

General Education Assessment
Mathematics Action Plan

Please interpret the findings and provide a specific action plan that can be implemented to improve or reinforce student learning as a result of the assessment process. The action plan should address the area(s) in need of improvement or reinforcement. The plan does not have to be limited to general education student learning but could include departmental initiatives designed to improve student success.

Part One: Results Discussion / Reflection

Please provide insightful interpretations of the results presented in the Findings section, noting any relevant context / background or concerns the unit may have.

Question 1

Learning Outcome 2:

The unit is not surprised that 1065 student performed the worst on learning outcome 2. The questions that assess this learning outcome all involve exponential and logarithmic rules/properties, formulas, equations, and functions. In general, and historically, exponential and logarithmic functions/equations are the most difficult for 1065 students. These functions/equations are covered during the last 2-3 class meetings (giving students less time to process and retain all the formulas, techniques to solve these equations, how these techniques are connected, etc). Additionally, in order to answer many of the exponential and logarithmic problems a student must have a strong foundation of exponential rules, factoring, how to solve a linear equation and inequality, how to solve a quadratic equation, how to solve a polynomial equation, and evaluating functions.

The unit will be revisiting the questions used to assess learning outcome 2 to determine if the current questions are appropriate for learning outcome 2 and whether additional questions can be added that cover non-exponential and logarithmic problems.

Learning Outcome 3:

The unit is not surprised that 1065 students performed the best on learning outcome 3. During 8 of the 14 Math 1065 class meetings, instructors cover examples of modeling/solving applications that describe various phenomena in nature and society. We spend a significant amount of class time on applications (“word problems”) for several reasons: (1) students are traditionally anxious when presented with a word problem, (2) word problems are generally difficult for students to solve, and (3) word problems connect mathematics to other fields of study (physics, biology, chemistry, economics, etc) as well as the real world.

The unit will continue spending a significant amount of class time on examples of modeling/solving applications that describe various phenomena in nature and society as this approach is producing success with the students.

Question 2

The unit was happy to see that there is no statistical difference in Math 1065 exam scores between students taught by faculty and students taught by GTAs. Based on feedback from class observations performed by the mentors of GTAs teaching Math, in fall 2015 the unit began requiring GTAs to observe a 1065 class for an entire semester before being assigned to teach Math 1065.

The unit will continue making this requirement of GTAs.

Question 3

The unit was not surprised that non-transfer students tend to score higher on the Math 1065 exam than transfer students. As ECU does not require transfer students to complete a math course at their transferring institution, we have two types of transfer students: those that completed a math course at their transferring institution and those that did not. For transfer students that did not complete a math course it has been several semesters/years since they have completed a math course. Math is a field of study that requires regular use and/or practice in order to retain it. Therefore, these students are not as prepared for Math 1065 compared to the non-transfer students that completed a math course during their senior year of high school. For transfer students that did complete a math course, it is possible that the course completed did not cover the topics needed to prepare a student for Math 1065. For example, a Quantitative Literacy course would not prepare a student for College Algebra (Math 1065). Additionally, the unit allows transfer students to take the Accuplacer placement test to determine if they are prepared for Math 1065. Based on data provided by IPAR to the unit, Accuplacer does not successfully place students into Math 1065. Therefore, transfer students are being placed into a math course that they are not prepared for.

The unit plans to investigate alternative placement tests for transfer students.

Question 4

The unit was not surprised to learn that there is a significant difference in Math 1065 exam scores between students that have taken remedial math and students who have not. Remedial students do not have the same foundational mathematical knowledge as the students that start in Math 1065. In general, these students tend to be weaker math students and typically struggle with math. Whereas students that start directly in Math 1065 have stronger foundational knowledge and may have scored high enough to start in a higher math course (pre-calculus or calculus).

The unit plans to investigate the topics being taught in remedial math to see if changes need to be made in order to increase student success in Math 1065. The unit also plans to try other approaches to remediation (see section a of Part Two for further details). Please note that all NC Community Colleges will no longer be offering remedial math courses per state legislation. The NC Community College system has until Fall 2019 to adopt a co-remediation model for math

courses. Therefore, it is possible that mathematical remediation courses will not be offered at ECU in the future.

Question 5

The unit was surprised to find that students scored lower if they were taught by instructor 4 or 7. The unit will be looking at instructor DWF rates before assigning instructors to Math 1065.

The unit was surprised and confused to find that students scored lower if they took Math 0045. The results from Question 4 show that there was no significant difference between Math 0001 students and Math 0045 students' performance on the Math 1065 exam. However, the results from Question 5 state students scored lower on the exam if they took Math 0045. This same conclusion was not drawn about Math 0001 students (most likely due to the small n size of Math 0001 students). The unit is not sure how to best respond to this data as it seems to be contradictory. Further data collection and analysis needs to be completed.

The unit was not surprised to learn that students scored higher if they waited one semester (up to 1 year) to take Math 1065 for the first time. Many freshmen spend their first semester learning how to be successful at ECU (attending class when it isn't required, spending time outside of class to study, looking ahead to be prepared for class, learning how to manage time wisely, learning how to study, etc). Math 1065 students need to be proficient in these things in order to be successful. Math 1065 students will have to complete CAVE hours outside of scheduled class times, register for dates/times to take tests and the final exam, complete assignments that take hours to finish, and spend time each day working on assignments in order to master topics (you cannot learn math by cramming). The unit plans to share this finding with advising. The unit also understand that some majors require that Math 1065 be taken the first semester in order to graduate in 4.

Part Two: Action Plan

Please describe what actions you will take as a result of the assessment in the following four areas.

a. Pedagogical / Curriculum

Switch from MyMathLab to ALEKS

Starting in Fall 2016, the Math 1065 Course Coordinator, began piloting sections of Math 1065 using ALEKS (adaptive learning platform that uses a mastery-based approach to learning mathematics). Due to several technical issues with MyMathLab, and the success of students using ALEKS, all sections of Math 1065 switched to using ALEKS starting Summer 2017.

New Format for Teaching Math 1065

In addition to using ALEKS, the pilot sections of Math 1065 follow a different format. Class meets for 1 hour and 50 minutes in the CAVE (or computer lab). In class the instructor provides mini lectures to groups of students. Students are assigned to groups based on their performance

on assignments. If a student is not assigned to a group, then he/she has the option to either attend the group mini lecture or continue working in ALEKS. There are tutors and GTAs in the class to help students that do not participate in the groups. Another key difference in the pilot sections is the CAVE hour requirement. Instead of the weekly requirement of 3 CAVE hours (a minimum requirement), each student's CAVE hour requirement is based on his/her performance in the course. In general, a student whose overall grade and/or test grade is below a 70% must complete a minimum of 2 CAVE hours each week. A student whose overall grade and test grade is a 70% or higher must complete a minimum of 1 CAVE hour each week.

Results of pilot:

Fall ABC Rates

Year	PILOT Rate	Overall 1065 Rate
2016*	63%	65%
2017	72%	66%

* During the Fall 2016 pilot there were no CAVE hour requirements.

Spring ABC Rates

Year	PILOT Rate	Overall 1065 Rate
2017	79%	65%
2018	83%	74%

As seen in the above charts, if we exclude Fall 2016 (semester with no CAVE hour requirements) the pilot sections have resulted in significantly higher ABC rates. The unit would like to offer more sections of Math 1065 that follow the pilot format. In order to do this, the unit will need additional resources.

In this new format the CAVE will be open for classes for 22 hours a week. A 1065 instructor, a GTA, and 2 undergraduate tutors will be present in each class. The GTAs and undergraduate tutors will provide $22 \times 28 \times 3 = 1848$ class tutorial hours/academic year. The CAVE will also be open for 34 hours a week for the 1065 students to complete their required CAVE hours. During these operational hours 1 GTA and 3 undergraduate tutors will be present providing $34 \times 28 \times 4 = 3808$ CAVE tutorial hours/academic year. Assuming the unit has 7 GTAs that can provide a total of 70 tutorial hours per a week, then GTAs will be providing $70 \times 28 = 1960$ tutorial hours/academic year. Therefore, the number of undergraduate tutorial hours needed will be $(1848 + 3808) - 1960 = 3696$ hours/academic year. CAVE undergraduate tutors are paid \$10/hr, so the unit will need $10 \times 3696 = \$36,960$ per academic year. The unit currently received \$24,000 per academic year to pay CAVE undergraduate tutors. Thus, the unit would need an additional

$\$36,960 - \$24,000 = \$12,960$ per academic year in order to fully implement the new format for Math 1065 described above.

Co-remediation Approach

During Fall 2018, the Math 1065 Course Coordinator will be piloting a co-remediation model. The Course Coordinator learned about co-remediation at a conference she attended in Fall 2017. Students that would typically complete Math 0001 and then take Math 1065 are taking these courses simultaneously. The co-remediation courses are Math 0001 section 3 and Math 1065 section 21. Math 1065 section 21 is composed of the students in section 3 of Math 0001 and students that placed into Math 1065 via SAT/ACT scores, Accuplacer, or Summer Bridge placement.

The co-remediation students (students registered for both Math 0001 and Math 1065) have the following schedule. Math 0001 meets on Tuesday (11am-12:15pm) and Thursday (11am-12:15pm) in a regular classroom. Math 1065 meets on Wednesday (1pm-2:50pm in the CAVE). On Tuesday the Math 1065 Course Coordinator covers the prerequisite knowledge needed for the material that will be covered in 1065 that week. On Thursday the Math 1065 Course Coordinator finishes the prerequisite material (if needed) and goes over any topics the students struggled with during Wednesday's 1065 class. The Math 1065 class follows the pilot format described above.

The unit plans to continue this co-remediation pilot during Spring 2019. During Summer 2019, the unit plans to look at student success in this model and analyze results to determine if more co-remediation sections should be offered. If this co-remediation model is successful, then the unit will need additional resources and a larger CAVE before full implementation can be completed.

b. Student Support Services

Tutorial Support

The CAVE is open 52-56 hours a week. Math 1065 students can go to the CAVE during any of these hours in order to receive individualized help from a CAVE tutor and/or GTA.

Math 1065 tutoring is also offered by the Pirate Academic Success center.

Advising

During Spring 2018 the Math 1065 Course Coordinator made presentations to each of ECU's Colleges about what introductory GE math course is most appropriate for their majors. The purpose of these presentations was to inform the various colleges about what topics are taught in each of our introductory GE math courses (Math 1050, Math 1065, and Math 1066). Each

college was asked to then determine what introductory GE math course was most appropriate for their majors and make changes to requirements/4 year plans as needed.

As stated in Part One, the unit plans to share with advising that students scored higher if they waited one semester (up to 1 year) to take Math 1065 for the first time. Hopefully this will encourage students to wait at least 1 semester before attempting Math 1065 as their programs will allow it (not delay their graduation date).

2018 Summer Bridge Program

The Math 2018 Summer Bridge Program is an online program that helps prepare incoming students for their first math course at ECU. Students self-selected to participate in the Math 2018 Summer Bridge Program. The program was designed for the following types of incoming students:

- A student that wishes to begin in a math course higher than the course his/her ACT/SAT score placed him/her into.
- A student that needs a fresher in math before taking his/her first math course at ECU (i.e. a freshman student that did not take a math course during his/her last semester of high school).
- A student that struggles with math.

Students in this program registered for and used ALEKS. ALEKS is an artificial intelligent assessment and learning system that uses adaptive questioning to determine exactly what a student knows and doesn't know. All 2018 Summer Bridge Program participants were given an opportunity to take a proctored placement test (adaptive test in ALEKS) before the Fall 2018 semester began in order to determine what math course they are best prepared for.

The unit is collecting data on the Summer Bridge students that placed into a higher math course than they placed by SAT/ACT. Some of the data being collected includes: initial knowledge check score, total time spent in ALEKS, percent of topics learned/mastered in ALEKS, major, placement test score, grade earned in course placed into, SAT/ACT scores, unweighted high school GPA. The unit plans to submit a request to IPAR (during Summer 2019) to analyze this data and provide answers to some questions: does the initial knowledge check score predict success on placement test, does the percent of total topics learned/mastered predict success on placement test, should we require a minimum number of topics to be completed in order to take the placement test (what should that number be), does the total amount of time spent in ALEKS predict success on placement test, should we required a minimum amount of time spent in ALEKS in order to take the placement test (what should that time be), do the current cut off scores for the placement test predict success in math course placed into (if not then what should our new cut off scores be), do ACT/SAT scores predict success on the placement test, does unweighted high school GPA predict success on the placement test.

It is the unit's understanding that these students have been given a special identification in Banner in order to make data collection easier.

c. Faculty Development

Faculty and GTAs

The unit requires faculty and GTAs teaching Math 1065 to attend all Math 1065 meetings (3-4 meetings a semester). The first Math 1065 meeting happens before classes start and it acts as a training. During this training the 1065 Course Coordinator covers: important course policies, first day of class expectations, first day of class attendance policy, first week duties in CAVE, course documents (syllabus, calendars, time sheets), and an overview of how to use the Math 1065 course pack.

Faculty new to teaching Math 1065 are mentored by the 1065 Course Coordinator. All GTAs teaching Math 1065 are mentored by other math faculty.

Faculty and/or GTAs that will be teaching Math 1065 for the first time are required to attend an ALEKS training hosted by the 1065 Course Coordinator (typically the semester before teaching Math 1065). Before the training everyone is given a student ALEKS account. The coordinator asks everyone go into an ALEKS course and work as a student (complete tools tutorial, complete initial knowledge check, and work on an assignment). This gives the faculty and GTAs an opportunity to experience what their Math 1065 students will be doing and makes them better prepared to explain how ALEKS works to their students. During the ALEKS training the 1065 Course Coordinator answer questions the faculty has about the student side of ALEKS and then gives a presentation on how to best use the instructor side of ALEKS.

CAVE Employees

All CAVE tutors are required to complete 4 modules in ALEKS, earning a 100% on each module, before being hired to work in the CAVE as a tutor.

Additionally, all CAVE employees (new and returning) are required to attend a face to face training in the CAVE before the fall semester begins. During this training the CAVE Director covers: CAVE polices, CAVE employee code of conduct, how to clock in/out, expectations when working the front desk, expectations when tutoring, tutoring best practices, how to help students register for ALEKS, how to help students register for tests, when to provide help to a student on a problem in ALEKS, how to determine if the student is completing a random knowledge check versus a scheduled knowledge check, and how to encourage student thinking and collaboration.

d. Other Areas

Math 1050 Initiative

Prior to the fall 2018 semester, Math 1050 instructors had the liberty of teaching the course however they desired. The only requirement was that each instructor was obligated to teach at least 4 units from a set list of 8 or 9 units. Most instructors overlapped somewhat in their preferences, typically with the algebra or statistics unit, but then varied from there. The majority of instructors also used MyMathLab to assign homework, but some assigned it directly from the

textbook. The instructors also had the liberty of assigning quizzes, online or in class, as well as developing their own tests. Additionally, the course mainly focused on the non-STEM majors, such as Art, Music, History, and English.

In the Fall of 2017, the math department wanted to redesign Math 1050 and offer the course to all majors that were not required to take Calculus. A committee was formed and tasked with developing new curriculum that would be consistent for all instructors teaching Math 1050. The new curriculum, which includes an algebra and personal finance unit, a geometry unit, a statistics unit, and a probability unit was reviewed and approved by other departments.

While redesigning the course, Susan Howard and Joseph Bland received The UNC Student Success Grant in the Spring of 2018. The requirement of this grant centered on utilizing an adaptive learning technology to help improve student success. To make the course consistent for all instructors and to fulfill the requirements of the Student Success grant, a course pack was developed and the ALEKS software was incorporated. In ALEKS, students can complete homework assignments, quizzes, and practice tests to help prepare for the actual tests that are offered in class. To help monitor student progress throughout the semester, ALEKS utilizes knowledge checks, which can be given at various points throughout a semester. For Math 1050, knowledge checks have been set at the beginning, middle, and end of the semester. A report will be completed at the end of the semester to review how well students progressed in Math 1050 while using the ALEKS software.

New Math 1064 Course

At the request of the College of Business, a new course (Math 1064) has been created to replace Math 1066 for Business students. This work included developing the syllabus, preparing teaching materials, such as tests, quizzes, handouts, creating content and recording videos for the Distance Education sections, reevaluating the assessment tools and criteria, as well as the placement and the pre-requisites. Currently, we are in the process of teaching Math 1064 for the first time. The work ahead will focus on making improvements and adjustments based on the feedback from the students and the faculty, and on students' performance.

Concluding remarks

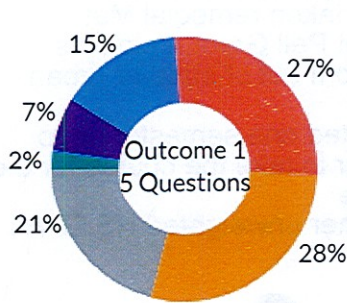
Any new initiatives in mathematics foundation courses such as the new Math 1064 course, the co-remediation pilot, and other pilot sections leading to pedagogical innovations will need to be met with a corresponding support for increase fixed-term and regular faculty positions.

General Education Assessment 2016-2017

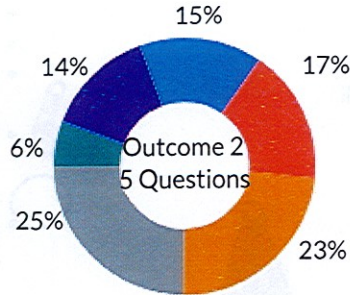
Mathematics (Quantitative Reasoning)

GE Math Learning Outcomes

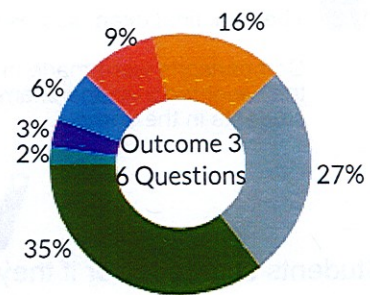
i Only the scores of the 16 questions mapped to three GE Math learning outcomes were used.



Correctly use / interpret Mathematical notation and terminology to solve problems.



Apply general concepts and principles of Mathematics to solve various kinds of problems.



Model/solve problems related to applications that describe various phenomena in nature and society.

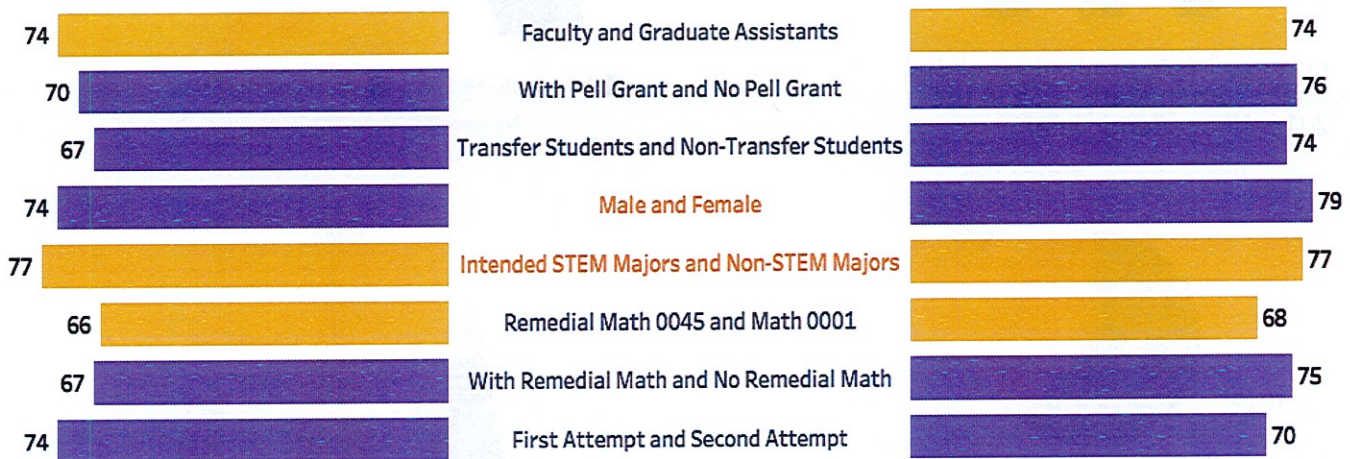
of Correct Responses: 0, 1, 2, 3, 4, 5, 6

Percentage of Correct Responses for Each GE Math Learning Outcome (N = 1,658)

Group Comparisons

i The total final exam scores were used to compare the performance of various groups of students. A statistically significant difference means the difference is not likely to have happened by chance.

Type: Average Exam Score (dark blue), Median Exam Score (orange)
 Result: Not Statistically Significant (yellow), Statistically Significant (purple)



Mathematics (Quantitative Reasoning) 2016-2017

Multiple Regression Results



The total final exam scores were used.

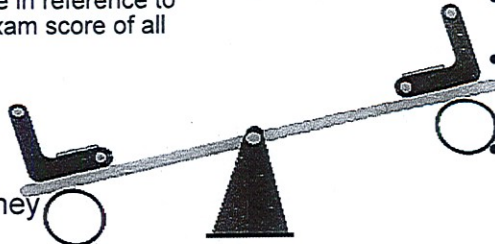
Comparisons were made in reference to the weighted average exam score of all students in the sample.

Students scored higher if they

- were taught by instructor 5
- had not taken remedial Math
- were not Pell Grant recipients
- came from out of state or urban areas
- had waited one semester up to one year to take the course for the first time
- had higher unweighted HS GPAs

Students scored lower if they

- were taught by instructor 4 or 7
- took remedial Math 0045
- were Pell Grant recipients
- came from rural areas
- were sophomores,
- or had waited more than one year to take Math 1065 for the first time

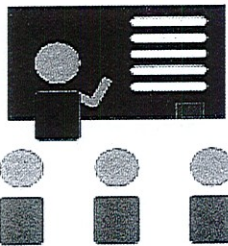


Over one-third of the students taking the final exam did not pass the final exam.

(70 out of 100 = Passing)

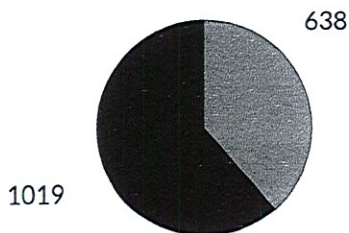
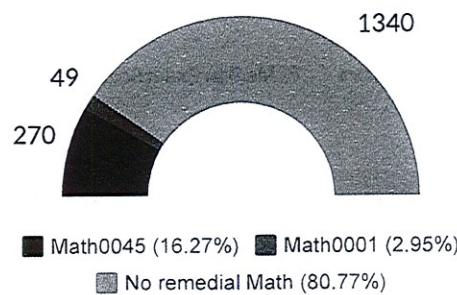


Rural students were defined as students who came from Tier 1 and Tier 2 counties in NC. The Tier designations data we used were from 2016: <https://www.nccommerce.com/research-publications/incentive-reports/2016-county-tier-designations>

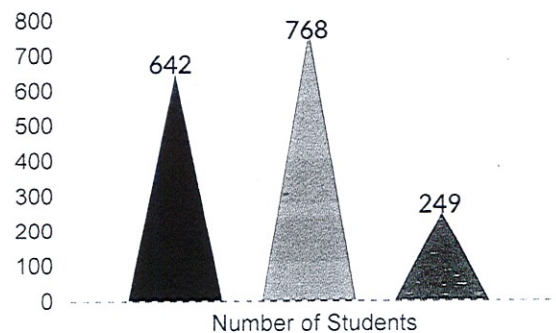


In total, 1,659 students took the final exam in Math 1065 in the 2016-17 academic year.

Sample Profile



Male (38.50%) Female (61.50%)



Rural Urban Out-of-State