding to cover costs
New Director of Center for Math Across Campus (MAC) + Math Department Assessment Coordinator	New MAC position	Strong	New MAC position
New Math Department Assessment Committee	Nominated by Math Dept. Chair	Strong	Funds for training + professional development
Create a Center for Math Across Campus	New MAC position	Moderate	New MAC position
Implement Q-courses	New MAC position	Moderate	New MAC position
Inform first and second year advisors of all general education mathematics offerings	Math chair nominates faculty member	Strong	None
Math Department should partner with Center for Student Success	New MAC position	Strong	New MAC position
Math Department should continue participation in GAP Analysis Working Group and Governor's P-20 Council	Tim Flood and Karla Childs	Strong	None
Math Department should continue to investigate options for College Algebra to improve student success	College Algebra coordinator	Strong	Additional prof dev funds on a regular basis
Increase sections of MATH 133 as needed	Math Dept. Chair	Strong	None
Math Department should consider developing an applied algebra class	Math Dept.	Strong	Summer grant to develop course
Math Department should consider developing an applied calculus class	Math Dept.	Strong	Summer grant to develop course
Bring in expert in Gen Ed Math Assessment	New MAC position + Math Dept Assessment Committee + Math Dept. Chair	Strong years 1,2, and 3	Honorariums + travel

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APPENDIX

- A. Rubric
- B. Survey Results
- C. Focus Group Questions and Reports
- D. Survey of Other Universities
- E. Expert: Dr. Madison
- F. Literature Subcommittee Report
- G. Survey Subcommittee Report
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