

College Algebra (MATH 105) Course Redesign at Eastern Michigan University

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Historically, College Algebra at Eastern Michigan University (EMU) has had high enrollments and high DFWI rates. Hence, College Algebra is designated as a gateway course. In an effort to reduce the DFWI rates across all student demographics while paying particular attention to equitable outcomes, EMU has partnered with the Gardner Institute in the initiative Gateways to Completion. Here, we give a data-driven case study on the G2C College Algebra redesign and outcomes.

STATEMENT OF THE PROBLEM

College Algebra is labeled as a gateway course because it has high enrollments (approximately 800 per year across 25 sections) and high DFWI rates (approximately 44%). In addition, 148 programs list College Algebra as a component (required, elective or a prerequisite). Thus, the high enrollments coupled with the high DFWI rates have a significant negative impact on the completion rates of a breadth of programs across campus.

The following data reveal that the before-G2C baseline DFWI rates for African American (AA) students are higher than the average of 44%.

- The DFWI rate for African Americans in 2015-2016 was 47%.
- The DFWI rate for African Americans in 2016-2017 was 57%.

Thus, we sought a College Algebra redesign which (1) reduces the DFWI rates across all student demographics and (2) promotes equitable outcomes.

In order to redesign College Algebra so as to attain these two outcomes, the G2C Course Specific

Committee, in winter semester of 2017, undertook an extensive guided analysis of those factors which impact success/failure in College Algebra. The findings of this analysis, together with the combined expertise and experience of the committee members led to seven College-Algebra redesign recommendations.

METHODS AND OUTCOMES

Redesign recommendation #1. Foster a community of College Algebra instructors who are dedicated to improving the course.

This may be the most important recommendation of them all, since it is the instructors who deliver the content and set the tone in the class. It is their enthusiasm, sincerity, and connections with students (especially under-represented students) that come across loud and clear.

Recommendations 2 through 7 of the Course Specific Committee were implemented according to the following schedule:

- Fall 2017 and Winter 2018, redesign implemented in 7 out of 12 sections.
- Fall 2018 and Winter 2019, redesign implemented in 7 out of 12 sections.
- Fall 2019 and Winter 2020, redesign implemented in 11 out of 11 sections.

We wanted instructors who were excited about implementing the G2C recommendations, so instructor participation was voluntary; this is why we did not, initially, have enough G2C instructors to cover all of the sections of College Algebra.

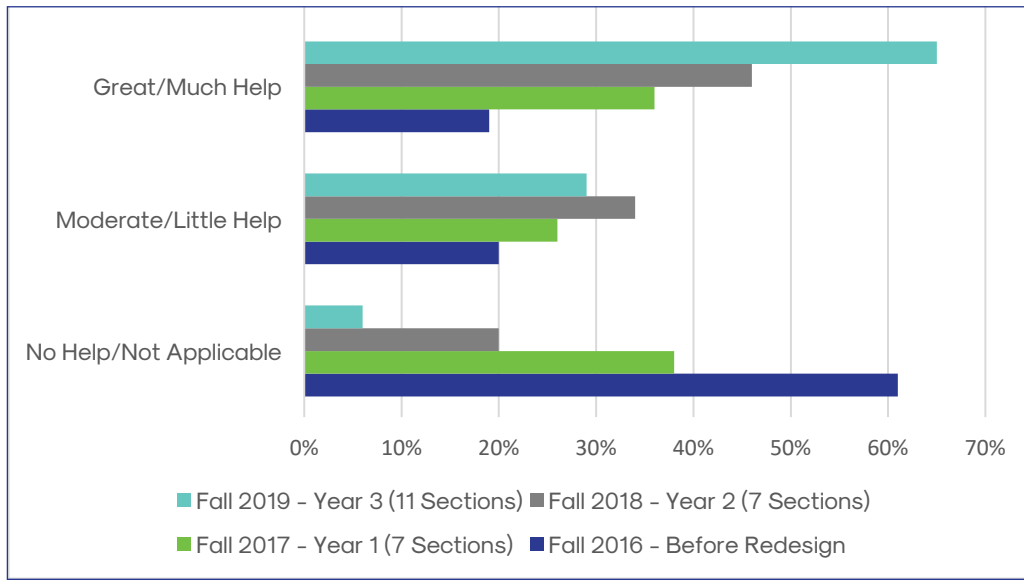
Redesign recommendation #2. Employ active learning strategies in the classroom.

It is important to note that at monthly meetings, the instructors discussed some options for implementing active learning. Ultimately, however, the details of how to implement active learning were left to each individual instructor. The idea was to support instructors while encouraging them to unleash their creativity. Following are a few of the various activities employed by the EMU College Algebra instructors:

- Students work on in-class activity sheets
- Students think, pair and share during class
- Students preview the lesson for the day
- Students complete partial notes
- Students complete exam wrappers

The Student Learning Gains (SLG) Survey was implemented over 4 years and the student responses to the survey item “Doing hands-on class activities was...” are graphed in the chart below. The chart shows the year-after-year improvement. For example, the students responding “great/much help” increased from 19% to 65%. It appears that the implementation of active learning improved over time, possibly due to the instructors’ comfort level with active learning increasing over time.

Figure 1
“Doing Hands-On Class Activities Was...”



Redesign Recommendation #3. Teach students how to study and learn mathematics (metacognition).

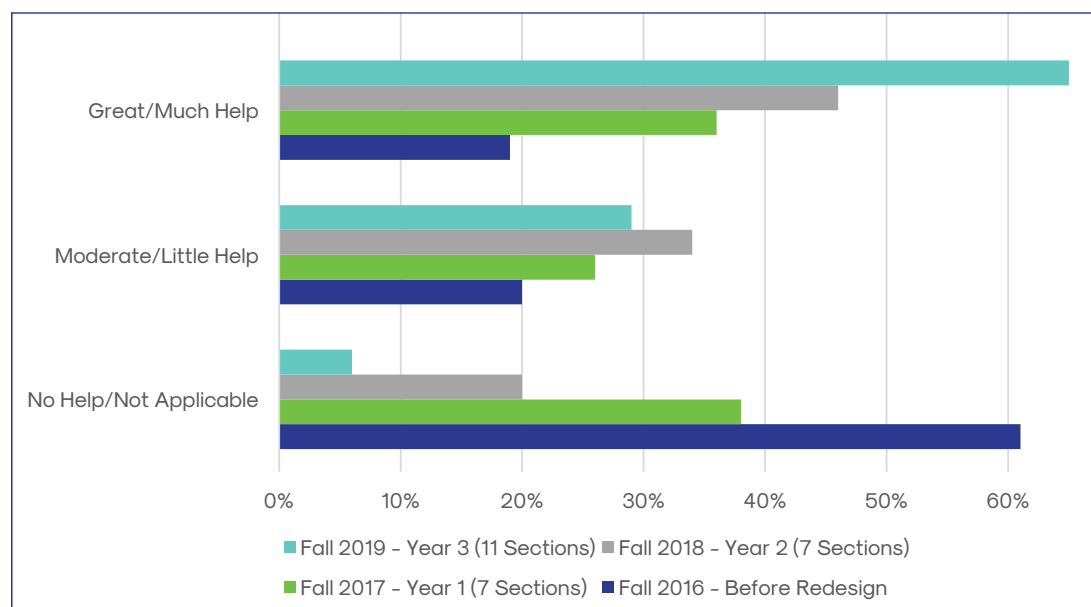
Again, we did not tell the G2C instructors how to incorporate metacognition into their daily lessons. We simply gave them some ideas and materials and encouraged them to be creative. Following are a few of the metacognitive strategies employed by the G2C instructors:

- Instructors express confidence in their students.
- Bloom’s taxonomy
- Growth mindset versus fixed mindset
- Know the goal and how the information is organized
- Active listener versus the passive hearer

The results of the SLG to the item “Explanation given by the instructor of how to learn or study the materials was ...” are graphed below. Again, we see student responses becoming more positive over the 4 years of the survey. Note that active learning and metacognition (recommendations 2 and 3) are key components of an inclusive pedagogy.

Figure 2

“Explanation Given by the Instructor of How to Learn or Study the Materials Was ...”



Recommendation #4. Use the online tutorial/homework system MyMathLab.

MyMathLab has great tutorial help and has been especially helpful to underprepared students. The \$75 cost for MyMathLab and the online textbook is assessed as a course fee. Thus, all necessary materials to succeed in the class are paid for upon registration. This is especially helpful to underprivileged students. Historically, it was not uncommon for financially struggling students to register for a class, not have the funds to purchase the course materials, and as a result, fail the course.

Recommendation #5. Employ spiraling homework sets which repeatedly spiral back to important concepts and skills from previous lessons.

Taking ownership of new concepts and skills requires repeated practice over an extended period of time. Employing spiraling homework sets is an attempt to create that repetition over time. The basic idea is that spiraling homework sets repeatedly spiral back to important learning objectives from previous lessons.

Recommendation #6. Give frequent exams (e.g., 6 per semester).

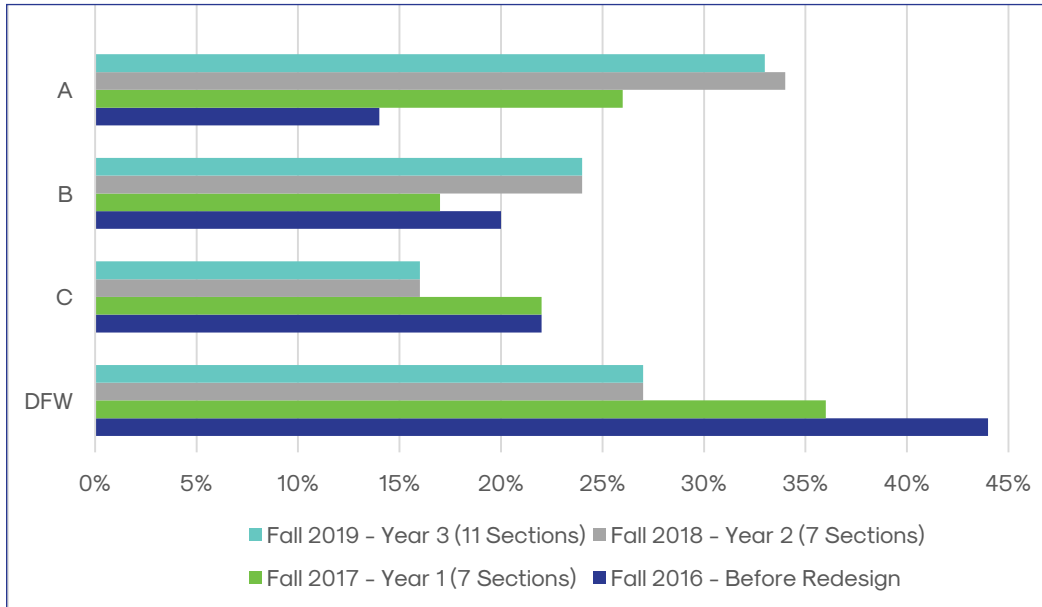
Increasing the number of exams, reduces the amount of content on each exam, thereby making each exam less demanding. In addition, increasing the number of exams increases the frequency with which students receive feedback.

Recommendation #7. Employ the early alert system Starfish.

Starfish is a great tool for initializing an outreach to a student, especially a minority student who might not feel connected to the class or the instructor. However, to be meaningful, this outreach must be followed by an intervention such as an office visit.

As the following chart shows, the student grade distributions improved over the three years of the G2C redesign implementations. In particular, the DFWI rate dropped from 44% before the redesign implementations to 27% afterwards. In addition, the percentage of A grades rose from 14% before the redesign to 34% after the redesign.

Figure 3
Distribution of Course Grades



PLANS FOR CONTINUATION AND EXPANSION

One of the G2C instructors implemented the G2C recommendations in a section of MATH 120 Calculus I. In the chart below, the grade distribution is compared to the grade distribution for two non-G2C sections of Calculus I taught by the same instructor. Note that the grade distribution for the G2C section is significantly better than the grade distribution for the two non-G2C sections. We are encouraged to try the G2C recommendations for other lower-level classes such as:

- MATH 104 Intermediate Algebra
- MATH 107 Trigonometry
- MATH 112 Precalculus
- MATH 122 Introduction to Linear Algebra

Figure 4
Grade Distributions

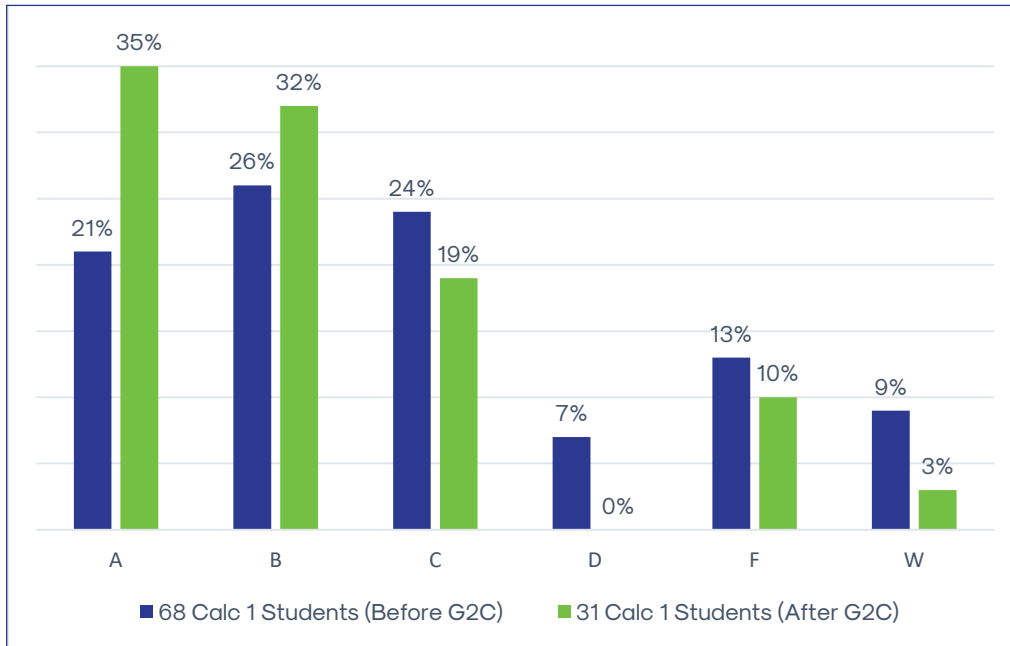
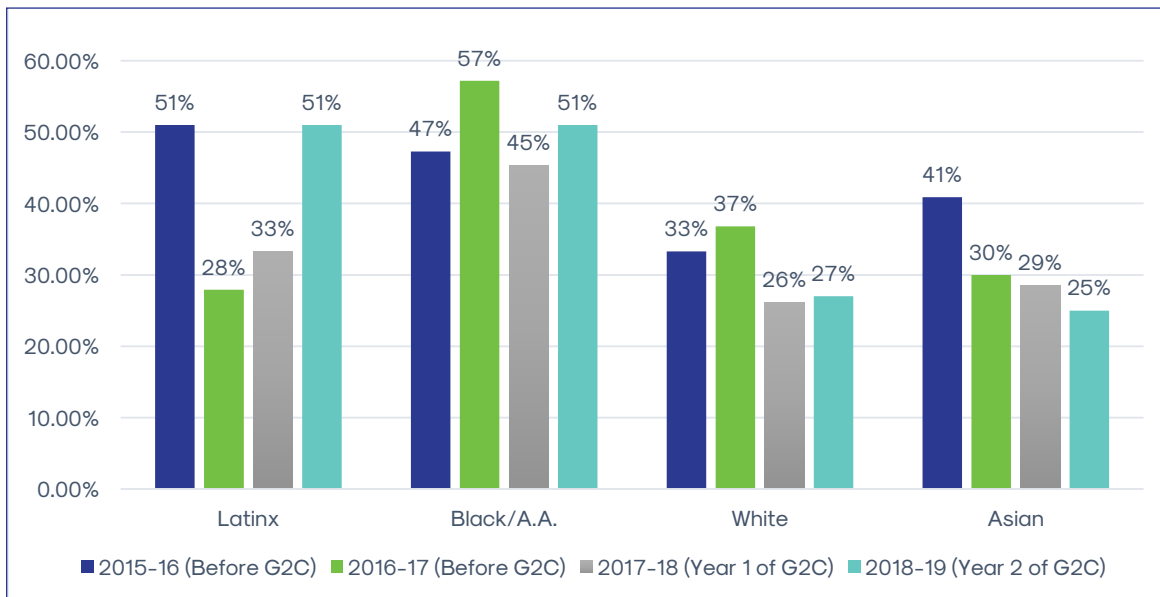


Figure 5
DFWI Rate by Ethnicity/Race



LESSONS LEARNED AND POTENTIAL IMPLICATIONS

As the following chart shows, the DFWI rates were lower for the Asian students and the white students during the redesign years than during the years before the redesign. However, for the Latinx students and the African American students, the before-and-after DFWI rates were relatively unchanged.

The above chart incorporates data from the following:

- Fall 2015 – all 12 sections offered – before the G2C redesign
- Fall 2016 – all 12 sections offered – before the G2C redesign
- Fall 2017 – all 12 sections offered, 7 of which were taught by G2C instructors – year 1 of the G2C redesign
- Fall 2018 – all 11 sections offered, 11 of which were taught by G2C instructors – year 2 of the G2C redesign

This chart suggests that we need a shift of emphasis in our pedagogy. While the G2C instructors have implemented recommendations #2 through #7, the impact has not benefited all student demographics. We need a more inclusive pedagogy. Perhaps implementing more peer-to-peer time in the classroom and placing more emphasis on creating an atmosphere in which all students have a sense of belonging would engage under-represented students. We should do the following:

- learn students' names early
- build personal relationships with students by revealing occasional anecdotes about ourselves
- model respect and fair treatment
- include positive comments in response to student questions and comments
- encourage one-to-one office visits
- in general, create a culture of caring

As always, we instructors have the challenge of working in unison toward a common goal while bringing out the best in one another and our students.