# College Algebra (MATH 1111) Course Redesign at the University of North Georgia

## Redesigning College Algebra: A Vision for the Future

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The Gateways to Completion committee was appointed to study and redesign College Algebra at the University of North Georgia and began work in Fall 2018. The committee began the three-year process of examining the course, identifying areas of concern, proposing, piloting, and implementing the redesign. The committee studied data from the Office of Institutional Effectiveness, surveyed faculty and students, analyzed previously published objectives, created new objectives with sample questions, and piloted textbook curricula and online platforms. The 2019-2020 academic year began the enactment of the piloted redesign. The committee continues to analyze data in anticipation of year three.

## STATEMENT OF THE PROBLEM

The University of North Georgia (UNG) contains five geographical campuses with the following undergraduate student enrollments in Fall 2019: Gainesville (7,913 students), Dahlonega (7,296 students), Oconee (2,504 students), Cumming (1,291 students), and Blue Ridge (197 students) (Rogers, 2019). Dahlonega is the only campus with a residential student population. The remaining four campuses do not have student housing options. The target student population and corresponding faculty population are large. For example, in Fall 2019, the Math department served 2,726 College Algebra students who were enrolled in nearly 90 sections taught by 45 tenure-track faculty, 10 full-time, non-tenure track faculty, and 11 adjunct faculty. College Algebra is a gateway course for students entering a variety of STEM and non-STEM majors. Upon examination, we quickly realized there were significant differences between campuses in terms of student populations. Comparisons were made among a number of categories such as the number of financial aid recipients, first-generation students, dual-enrollment students, non-traditional students, students placed in mandatory co-requisite support classes, commuter and residential students, part-time and full-time students, as well as students of a given gender or ethnicity. Additionally, the committee collected final exams and syllabi from faculty in the department to learn what variation might occur in the teaching or administration of the course. We learned from category comparison that student populations are highly diverse and from the faculty's materials that the students' experiences are divergent, both in content and rigor. The actual charge of our committee was to work with an external partner, the Gardner Institute and our own Center for Teaching, Learning & Leadership (CTLL) to redesign College Algebra and improve student outcomes. We pondered how to effectively measure student success in College Algebra as one of the first steps on a pathway to a career in STEM and how to improve students' mathematical knowledge. Through the

professional development provided by the Gardner Institute and CTLL our visions for reform began to take shape.

## METHODS

With the wide diversity in the student population, faculty, and campuses outlined above, the committee members targeted a curriculum redesign to achieve uniformity in the learning outcomes across UNG campuses. Using Bowen (2017) and Fink (2013), the committee chose a backward design methodology to identify and describe the content outcomes and abilities for a student who has successfully completed the College Algebra course. We developed course themes, to be implemented throughout the semester, that support further learning in mathematics, based on STEM field requirements. Themes include the understanding of transformations, inverses, symbolic manipulation, graphing characteristics and real-world applications of classes of functions. In support of those themes, we established learning objectives with vocabulary and sample questions to aid instructors' focus of content and to justify rigor. Uniformity in the College Algebra curriculum across three campuses (and eventually across all 5 campuses) has not previously occurred in the history of UNG. Campuses still use different textbook partnered with various learning platforms. In Fall 2019, all 6 members of the Committee piloted the new objectives and sample questions in their College Algebra classes and gave a single pre-/post- assessment at the beginning and end of the semester. In addition, the Committee had ongoing discussions, meeting every other week, about our materials and the feasibility and enactment in the classrooms. There were 12 pilot sections with 331 students in all. The result of this pilot will be described in the next section.

## OUTCOMES

Data collected from the Office of Institutional Effectiveness (OIE) included pre-/post-test assessment scores as well as DFWI and non-DFWI data for both the pilot and non-pilot sections for all five campuses. In the Fall 2019, 18.59 % of students enrolled in the 12 pilot sections have been categorized as DFWI, whereas 22.25 % of students enrolled in the non-pilot sections were categorized as DFWI. The results of the pre-/post-test assessment for pilot classes were tallied by the committee and are as follows: Pre-Test, Post-Test means were 19.44 % and 63.66 % respectively. Likewise, the Pre-/Post-Test standard deviations were 4.99 % and 6.18 %, respectively. The expected value of the pilot Pre-Test data is 19.34 % with a standard deviation of 7.50 %. We found that, in the long run, if the mean Pre-Test data of 19.44 % is used to estimate UNG's Pre-Test population mean, then 99 % of the time, the population mean will be between 17.10 % and 21.79 % with a margin of error of 2.34%. It was obtained that the sample proportion of 40.79 % of students scored the expected Pre-Test score of 19.34 %. If the sample proportion data is used to estimate UNG's population proportion, then the population proportion will fall in the interval of (36.34 %, 45.23 %) with a margin of error of 4.44 % almost 90 % of the time. The expected value of the pilot Post-Test data is 66.83 % with a standard deviation of 20.85 %. We found that, in the long run, if the mean Post-Test data of 63.66 % is used to estimate UNG's Post-Test population mean, then 99 % of the time, the population mean will be between 60.97 % and 66.35 % with a margin of error of 2.69 %. It was obtained that the sample proportion of 41.69 % of students scored the expected Post-Test score of 66.83 %. If the sample proportion data is used to estimate UNG's population proportion, then the population proportion will fall in the interval of (37.23 %, 46.15 %) with a margin of error of 4.46 % almost 90 % of the time. The OIE has reported that the mean Pre-Test score for students in Fall 2018 was 18.33 %. We performed a t-test at the significance level 0.01. With the mean Pre-Test score, 19.44 %, obtained from the pilot sections, the test has concluded that there is not enough evidence to reject the fact that the mean Pre-Test score at UNG is still 18.33 %. The OIE has

reported that the mean Post-Test score for students in Fall 2018 was 56.67 %. We performed a t-test at the significance level 0.0001. With the mean Post-Test score, 63.66 %, obtained from the pilot sections, the test has concluded that there is enough evidence to reject the fact that the mean Post-Test score for the pilot sections has not increased. Thus, if the pilot sections are used for understanding the betterment of effective learning in College Algebra classes, our results show that at 99.99% confidence level the mean Post-Test scores for students has increased.

## PLANS FOR CONTINUATION AND EXPANSION

The statistics presented above on the pilot semester support favorable outcomes. To be clear, the outcomes of the pilot provides evidence for lower DFWI rates and an increase in College Algebra knowledge. The Committee has continued to make small changes to make the new curriculum adaptable to the five campus. Our next step is to broaden the scope of the study; and therefore, the Committee is moving forward with the vetting of the new curriculum redesign through the Departmental Curriculum Committee (DCC). The DCC has the authority to approve and make changes at a program level. They are tasked with understanding how our new curriculum impacts subsequent Mathematics courses of which there are many and determining how alignment among the STEM series of courses may change. These changes could significantly impact co-requisite support courses that are taught in tandem with College Algebra. Students that participate in co-requisite courses are particularly vulnerable. Furthermore, students that participated in the pilot sections have not had the opportunity to complete other courses yet; therefore, long term and lasting effects are yet to be determined. Wide scale departmental implementation is planned for the 2020-2021 academic year in phases. The Committee has requested a cohort approach with the direction of a professional development coordinator. With each cohort, we plan to continue to gather data and adjust as necessary.

## LESSONS LEARNED AND POTENTIAL IMPLICATIONS

With a thorough review and consideration of the content of College Algebra, and its place in the continuum of mathematics courses for students in the STEM pathway, the committee feels that it successfully trimmed and refocused objectives with the intent of ensuring students would be properly prepared for future studies. Increasing the focus on applications in algebra coursework did not come at the expense of students' mastery of those objectives considered essential to student success in the STEM pathway. Individual instructors retained the flexibility to emphasize some content areas more if they desired but a higher level of consistency in core knowledge ensures that students are uniformly prepared for Precalculus and subsequent coursework. The significance of results in pilot sections, compared to non-pilot sections, occurred in spite of the results for non-pilot sections of College Algebra exceeding historical norms. Understanding the potential for improving student knowledge and performance will take time when additional cohorts progress through the new curriculum.

## REFERENCES

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