Evaluation Report of the RT3-Funded Components of the Distance Calculus Program, 2011-2014

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Executive Summary

This report provides findings from the evaluation of the Race to the Top (RT3) funded components of the Georgia Institute of Technology's Distance Calculus Program (DCP). The Distance Calculus Program is a dual enrollment program that allows advanced mathematics students at Georgia public high schools to complete Georgia Tech Calculus II and III. Upon successful completion of these courses, high school students receive Georgia Tech credit. This report provides a detailed description of the Distance Calculus Program, examines DCP Alumni Academic performance at Georgia Tech, and describes the impact of Race to the Top on the DCP. This internal evaluation was conducted by the Georgia Tech Center for Education Integrating Science, Mathematics, and Computing (CEISMC).

Georgia Tech CEISMC's Race to the Top DCP work began in fall semester 2011 and ended in spring semester 2014. The Race to the Top goal and action item related to the Distance Calculus Program states: **GOAL 1: Offer a rigorous course of study in mathematics, the sciences, technology, and engineering. ACTION (7):** Offer college-level calculus II and III to advanced high school students through Georgia Tech/CEISMC, which has pioneered the use of live video conferencing for these courses. The RT3 initiative will expand the reach of the program by 150 students (to 400/year), include additional school systems and individual students in rural[1] counties, and will offer other advanced distance courses such as Computer Science, Introductory Engineering, or post-AP chemistry or physics.

The DCP traditionally utilized a video-conferencing system to deliver the Calculus II and III courses to whole class groups of students in partner high schools. The course was offered in two parts: lecture and recitation. The recitation section, normally taught by a graduate student, allows students to review lecture material and ask questions. Through Race to the Top, Georgia Tech was able to pilot an online recitation section, which allowed for participation by single students from schools around the state.

Methods

For the purpose of understanding student learning in the DCP, grades on four quizzes and one final exam per semester were examined for participants in academic years 2011/12, 2012/13, and 2013/14. Student engagement in the new online format was also measured through an Engagement Survey administered at three points across the 2013/14 academic year. The level of engagement of students in the new online section was of interest because the physical learning environment was different from the traditional DCP live video-conferencing environment, the primary difference being attendance without other students being in the same physical location. Satisfaction with, and benefits of, the course and online section were also captured through an end-of-course questionnaire.

[1] For DCP, "rural" referred to any district/school that was outside of the Atlanta-metro area, although it is acknowledged that some areas outside of this area also have high population density, a characteristic that is typically included in rural definitions.

Additional measures to capture the benefits of participation in Distance Calculus were collected through an Alumni Survey and school system-level DCP Coordinator interviews. The Alumni Survey was administered to all DCP participants who matriculated to Georgia Tech during the 2012/13 and 2013/14 academic years. The survey captured benefits related to preparation for college courses and the perception of skills gained through DCP that aided participants in meeting college academic requirements. Also of interest was the DCP participants' Intention to Persist in STEM fields, which was also captured through the Alumni Survey. The DCP Coordinators within each participating district provided input regarding their perspectives of the benefits of DCP for their students, their teachers, and their schools/districts. This data was gathered through participation in either a focus group or a telephone interview.

Key Findings

Increased involvement of individual students

The RT3 initiative allowed Georgia Tech to expand the reach of the DCP by increasing the involvement of individual students, particularly in rural school systems. As a result of Race to the Top funding, an online DCP recitation section was created. This section allowed individual eligible students (those with ACT scores above 30 or SAT scores above 2000, GPA's of at least 3.5, and Advanced Placement (AP) Calculus scores of 3 or 4) to participate in the DCP. Up until this time, the DCP program structure was geared towards partnering with districts and schools in metro Atlanta. Students not applying from a partner school were not accepted. For example, a single eligible student in a non-partner school or district outside of metro Atlanta applying to the program was not accepted. Due to the Race to the Top initiative, forty-two students participated from rural school districts or districts without prior involvement.

Increased interaction between students across different schools and districts

Utilization of an online recitation section allowed individual students in different geographic locations to interact with each other and the teaching assistant (TA), a Georgia Tech post-doc with a PhD in mathematics. The technology allowed students to communicate with each other including working in small groups and posing questions to the teaching assistant and each other. Students also had the ability to diagram questions using an online white board. The traditional DCP video-conferencing format allowed students to ask questions of the TA, but not diagram questions using an online white board, an important component to increasing understanding of challenging mathematics concepts. Data also suggests that participation in DCP prepares students to participate in online learning, an experience they may not have had in high school.

Higher achievement by students in the online recitation section

Data suggests that students in the online recitation section performed better in the course when compared to participants in the traditional video-conferencing section and freshman level Georgia Tech students. It should be noted that differences in grading and in the group membership might also contribute to these differences in performance; therefore this finding is made with caution.

Increased confidence in college-level study by advanced mathematics students
Responses from the DCP alumni survey, of those who matriculated at Georgia Tech, suggest that they were more confident about their ability to succeed in college (66% "agree" or "strongly agree"), developed more realistic expectations of college (63% "agree" or "strongly agree"), and were better prepared academically for college (60% "agree" or "strongly agree") because of their participation. Alumni also reported improved study and time management skills as a result of participating in the DCP.

Programmatic Recommendations

1. Consider utilizing an online format for all recitation sections.

The online recitation section allowed participants to interact with each other across districts including working in small groups. Additionally, participants had the ability to draw and diagram their questions using an online whiteboard. Slightly better achievement by students in the online section compared to freshman level Georgia Tech students and DCP students in the traditional section possibly indicates online recitation increases student achievement. While causality could not be determined, it should be noted that online recitation section students entered the course with lower GPAs and SAT scores than students in the traditional videoconferencing section and performed better.

2. Develop a DCP awareness campaign targeted towards rural school districts.

The online recitation section provided Georgia Tech with a mechanism to provide Calculus II and III to individual eligible students, particularly from rural areas. An awareness campaign could serve as a recruitment tool for the DCP program and possibly further increase participation by students in rural districts. Students in rural areas currently learn about the program by visiting the Georgia Tech website, by word-of-month or participating in the Governor's Honors Program. The Office of Admissions specifically recruited students who were alone in their schools who would qualify for DCP at Governor's Honors during the summer of 2014, and accepted those students into the program after the official closing date.

3. Invest in developing a K-12 pipeline program, with the goal of increasing the number of diverse eligible students.

While Race to the Top increased participation in DCP by students in rural school districts, data indicates participation by racial and /or ethnically diverse students did not increase over the three-year Race to the Top project period. While this was not a stated-goal of the Race to the Top component, the low participation rate (approximately 5%) by racial and ethnically diverse students indicates that not enough eligible students are in the DCP pipeline. Development of a program that focus on increasing participation and achievement in accelerated math courses at the middle and high school levels by racial and ethnically diverse groups of students should be investigated.

Background on the Distance Calculus Program (DCP)

The Georgia Institute of Technology, in collaboration with various school systems in Georgia, has been offering sophomore college level courses via distance learning to advanced high school students through its Distance Calculus Program (DCP) since 2005[2]. This report provides a detailed description of the Distance Calculus Program, examines DCP Alumni Academic performance at Georgia Tech, and describes the impact of Race to the Top on the program.

History of the DCP

According to Morley et al (2009), in the fall of 2004, a conversation between a staff member from Georgia Tech's Center for Education Integrating Science, Mathematics and Computing (CEISMC), and a Fulton County School System curriculum coordinator, revealed there was a growing number of students in the school system taking AP Calculus during their sophomore or junior years. The curriculum coordinator was in the process of examining options for advanced students to complete freshman level college calculus at Georgia Tech while still in high school. A state-level dual enrollment option was already in place. Because the option allowed high school students to enroll in university system courses, Georgia Tech and the Fulton County schools were able to develop a program that allowed students to enroll at Georgia Tech and complete the two – semester freshman level calculus course sequence (Calculus II and Calculus III). However, due to transportation costs and lack of time, it was physically impossible for Fulton County students to attend courses on the Georgia Tech campus. Therefore, offering instruction through the use of distance learning was explored and implemented as a viable option.

Beginning in the fall of 2005, the Distance Calculus Program (DCP) began by providing freshman calculus to students in five schools within the Fulton County School System using a distance-learning format. Students successfully completing the course with a grade of A, B, or C earned 4 credit hours of Georgia Tech credit for each semester. The credit was transferable to other universities across the country. In year one, 34 students from five Fulton County High Schools enrolled in the program. By the 2008 – 2009 school year, the program grew to include 205 students in 21 high schools from four school systems. Table 1 lists participation in the program from 2005 – 2009.

[2] Morley, T., Usselman, M., Clark, R., Baker, N. (2009). *Calculus at a Distance: Bringing Advanced Mathematics to High School Students through Distance Learning.* Paper presented at the ASEE 2009 Annual Conference & Exposition.

Table 1 Participation in the first four years of the DCP.

Year	# School Systems	# Schools	# Appli-cants	# Students Enrolled	Seniors	Juniors	Soph.
2005-06	1	5	42	34	33	0	1
2006-07	2	9	87	79	76	3	0
2007-08	2	12	107	98	92	6	0
2008-09	4	21	232	205	197	5	3

High school students entering the DCP were (and still are) required to have a math GPA of 3.5, complete the Advanced Placement (AP) Calculus AB or BC course at their high school, and earn a 4 or higher on the AB Calculus exam or a 3 or higher on the BC exam. Advanced Placement courses, developed by the College Board, offer college-level curricula and examinations to high school students. American higher education institutions grant placement and course credit to students who obtain high scores on the examinations. It should be noted that these are the minimum requirements to meet eligibility for DCP, but does not guarantee acceptance due to the competitiveness of the program. According to information presented in the DCP Eligibility Guidelines posted on the DCP website[3], the middle 50% of admitted students in 2013-2014 scored from 30 to 33 on the ACT and 2000 to 2250 on the SAT.

The College Board provides the following descriptions of Advanced Placement Calculus courses:

> Calculus AB: "AP Calculus AB is roughly equivalent to a first semester college calculus course devoted to topics in differential and integral calculus. The AP course covers topics in these areas, including concepts and skills of limits, derivatives, definite integrals, and the Fundamental Theorem of Calculus. The course teaches students to approach calculus concepts and problems when they are represented graphically, numerically, analytically, and verbally, and to make connections amongst these representations.[4]"
>
> Calculus BC: "AP Calculus BC is roughly equivalent to both first and second semester college calculus courses and extends the content learned in AB to different types of equations and introduces the topic of sequences and series. The AP course covers topics in differential and integral calculus, including concepts and skills of limits, derivatives, definite integrals, the Fundamental Theorem of Calculus, and series. The course teaches students to approach calculus concepts and problems when they are

[3] http://admission.gatech.edu/apply/programs-high-schoolers/distance-calculus-program/eligibility-guidelines retrieved September 10, 2014

[4] The College Board (2014). *AP Calculus AB* (Overview). Retrieved from http://media.collegeboard.com/digitalServices/pdf/ap/ap-course-overviews/ap-calculus-ab-course-overview.pdf on September 10, 2014.

represented graphically, numerically, analytically, and verbally, and to make connections amongst these representations.[5]"

Applicants pay the normal $50 university application fee to apply. The Accel Program covers course tuition and a percentage of necessary books for students who enroll in university system courses during their junior or senior year in high school. Specifically, "the Accel program is for students at eligible high schools that wish to take college level coursework for credit towards both high school and college graduation requirements.[6]" This program eliminated the most obvious student funding issue, though there are still costs associated with the distance transmission. The costs for the program are $100/per student per semester plus $6000.00 - $8000.00 per school for distance learning equipment.

The traditional DCP model consists of two semester-long courses. From Monday to Friday, 8:05 am to 8:55 am, high school (HS) students enrolled in the DCP gather in classrooms in their respective schools for live, synchronous lectures and recitations mediated through video-teleconferencing (VTC) equipment[7]. On Tuesday and Thursday mornings, students are subdivided into recitation sections where Teaching Assistants (TAs) solve problems and answer questions that students may have.

DCP students enrolled in the traditional format rely on VTC equipment to connect to live recitations on Tuesday and Thursday mornings. The VTC equipment carries a live video stream of their instructor and their TAs: distance students simultaneously see and hear their TAs, and what they are writing on a whiteboard with a Tablet PC. Students can pose questions to their TA. The remote site where a student is asking a question is shown on large screens at the rear of the rooms where recitations are held. However, there is no way for students at different high schools to work together during recitations, and there is no way for distance students to draw on the whiteboard that their TAs use.

Historical Outcomes

Program enrollment numbers have steadily increased since 2005, and the high school students that complete the DCP receive, on average, higher grades than the Georgia Tech students who complete the same courses on campus (Table 2). The program has also been an effective recruitment tool for attracting academically advanced students in the state to Georgia Tech. Students who completed the DCP in its first two years have been found to perform very well in their freshman year (Table 3).

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[5] The College Board (2014). *AP Calculus BC* (Overview). Retrieved from http://media.collegeboard.com/digitalServices/pdf/ap/ap-course-overviews/ap-calculus-bc-course-overview.pdf on September 10, 2014.

[6] GACollege411(2009). Accel Program. Retrieved from https://secure.gacollege411.org/Financial_Aid_Planning/Scholarships/Grants_and_Scholarships/Accel_Program.aspx on September 10, 2014.

[7] Morley, T., Usselman, M., Clark, R., Baker, N. (2009). *Calculus at a Distance: Bringing Advanced Mathematics to High School Students through Distance Learning.* Paper presented at the ASEE 2009 Annual Conference & Exposition.

Table 2 Academic performance of students in the DCP in the first four years.

Semester	# of Districts	# of Students	A	B	C	D/F/I	Withdrew
Fall 2005-06	1	34	79%	21%	-	-	-
Spring 2005-06	1	32	81%	16%	-	3%	-
Fall 2006-07	2	79	90%	8%	3%	-	-
Spring 2006-07	2	71	90%	7%	1%	1%	-
Fall 2007-08	2	95	83%	16%	-	-	1%
Spring 2007-08	2	82	85%	13%	1%	-	-
Fall 2008-09	4	205	87%	9%	2%	2%	-
On-Campus Students							
Spring 2007-08		200	36%	45%	17%	4%	

Table 3 Academic performance of students in their freshman year who completed the DCP in the first two years of its existence and matriculated to Georgia Tech.

Year in Program	# Completed Program	# Entered this University	% Had 4.0 GPA Fall Term	% Had 3.5 or Better GPA Fall Term
2005-06	32	17	47.10%	76.50%
2006-07	71	32	46.90%	78.10%

Purpose of RT3-Funded Work

In order to meet the RT3 goal of offering a rigorous course of study in mathematics, the sciences, technology, and engineering, Georgia Tech offered college level calculus II and III to advanced high school students. The RT3 initiative allowed Georgia Tech to expand the reach of this program by developing an online format, which allowed individual students from school systems around the state to participate. Prior to Race to the Top, only students from specific partner schools in metro Atlanta could participate. During the Race to the Top time period, all students in Georgia public schools with competitive academic scores, from any school district, were eligible to apply. The Georgia Tech Office of Admissions accepted students into the program based on the strength of their academic record.

The Race to the Top goal and action item related to the Distance Calculus Program states: **GOAL 1: Offer a rigorous course of study in mathematics, the sciences, technology, and engineering. ACTION (7):** Offer college-level calculus II and III to advanced high school students through Georgia Tech/CEISMC, which has pioneered the use of live video conferencing for these courses. The RT3 initiative will expand the reach of the program by 150 students (to 400/year), add additional school systems and individual

students in rural[8] counties, and will offer other advanced distance course such as Computer Science, Introductory Engineering, or post-AP chemistry or physics.

Changes to DCP Course Structure and Design

A new recitation section was developed based on multiple considerations. First, in order to expand the reach of Distance Calculus, rural school districts were included that had limited numbers of students. In the established school systems, many students attended the lectures and recitation sections together in a classroom in their schools. However, in these new districts where very few, often singular, students were participating, the inability to interact with other students was deemed to be potentially detrimental to their learning. The recitation section that consisted primarily of students who were alone in their districts was established to encourage a sense of community and, pedagogically, to allow the ability to construct knowledge with other students.

The rationale for moving from the VTC format to a web-conferencing environment was not only to allow more flexibility in the ability of students to access the course and to participate in the recitation sections, but also to address the cost-prohibitive nature of the course. As mentioned earlier in this report, currently, for the traditional distance model, Georgia Tech charges $100/student for the technical assistance, and this amount is capped at $3K/school should any one school have more than 30 students in the program. However, there is a cap on the total school district for this technical assistance fee at $15K. Additionally, the video conferencing equipment costs $6,000 to $8,000, which can be prohibitive for schools with smaller enrollments.

The format of the new recitation section replaces VTC equipment with a combination of live webcasts for lectures, and web-conferencing software for recitations. Each student in this format must be 1) connected to a computer with an Internet connection, and 2) logged into the web-conferencing software during the recitations. Figure 1 shows a screen capture of the web-conferencing environment during a recitation of the Spring 2013 semester. Personal identifiers have been redacted with grey boxes. Students were able to interact with the TA and other students with an instant messaging tool and draw anonymously on the board to ask and answer questions.

Equipment was loaned to students in the new recitation format. As it can be difficult to write mathematical expressions on a white board without a graphics tablet, all students in the pilot and the TA were provided “Wacom Bamboo Splash” tablets for the entire duration of the Distance Calculus Program. Students in the 2013-14 academic year were also provided microphones if they did not already have one.

Breakout rooms were used to facilitate group work activities in roughly 40% of the recitations held during the two cohort years. During group work, students in a recitation

[8] For DCP, “rural” referred to any district/school that was outside of the Atlanta-metro area, although it is acknowledged that some areas outside of this area also have high population density, a characteristic that is typically included in rural definitions.

session moved out of a "main" room and into "breakout" rooms where students worked in small groups for roughly 10 to 20 minutes to solve a given problem on a shared whiteboard. The TA moved between breakout rooms to interact with students as they were working in groups. Figure 2 shows a screen capture of the web-conferencing environment during a group work activity held in the Spring 2014 semester.

Not shown in Figures 1 and 2 is the video feed of the TA. Students received a video and audio feed of the TA, but the TA did not have a video feed of the students. Students who had a microphone could use it to speak to the other participants in the recitations.

Finally, it should be mentioned that the web-conferencing software is only used in the new recitation format. Students who are enrolled in this format view live lectures that are also offered via a live webcast. Students in the pilot section, who did not have access to VTC equipment, were expected to view lectures in this way. Those students viewing the lectures through the webcast can pose questions to their instructor through an instant messaging system. All lectures and recitations are archived and made available for students to review.

Figure 1 A screen capture demonstrating the web-conferencing environment in Wimba Classroom.

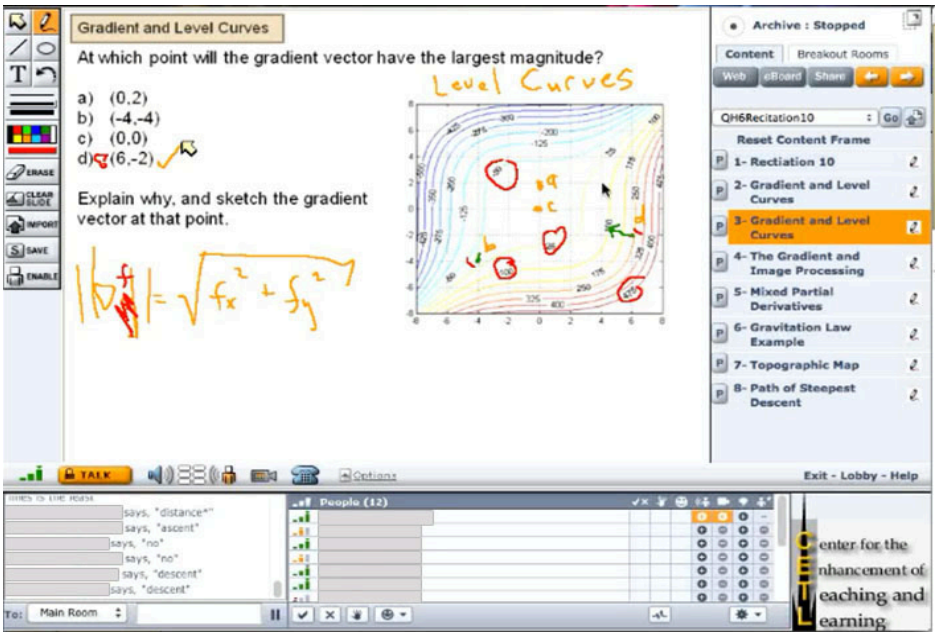
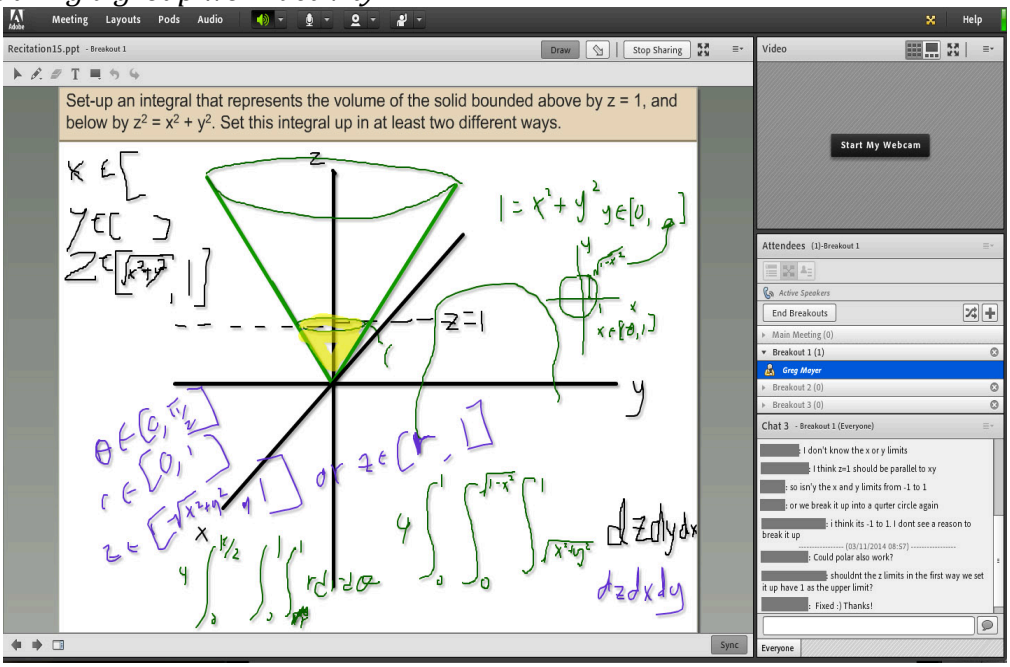


Figure 2 A screen capture demonstrating the web-conferencing environment in Adobe Connect during a group work activity.



Methods

The evaluation of the DCP included two primary questions: (a) What were the impacts of the program on student performance in the advanced mathematics courses, and (b) What was the level of engagement of the new students in the new recitation section?

For the purpose of understanding student learning, students' performances in the DCP courses were collected, which included four quiz grades and one final exam per semester. The level of engagement of students in this new recitation section was of interest because the physical learning environment was different from the traditional classroom, the primary difference being attendance without other students being in the same physical location. Student engagement was measured through an Engagement Survey that was administered at three points across the 2013-2014 school year. Satisfaction with, and benefits of, the course and recitation section were also captured through an end-of-course questionnaire.

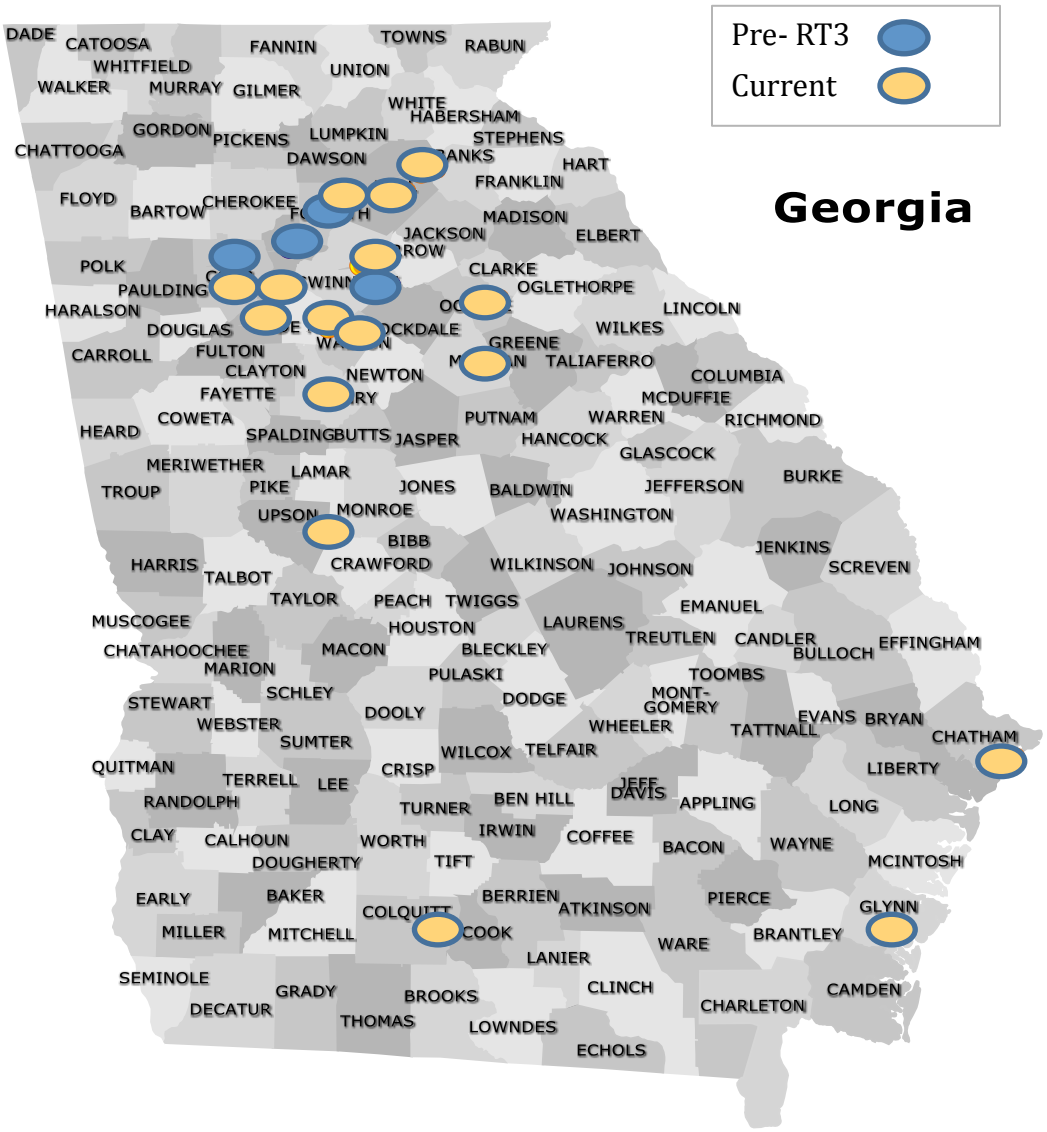
Additional measures to capture the benefits of participation in Distance Calculus were collected through the Alumni Survey and DCP Coordinator interviews. The Alumni Survey was administered to all those in Cohort 1 and Cohort 2 that matriculated to Georgia Tech. The survey captured benefits related to preparation for college courses and their perception of skills gained through DCP that aided them in meeting college academic requirements. Also of interest was the students' Intention to Persist in STEM fields, which was also captured through the Alumni Survey. The DCP Coordinators within each participating district provided input regarding their perspectives of the benefits of DCP for their students, their teachers, and their schools/districts. This data was gathered through participation in either a focus group or a telephone interview.

Results

Expansion of the DCP

Prior to RT3 funding, four school districts were involved with DCP: Gwinnett, Cobb, Forsyth, and Fulton Counties. The RT3 initiative allowed an additional 12 districts to participate, none of which had been previously involved with the DCP, and many of which were rural: Hall, Henry, Atlanta Public Schools, Gainesville City, Glynn, Morgan, Oconee, Savannah-Chatham, Colquitt, Upson, DeKalb, and Walton. Figure 3 indicates number of participating districts pre–RT3 and currently.

Figure 3 Participating School Districts, Pre-RT3 and Currently



Enrollment Data

The number of students that were enrolled in the DCP from Fall 2011 to Spring 2013 is shown in Table 4 below. Approximately 940 unduplicated high school students participated in the DCP across the three academic years of RT3 funding. Table 5 indicates enrollment by district, 2011 -2014.

Table 4 Participation in DCP between Fall 2011 and Spring 2014

Format	Cohort 1		Cohort 2		Cohort 3	
	Fall 2011	Spring 2012	Fall 2012	Spring 2013	Fall 2013	Spring 2014
New	NA	NA	16	16	20	17
Traditional	304	295	296	290	309	294
TOTAL	304	295	312	306	329	311

Note: Counts include students receiving grades at the conclusion of each semester.

Table 5 – Participation by District, 2011 - 2014

District	2011-2012	2012-2013	2013-2014
APS	0	6	4
Cobb	49	51	47
Colquitt	0	1	0
DeKalb	0	3	0
Forsyth	37	43	42
Fulton	141	127	125
Gainesville City	0	1	1
Georgia Military HS	0	0	1
Glynn	0	0	1
Gwinnett	64	76	96
Hall	1	2	1
Morgan	0	0	1
Oconee	0	0	3
Chatham	0	5	2
Upson	0	0	1
Walton	0	0	1
Not Reported	7	0	0
Total	**299**	**315**	**326**

Note: Counts were provided by Georgia Tech Undergraduate Admissions Office and may have slight discrepancies with counts of students who received grades as presented per semester above (Table 4).

Demographics of DCP Participants

When applying to the DCP, students were asked to indicate their gender and ethnicity. Table 6 presents gender and ethnicity distribution data for students in Cohorts 1, 2, and 3, as well as for freshman Georgia Tech students[9]. The "Other" ethnicity category includes students whose ethnicity is unknown and students who indicated they were American Indian, Alaskan Native, Native Hawaiian, or Pacific Islander.

The proportions of males and females among Distance Calculus students were similar to those of the Freshmen Class overall[10], with just over a third of students being female across cohorts. However, the proportion of students who indicated an Asian ethnicity was between 21% and 24% higher in the Distance Calculus program than among the Georgia Tech freshman students across cohorts. Subsequently, the proportion of White, African-American, and Latino/a students in Distance Calculus tended to be lower than Georgia Tech freshman.

Table 6. Enrollment by gender and ethnicity among Distance Calculus participants and all Georgia Tech Freshmen.

	Fall 2011		**Fall 2012**		**Fall 2013**	
	DCP Cohort 1	**GT Freshman**	**DCP Cohort 2**	**GT Freshman**	**DCP Cohort 3**	**GT Freshman**
Sample Size	**299**	**2483**	**315**	**2619**	**326**	**2244**
Female	37%	38%	38%	37%	34%	37%
Male	63%	62%	62%	63%	66%	63%
African-American	3%	7%	3%	7%	2%	8%
Latino/a	4%	7%	3%	8%	4%	6%
Two or More Races	3%	4%	3%	5%	6%	4%
White	51%	64%	51%	61%	45%	61%
Asian	38%	17%	40%	19%	44%	20%
Other	1%	1%	0%	1%	0%	1%
Total	100%	100%	100%	100%	100%	100%

Note: Counts of DCP students were provided by Georgia Tech Undergraduate Admissions Office and may have slight discrepancies with counts of students who received grades per semester (Table 4).

Average High School GPA, average AP Calculus scores, and SAT (Verbal and Math) scores for students in Cohorts 1, 2, and 3 at the point of enrollment in the program are shown in Table 7 below. Average GPA, SAT, and AP Calculus scores are similar across the three-year period considered for this study, and they characterize the overall academic achievement of the students who have enrolled in this program over recent years. Students who enrolled in the new recitation format had slightly lower GPA, SAT, and AP Calculus scores on average than did their Distance Calculus colleagues.

[9] Gender and ethnicity information of the Georgia Tech Freshman class in Table 6 does not include information related to international students.

[10] Source of Georgia Tech freshmen data presented in this section was the Georgia Tech FactBook: http://www.irp.gatech.edu/publications/fact-book-archives/

Table 7. Average GPA, SAT (Verbal & Math Composite), and AP Calculus scores of students who were admitted into the Distance Calculus program.

	Cohort 1	Cohort 2 (Fall 2012)		Cohort 3 (Fall 2013)	
	Traditional Recitation Format	**Traditional Recitation Format**	**New Recitation Format**	**Traditional Recitation Format**	**New Recitation Format**
Sample Size	**299**	**298**	**16**	**306**	**20**
Average GPA	4.08	4.11	4.03	4.17	4.15
Average SAT	1448	1488	1447	1483	1474
Average AP Calculus	4.70	4.92	4.80	4.92	4.85

Note: Counts of DCP students were provided by Georgia Tech Undergraduate Admissions Office and may have slight discrepancies with counts of students who received grades per semester (Table 4).

Average SAT Verbal and Math composite scores of entering GT freshman are shown in Table 8. On average, the SAT scores of GT Freshman were 54 to 83 points lower than those students in Cohorts 1, 2, and 3.

Table 8 Cumulative average of SAT (Verbal & Math Composite) scores for Entering Freshman.

Year	Composite SAT Score
Fall 2011	1394
Fall 2012	1405
Fall 2013	1420

Student Performance

A summary of course grades obtained by students in Cohorts 2 and 3, which included the new recitation sections, are shown in Table 9 below. It should be noted that all students in the Distance Calculus program were given an opportunity to be exempt from having to write the final exam: those who had earned a grade of at least 91.5% based on their quiz and homework scores at the end of every semester were exempt, asked to *not* write it, and assigned a final grade of 100% on the exam. As such, the table below presents statistics related to the final grades (which includes final exam scores and would be affected by this policy) and statistics related to the average earned on quiz grades (which are not affected by this policy).

Comparisons of final grades between the two groups are complicated because each groups had different TAs, recitation curriculum and activities were not identical across sections, and the grade weightings and the technologies that were used in these sections were also different. Grade weightings for both semesters are shown in Table 10. Students in the new recitation format were asked to complete group work activities, some of which counted towards their final grades. Nonetheless, grade data suggest that, on average, students in the new format section received equivalent grades to those of their peers in the other sections, and superior grades to those attending on campus.

Because of the multiple challenges to comparing the data between formats that are noted above, statistical comparisons were not conducted because of the inability to interpret these results. The slightly higher grades among New DCP formats compared to the Traditional DCP format may be resultant from greater learning, or it may be an artifact of the TAs' grading subjectivities, the format of the course, the sample of students in the New DCP format, etc. The grades presented below, therefore, are provided as supporting evidence of the success of both the students participating in the Traditional and New DCP sections. However, given the consistently higher grades among the DCP students compared to the on-campus students, coupled with the higher average SAT scores (see Tables 7and 8 above), it is reasonable to conclude that DCP students perform at a higher level than do the average Georgia Tech student, at least in mathematics courses. This higher performance, however, cannot be attributed to their participation in DCP; rather, their participation in DCP more likely reflects their ability to excel in mathematics.

Table 9. Final and quiz grade distributions obtained by students in the DCP in 2012/13 (Cohort 2) and 2013/14 (Cohort 3).

		Fall Semester				**Spring Semester**			
		quiz grade		**course grade**		**quiz grade**		**course grade**	
Cohort	**format**	**Avg.**	**SD**	**Avg.**	**SD**	**Avg.**	**SD**	**Avg.**	**SD**
Cohort 2	On campus	89%	9%	91%	10%	76%	12%	79%	12%
	Traditional DCP	94%	9%	96%	7%	83%	8%	88%	9%
	New DCP	96%	4%	96%	5%	89%	10%	90%	11%
Cohort 3	On campus	83%	12%	88%	11%	83%	10%	84%	12%
	Traditional DCP	91%	7%	95%	7%	87%	6%	91%	7%
	New DCP	94%	6%	95%	5%	93%	3%	96%	4%

Table 10. Grade Weightings for students in the new recitation sections vs. all others in the DCP.

Source of Grade	New DCP	On campus and Traditional DCP
Homework	10%	10%
Final exams	25%	25%
Quizzes	60%	65%
Group work in recitations	5%	NA

Student Engagement and Satisfaction in the New Recitation Section

Because a central purpose of the new recitation section was to allow students who were alone in their districts to interact with other students in similar circumstances for the purposes of providing support and additional learning opportunities, the perspectives of the students were examined. An online survey was administered to students in the new recitation format in August 2013, January 2014, and April 2014 that contained a subset of

the items adapted from the College and University Classroom Environment Inventory (CUCEI)[11] and a set of open-ended questions. The items from the CUCEI were administered to capture the change in student 1) Satisfaction, 2) Involvement, and 3) Cohesiveness over the school year. Each scale consisted of seven Likert-type rating items that ranged from "strongly disagree" (=1) to "strongly agree" (=4). Satisfaction captured the students' enjoyment of classes (e.g., "I look forward to taking part in recitations"). The Involvement scale measured the "Extent to which students participate actively and attentively in class discussions and activities" (p. 42) (e.g., "There are opportunities for students to express opinions in recitations"). Cohesiveness is defined as the "extent to which students know, help and are friendly toward each other" (p. 42) (e.g., "Students in recitations get to know each other well"). The average rating on each of these constructs is presented in Table 11 below.

The three columns under the "Unmatched" heading include the results from all students who completed the Engagement Survey at each time point. The columns under the "Matched" heading include average ratings for the subset of the whole class that had data available across all three-time points. These average ratings are presented separately, because the Matched averages are not impacted by the differences in group membership at each time point, whereas changes in the averages in the Unmatched columns might be impacted by differences in group membership. The larger sample sizes among the Unmatched, however, are valuable to better reflect the perspectives of the group as a whole.

Table 11. Survey results from the engagement survey.

Construct	Unmatched			Matched (n=7)		
	August (n=18)	January (n=9)	April (n=10)	August	January	April
Satisfaction	3.17	3.42	3.44	3.34	3.46	3.63
Involvement	3.18	3.33	3.28	3.33	3.43	3.36
Cohesiveness	1.94	2.11	2.52	2.17	2.19	2.55

Student Satisfaction and Involvement were well above the midpoint of 2.5 at the pretest. Cohesiveness, however, was below the midpoint, with an average of 1.94 overall for the Unmatched sample and 2.17 for the Matched group (near "disagree" = 2). Over the course of the two semesters, each of the three scales showed an increase from the initial August administration. Considering the Matched students, the largest changes from August to April occurred in the measure of Satisfaction (increase of 0.29, 7.2%) and Cohesiveness (increase of 0.38, 9.5%). These increases are statistically significant (Friedman's two-way ANOVA, $p \leq 0.05$). The Involvement scale showed a small, non-significant increase (0.03, 1%).

Students were also asked a number of open-ended questions on these surveys that provide further detail. When asked "How could recitations be improved?" many students on the surveys indicated that they would like to replace Wimba with a different software.

[11] Fraser, B.J. & Treagust, D.F. (1986). Validity and use of an instrument for assessing classroom psychosocial environment in higher education. *Higher Education 15,* p. 37-57.

For example, some of the comments in the August 2013 and January 2014 surveys were the following.

- *Wimba classroom seems to be a great learning tool, but also has many bugs.*
- *By changing the program we use for them, from wimba to something else.*
- *The main way that recitations could be improved would be if we used some other virtual blackboard software, rather than Wimba, whose technical glitches are frequent and inconvenient.*
- *Revelations are already great. The software could be slightly improved...*

Two comments in the April 2014 to the same question were as follows.

- *Never go back to Wimba. Don't even think about it.*
- *The switch to using Adobe Connect rather than Wimba was very helpful. If the TA was shown how to set everything up before the semester began, it might help things run a little more smoothly.*

In the April 2014 engagement survey, none of the students had positive comments related to Wimba. Over this time period, the software utilized for recitations changed to Adobe Connect, about which students had positive comments. Given that the recitations switched from Wimba Classroom to Adobe connect in February 2014, these comments could reflect some of the reasons behind the increase in the Satisfaction scores on the CUCEI.

DCP Alumni Academic Performance at Georgia Tech

Approximately 50% of DCP students matriculate to Georgia Tech. Academic data for these students who come to GT provides an idea of the success that DCP students have once they have transitioned to a university environment. When the data was available, the performance of the DCP alumni is presented alongside that of the GT Freshman class overall of which they are a part. Data presented in this section includes: Declared majors, participation in math courses during their freshman year, and academic performance in those first math courses. These data were not yet available for Cohort 3 at the time of the preparation of this report. As noted above, the DCP alumni data only includes students who matriculated to Georgia Tech.

Declared majors of the Distance Calculus students in Cohorts 1 and 2 who matriculated to Georgia Tech are shown in the table below. Roughly two thirds of these students enrolled in engineering, and over 93% of these students enrolled into computing, engineering, or science.

Table 12. Declared majors of students in Cohorts 1 and 2 who matriculated to Georgia Tech.

	Enrolled Fall 2012		Enrolled Fall 2013	
	DCP Cohort 1	GT Freshman	DCP Cohort 2	GT Freshman
Number Enrolled at GT	**149**	**3047**	**153**	**2673**
Architecture	1%	2%	1%	2%
Computing	11%	7%	14%	9%
Engineering	66%	71%	71%	72%
Liberal Arts	3%	4%	1%	3%
Sciences	16%	7%	11%	6%
Business	3%	8%	1%	8%

Out of 302 Distance Calculus students who matriculated to Georgia Tech, 210 (70%) took another math course during their first year; of these, 23 (8%) took two to four courses their first year. Tables 13 and 14 present the courses they took, and the grade distributions. Most of the Distance Calculus alumni that take math courses at Georgia Tech complete Differential Equations, which is next in the Calculus progression of courses, and over 7% take 3000 (junior) and/or 4000 (senior) level courses in their freshman year. Performance in these classes by the Georgia Tech freshman class overall was not available for comparison.

Table 13. Courses that Distance Calculus alumni completed at Georgia Tech in their freshman year, and the number and percentage of alumni who completed them in their freshman year.

		Cohort 1		**Cohort 2**	
Level	**Course Title**	**Number**	**Percentage**	**Number**	**Percentage**
1000	Honors Calculus II	0	0%	1	1%
2000	Differential Equations	91	71%	83	72%
	Abstract Vector Spaces	6	5%	5	4%
	Linear and Discrete Math	7	5%	8	7%
	Calc III for Comput Sci	4	3%	0	0%
	Special Topics	0	0%	1	1%
3000	Applied Combinatorics	10	8%	8	7%
	Probability & Statistics	7	5%	4	3%
	Honors Prob & Statistics	0	0%	1	1%
	Statistics & Applications	1	1%	3	3%
4000	Combinatorial Analysis	1	1%	0	0%
	Intro To Number Theory	1	1%	1	1%
	Total	128	100%	115	100%

Shown in Table 14 are the distributions of grades obtained by Distance Calculus alumni in the mathematics courses they completed at Georgia Tech during their freshman year. For example, 53% of the grades that Cohort 1 students obtained in mathematics courses in their freshman year were A's, 31% of these grades were B's, and so on. In both Cohort 1 and 2, over 80% of the grades these students obtained in their freshman year

math courses were either A's or B's. Disaggregated grades per course were not available. Credit attainment information was not available.

Table 14. Average grade distributions obtained by Distance Calculus alumni in mathematics courses at Georgia Tech in their freshman year.

Grade	Cohort 1	Cohort 2
A	53%	47%
B	31%	33%
C	9%	9%
D	4%	3%
F	0%	3%
W	2%	4%

Benefits of the DCP: Alumni Survey

A total of 85 DCP alumni responded to the survey invitation. Of these respondents, 61% attended the DCP during the 2011-2012 school year (Cohort 1) and 39% attended during the 2012-2013 school year (Cohort 2). Response rates for this survey were calculated out of the 280 total DCP students of Cohort 1 and Cohort 2 who matriculated to GT and whose contact information (email address) was available. The overall response rate, therefore, was 30%. Only students who matriculated to Georgia Tech were included in the sample because of the availability of their contact information.

The vast majority of respondents indicated that they were currently taking STEM courses (98%). When asked to indicate their college of enrollment, the largest group indicated College of Engineering (63%), followed by College of Computing (20%), and College of Sciences (16%). These proportions are similar to that of the entire DCP alumni sample, as presented previously in this report. It should be noted that the Alumni sample in general is skewed toward STEM majors because of the available sample being students at Georgia Tech. Although many DCP students do intend to pursue STEM majors, some students who were interested in non-STEM-related majors would likely attend other universities. Similarly, some STEM-interested students also enrolled in universities other than Georgia Tech. It is unknown how the students' responses to the survey, particularly to the ratings of benefits of their participation in DCP, may be impacted by their interest in engineering careers.

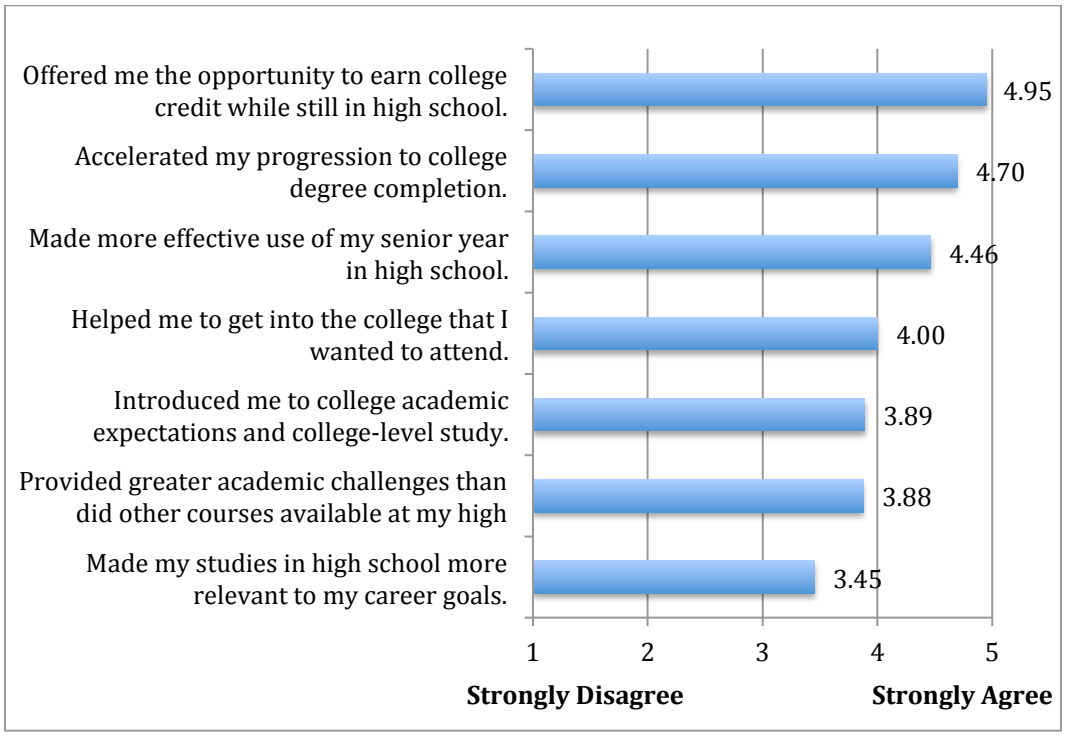
Demographically, 59% of respondents were male and 41% were female. The primary racial groups represented among respondents were White (66%), followed by Asian (29%), African American (2%), Hispanic/Latino (1%), and two indicated multiple groups (2%). The proportion of respondents that were female is slightly higher than that of the general DCP alumni population at Georgia Tech (~37%). The proportion of students who indicated a White ethnicity was 15% higher than what is found in the general DCP alumni population at Georgia Tech.

Alumni were asked to indicate the contribution of DCP on a number of rating items. The 5-point Likert scale on these items ranged from "Very Poor" (=1) to "Excellent" (=5) or captured level of agreement, ranging from "strongly disagree" (=1) to "strongly agree" (=5).

Of these respondents, 83% indicated that their overall experience with Distance Calculus was either "excellent" or "good:" 31% indicated it was "excellent" and 52% indicated it was "good." When asked if they would recommend DCP to current high school students, 96% indicated "Yes."

Participants were asked to indicate their level of agreement with a series of statements about the contributions of DCP. Ninety-six percent (96%) indicated that they "strongly agree" that DCP offered the opportunity to earn college credit while in high school (Mean = 4.95); 96% indicated that they either "agree" or "strongly agree" that participation helped to accelerate their progression to college degree completion (Mean =4.70); 88% indicated that they either "agree" or "strongly agree" that DCP made more effective use of their senior year in high school (Mean =4.46). To a lesser degree, 72% of alumni indicated that they "agree" or "strongly agree" that DCP introduced them to college academic expectations and college-level of study (Mean =3.89), 68% indicated that they "agree" or "strongly agree" it helped them get into the college that they wanted to attend (Mean =4.0), 67% indicated that they "agree" or "strongly agree" it provided greater academic challenges than did other courses available at their high school (Mean =3.88), and 52% indicated they "agree" or "strongly agree" it made their studies more relevant to their career goals (Mean =3.45).

Figure 4. Average Rating of Benefits of Distance Calculus (n= 82)

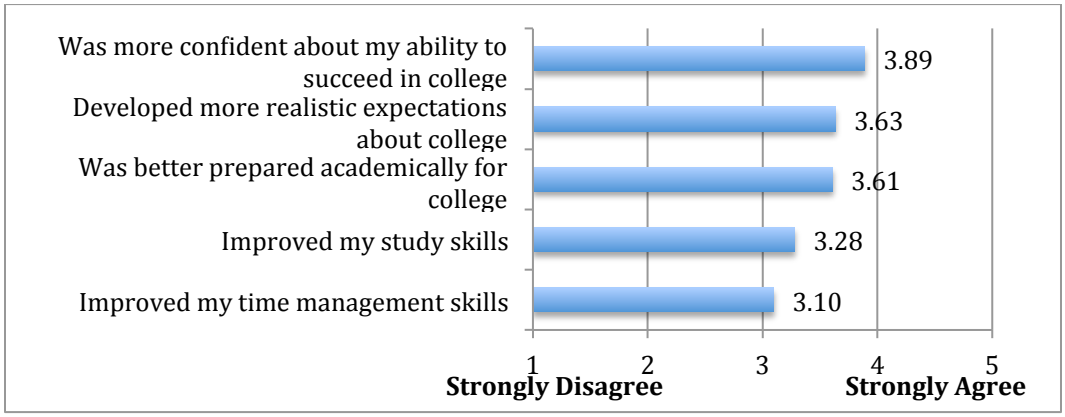


Note: Three DCP Alumni Survey respondents did not respond to these rating items.

In addition, alumni were asked to consider skills that were gained through their participation: 66% of respondents indicated that they either "agree" or "strongly agree" that participation in DCP improved their confidence that they could succeed in college

(Mean =3.89); 63% indicated that they either "agree" or "strongly agree" it helped them to develop more realistic expectations about college (Mean = 3.63); and 60% indicated that that they either "agree" or "strongly agree" they felt better prepared academically for college (Mean = 3.61).

Figure 5. Average Rating of Benefits of DC (n=82)



Note: Three DCP Alumni Survey respondents did not respond to these rating items.

Alumni were also asked to describe the most important reason that they chose to take the Distance Calculus course in an open-ended item. Most often, respondents noted the desire to attain college credit (n=45, 58%), but often they provided additional explanation beyond merely gaining credit. Students also indicated a desire to graduate more quickly or have additional time for other pursuits in college (n=10, 13%) or simply stating that they would not have to take it in college (n=7, 9%). The other common category of comments for taking DC was because they had a desire or need to take a math course their senior year in high school (n=20, 26%), many stating a desire to maintain continuity in their mathematics coursework (n=13, 17%), and several explaining that the other logical option of AP Statistics would not help in their college careers (n=3, 4%). A few students indicated that they wanted a challenge (n=4, 5%), had a desire to know what college-level courses were like (n=3, 4%), and one student wanted to test him/herself in a college-level course environment (1%). Two individuals (3%) thought that participation in the course would increase their chance of acceptance to Georgia Tech or to another college of their choice, and three (4%) wanted a GPA boost. Finally, one respondent indicated that Distance Calculus was less expensive than taking the course in college, one needed math credits for graduation, and one was told to take the course by a parent.

Intention to Persist in STEM

The intention of respondents to continue on an academic and career pathway in a STEM field was captured through a series of 10 rating items. These items were adapted from an existing instrument[12]. The respondents indicated how well each of the statements

[12] Toker, Y. (2010). *Non-ability Correlates of the Science-Math Trait Complex: Searching for Personality Characteristics and Revisiting Vocational Interest*. Unpublished doctoral dissertation, Georgia Institute of Technology, Atlanta, GA.

described their own intentions using a 6-point rating scale, ranging from "Very untrue of me" to "Very true of me." The three constructs captured by this instrument included: (a) Intention to Pursue a STEM Bachelors Degree, (b) Intention to Pursue a STEM Graduate Degree, and (c) Intention to Pursue a STEM Career. The mean rating for each item as well as the Grand Mean for each of these constructs is presented in the following table.

Table 15. Intention to Persist in a STEM Pathway

Construct/Item	Mean	N	*sd*
Intention to Pursue a STEM Bachelor's Degree	*5.89*		
Next semester, I intend to continue taking courses related to STEM.	5.91	80	0.284
I intend to stay in a major related to a STEM.	5.93	80	0.265
I intend to take courses related to STEM during the following school year.	5.86	80	0.443
I intend to get a bachelor's degree in a major related to STEM.	5.87	79	0.435
Intention to Pursue a STEM Graduate Degree	*3.75*		
I am planning to apply for a master's education in a field related to STEM.	3.98	80	1.458
I intend to get a master's degree in a field related to STEM.	4.09	80	1.425
I would like to pursue a PhD in a STEM related area.	3.18	80	1.421
Intention to Pursue a STEM Career	*5.54*		
I can see myself working in a STEM field in the future.	5.86	80	0.347
I am planning to spend my life working in a STEM field.	5.34	80	0.871
I intend to devote my career to an area related to STEM.	5.42	79	0.856

Both constructs Intentions to Pursue a STEM Bachelors Degree and Intentions to Pursue a STEM Career were high among respondents, averaging 5.89 and 5.54 on the 6-point scale. Ratings related to Intentions to Pursue a STEM Graduate Degree were lower than other constructs, with an average of 3.75. The average rating on the item capturing respondents' intentions to pursue a doctorate in a STEM field was the lowest, falling just below the midpoint of the scale (3.18).

Coordinator Focus Groups

In order to gain further understanding of the benefits of the DCP for (a) the students as well as for (b) the districts, schools, and teachers, the Distance Calculus Coordinators for each district were invited to participate in either a focus group or telephone interview. The focus group was conducted during the annual Distance Coordinator Meeting, in March 2014. Telephone interviews were conducted during April and May of 2014.

All coordinators who attended the Distance Coordinator Meeting provided feedback. All remaining coordinators were contacted on more than one occasion and invited to participate in the telephone interviews. Participation was voluntary. Two agreed to participate. A total of seven out of sixteen or 44% of school districts were represented. The participating districts were: Cobb, Forsyth, Fulton, Gwinnett, Hall, Henry, and Walton. The comments made through the focus groups and the interviews are summarized below under three themes: (a) Benefits for Students; (b) Benefits for teachers, schools, and districts, and (c) Consequences for students who were not accepted into DCP.

Benefits of Participation in the DCP for Students

The benefits identified by the coordinators aligned well with those most highly rated by students. Both coordinators and students indicated that DCP helped students to be accepted into the colleges of their choice, provided college credit, aligned better with student interests, and prepared students for the experience of attending college-level courses. In addition, the coordinators noted the convenience of distance learning versus dual-enrollment in a local college, which was often prohibitive to students. Also, coordinators noted the influence that having the option of DCP had on the students' choice of mathematics courses, where some students began taking the necessary math courses in earlier grades in order to be able to participate in the DCP by their senior year. Below is a summary of the main benefits for students noted by coordinators, along with selected quotations.

- Acceptance into the university of their choice
    - "I know we had some other seniors who were not admitted who also had a lot of AP on their resume. His take on it was that the GT credits helped him get in."
- Gaining college credit
- Preparing students for online learning
    - DC has allowed students to be exposed to "rigorous content and learning environment that is unique for high school and the wave of the future, a blended learning environment when part of it is going to be electronic."
- Preparing students for the necessary study skills needed at the university level
- Preparing students for the rigor of college courses
    - "I think he got a wake up call initially. I don't think it killed his GPA or anything. I think a wake up call to him was getting a 90 and not a 98. He realized there was a difference in rigorous between a high school class than a college class."
- Preparing students for college teaching style.
- Providing courses that are aligned with student academic and career interests
    - [We have a] "Growing number of advanced mathematics students and this allows them to study something that they have a passion about."
    - "If they love calculus and are excited about it but have to take AP statistics, a lot of times that they will not like the course and will slow them down in a math trajectory. [Students might think] I don't know how much I really like math. This is really a part of my future identity, whereas another trajectory might distract them."
- Allowing students to stay on the high school campus rather than travel to a college campus.
- Motivating students to take math courses earlier that will allow them to get into the DC course
- Providing students with a more realistic expectations of what a college course is like

    - "Success in distance learning requires that students be their own self-advocate and increase their organizational skills being able to balance and navigate the different resources. For example checking their email, which they are probably not accustomed to in a high school classroom. Being able to make sure that they are in charge of their learning."
    - "The partnership with GT makes University something that is real and relevant and it is not that faraway distant place for kids. Its helps them realize that its attainable and that professors are real people too and that they are accessible and that they have that comfort level with the professors and teaching assistants. It provides that extra benefit. It is not that strange scary place but a place that they can continue to study the things that they love.
- Online format and location in schools expands access to students who would not otherwise be able to attend due to financial barriers.

Benefits of Participation in the DCP to Teachers, Schools, and Districts

The coordinators noted a variety of benefits for their districts, schools, and teachers. Common benefits were related to improving the reputation of their school by offering advanced courses and being able to provide for the needs of students that were seeking advanced mathematics courses. In addition, some coordinators explained that having DCP available as an option raised the expectations of teachers and administrators for their students and for their math departments. Finally, exposure to successful distance learning, particularly through web-conferencing, has resulted in consideration of additional distance learning courses and has encouraged partnerships across district high schools using similar technology.

- Increases departmental expectations that students are able to perform at a high level. It also encourages mathematics departments to consider their own practices if few students are performing at a qualifying level.
    - The example was provided by a newer district that they had initially viewed one student who was advanced in mathematics as an anomaly, but once exposed to other districts who had 50 or 70 kids, they realize that "there's not something in the water, so there must be other students in our district that could qualify. "
    - "Increases expectations for our secondary math program overall. If we have an end goal in mind for students to enroll in AP calc. BC and be prepared to do well on that assessment. When all students were denied admission, they stepped back and asked 'What are we not doing right as a district to have them be competitive in this program,' so it has strengthened our secondary math program."
- Teachers, students, and districts are expanding their perspectives to consider additional advanced distance courses.
    - "Top students are definitely looking outside the box for options that are more applicable. They know other things are available because of DC."

- Involvement improves the reputation and competitiveness of the participating schools
    - "It shows we have the full package and can serve your best and brightest students."
- Participation has expanded the schools consideration of using video-conferencing and online tools for partnering across the district.
- The Distance Calculus Program has both fueled the demand for, and allowed schools to meet the demands for more advanced coursework.
- Keeps teachers knowledgeable of advanced content and college-level instructional practices.

Consequences for students who were not accepted into DCP

Coordinators indicated that those students who were interested in DCP but were not accepted tended to enroll in courses that were not as closely aligned with their academic interests. The courses that were often taken were other advanced courses, such as AP Statistics, or dual-enrollment programs offered by local colleges. Some communities did not have local colleges. Participation in dual-enrollment also posed problems related to transportation, which was often a barrier to students' participation. It also contributed to student lack of engagement in their local high school. Finally, the community colleges did not always have advanced mathematics courses to meet the needs of these students. For example, one student took College Algebra though he was clearly prepared for a higher-level math. In one case, the high school worked to develop a new course. Virtual schools offer some opportunities for advanced math courses, but the primary challenge is the lack of facilitators. Finally, some students took no mathematics courses their senior year.

Lessons Learned and Plans for the Future

The lessons learned for the DCP course are as follows:

- The online recitation section allowed participants to interact with each other across districts including working in small groups. Additionally, participants had the ability to draw and diagram their questions using an online whiteboard. Slightly better achievement by students in the online section compared to freshman level Georgia Tech students and DCP students in the traditional section possibly indicates online recitation increases student achievement. While causality could not be determined, it should be noted that online recitation section students entered the course with lower GPAs and SAT scores than students in the traditional videoconferencing section and performed better.
- The online recitation section provided Georgia Tech with a mechanism to provide Calculus II and III to individual eligible students, particularly from rural areas. An awareness campaign could serve as a recruitment tool for the DCP program and possibly further increase participation by students in rural districts. Students in rural areas currently learn about the program by

visiting the Georgia Tech website, by word-of-month or participating in the Governor's Honors Program. The Office of Admissions specifically recruited students who were alone in their schools who would qualify for DCP at Governor's Honors during the summer of 2014, and accepted those students into the program after the official closing date.

- While Race to the Top increased participation in DCP by students in rural school districts, data indicates participation by racial and /or ethnically diverse students did not increase over the three-year Race to the Top project period. While this was not a stated-goal of the Race to the Top component, the low participation rate (approximately 5%) by racial and ethnically diverse students indicates that not enough eligible students are in the DCP pipeline. Development of a program that focus on increasing participation and achievement in accelerated math courses at the middle and high school levels by racial and ethnically diverse groups of students should be investigated.

Based on the data, Georgia Tech has decided to continue offering one recitation section of the DCP using the new format with GT funds. The new format will be made available to districts where there are small numbers of students (between 1 to 3) at individual high schools. The School of Mathematics will evaluate how the format of the new format could be further improved.

Summary of Findings:

The RT3 initiative allowed Georgia Tech to expand the reach of the DCP by increasing the involvement of individual students, particularly in rural school systems. As a result of Race to the Top funding, an online DCP recitation section was created. This section allowed individual eligible students to participate in the DCP. Up until this time, the DCP program structure was geared towards partnering with districts and schools in metro Atlanta. Students not applying from a partner school were not accepted. For example, a single eligible student in a non-partner school or district outside of metro Atlanta applying to the program was not accepted. Due to the Race to the Top initiative, forty-two students participated from rural school districts or districts without prior involvement.

Utilization of an online recitation section allowed individual students in different geographic locations to interact with each other and the teaching assistant (TA), a Georgia Tech post-doc with a PhD in mathematics. The technology allowed students to communicate with each other including working in small groups and posing questions to the teaching assistant and each other. Students also had the ability to diagram questions using an online white board. The traditional DCP video-conferencing format allowed students to ask questions of the TA, but not diagram, an important component to increasing understanding of challenging mathematics concepts. Data also suggests that participation in DCP prepares students to participate in online learning, an experience they may not have had in high school.

Data suggests that students in the online recitation section performed better in the course when compared to participants in the traditional video-conferencing section and freshman level Georgia Tech students.

Data from the DCP Alumni survey, of those who matriculated at Georgia Tech, suggest that they were more confident about their ability to succeed in college (66% "agree" or "strongly agree"), developed more realistic expectations of college (63% "agree" or "strongly agree"), and were better prepared academically for college (60% "agree" or "strongly agree") because of their participation. Alumni also reported improved study and time management skills as a result of participating in the DCP.

Appendix

Distance Calculus Alumni Survey

Study description and consent

CONSENT DOCUMENT FOR ENROLLING ADULT PARTICIPANTS IN A RESEARCH STUDY
Georgia Institute of Technology

Project Title: Evaluation of the Distance Calculus Program
Principle Investigator: Dr. Donna Whiting

You are being asked to be a volunteer in a research study to evaluate the Distance Calculus Program. The evaluation is being coordinated by the Center for Education Integrating, Science, Mathematics and Computing (CEISMC) at the Georgia Institute of Technology in collaboration with Georgia's Department of Education.

Purpose:
The purpose of this study is to evaluate the impact of the Distance Calculus Program on its participants. All students who participated in the program when they were in high school from 2011 to 2013 and have matriculated to Georgia Tech are being invited to take part in this study.

Procedures:
Participation in this study consists of responding to an online survey. The survey is expected to take approximately 10 minutes to complete.

Risks/Discomforts:
The following risks/discomforts may occur as a result of your participation in this study: There are no identifiable risks associated with participating in this research.

Benefits:
The following benefits to you are possible as a result of being in this study: You are not likely to benefit in any way from joining this study, but we hope that the information you provide will help us to improve the courses and to understand the impact of the program on its participants.

Compensation to You:
There is no compensation for participating in this study.

Confidentiality:
The following procedures will be followed to keep your personal information private in this study: The survey is anonymous. No information will be collected that links you to the study. No data will be stored other than what you enter into the survey. The data that is collected about you will be kept private to the extent allowed by law.

Aggregated responses will be shared with Georgia Department of Education as a requirement of the State’s Race-to-the-Top initiative.

To make sure that this research is being carried out in the proper way, the Georgia Institute of Technology IRB may review study records. The Office of Human Research Protections may also look at study records.

Costs to You:
There are no costs to you to participate in this study.

In Case of Injury/Harm:
If you are injured as a result of being in this study, please contact Dr. Donna Whiting at (404) 894-0777. Neither the Principal Investigator nor Georgia Institute of Technology have made provision for payment of costs associated with any injury resulting from participation in this study.

Participant Rights:
Your participation in this study is voluntary. You do not have to be in this study if you don't want to be.

You have the right to change your mind and leave the study at any time without giving any reason, and without penalty.

Any new information that may make you change your mind about being in this study will be given to you.

Distance Calculus Alumni Survey

You do not waive any of your legal rights by participating in this research.

Questions about the Study or Your Rights as a Research Subject:
If you have any questions about the study, you may contact Donna Whiting at (404) 894-0777 or email at donna.whiting@ceismc.gatech.edu.

You can also call the Georgia Tech Office of Research Integrity Assurance at (404) 894-6942 or (404) 385-2175.

***1. If you would like to be in the study, select "Yes" below. If you select "Yes," it means you have read the information on this sheet and you'd like to be in the study, and you will then begin the survey.**

Do you wish to participate in the study?

- ○ Yes
- ○ No

In an effort to learn about the benefits and to improve the Distance Calculus Program, we are seeking your input. Please be as candid as possible. Thank you!

2. During which of the following semesters did you take Distance Calculus? (select all that apply)

- ☐ Fall 2011
- ☐ Spring 2012
- ☐ Fall 2012
- ☐ Spring 2013

3. I would rate my overall experience with Distance Calculus as...

- ○ Excellent
- ○ Good
- ○ Neutral
- ○ Poor
- ○ Very Poor

4. I would recommend Distance Calculus to current high school students:

- ○ Yes
- ○ No

Distance Calculus Alumni Survey

5. Do you think that your experience taking the Georgia Tech Distance Calculus Course during high school helped to prepare you for study at Georgia Tech?

- ○ Yes
- ○ No

If yes, how?

6. Please indicate your agreement with the following statements about your Distance Calculus experience. "Distance Calculus was helpful for me because it..."

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Offered me the opportunity to earn college credit while still in high school.	○	○	○	○	○
Introduced me to college academic expectations and college-level study.	○	○	○	○	○
Made my studies in high school more relevant to my career goals.	○	○	○	○	○
Helped me to get into the college that I wanted to attend.	○	○	○	○	○
Accelerated my progression to college degree completion.	○	○	○	○	○
Provided greater academic challenges than did other courses available at my high school.	○	○	○	○	○
Made more effective use of my senior year in high school.	○	○	○	○	○

7. Please indicate your agreement with the following statements. "By taking Distance Calculus in high school, I..."

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Was better prepared academically for college	○	○	○	○	○
Developed more realistic expectations about college	○	○	○	○	○
Was more confident about my ability to succeed in college	○	○	○	○	○
Improved my study skills	○	○	○	○	○
Improved my time management skills	○	○	○	○	○

Distance Calculus Alumni Survey

8. Are Calculus 2 and 3 required for your anticipated college major?

- ○ Yes, both Calculus 2 and Calculus 3 are required.
- ○ Calculus 2 is required, but not Calculus 3.
- ○ Neither Calculus 2 nor 3 is required.
- ○ I don't know.

9. What is the most important reason that you took Distance Calculus?

10. I am currently taking courses related to engineering, science, mathematics, or computer science.

- ○ Yes
- ○ No

Distance Calculus Alumni Survey

11. Please respond to the following items describing how true the following statements are about your education and career intentions.

For these items, "STEM" refers to science, technology, engineering, mathematics, and/or computer sciences.

	Very untrue of me	Untrue of me	Somewhat untrue of me	Somewhat true of me	True of me	Very true of me
Next semester, I intend to continue taking courses related to STEM.	○	○	○	○	○	○
I intend to find a job in a STEM field.	○	○	○	○	○	○
I intend to stay in a major related to a STEM.	○	○	○	○	○	○
I can see myself working in a STEM field in the future.	○	○	○	○	○	○
I am planning to apply for a master's education in a field related to STEM.	○	○	○	○	○	○
I am planning to spend my life working in a STEM field.	○	○	○	○	○	○
I intend to take courses related to STEM during the following school year.	○	○	○	○	○	○
I intend to get a bachelor's degree in a major related to STEM.	○	○	○	○	○	○
I intend to get a master's degree in a field related to STEM.	○	○	○	○	○	○
I would like to pursue a PhD in a STEM related area.	○	○	○	○	○	○
I am sure that I would like to continue with my education in STEM.	○	○	○	○	○	○
I intend to devote my career to an area related to STEM.	○	○	○	○	○	○

Demographic Information

12. What is your major? (you may indicate "undeclared")

Distance Calculus Alumni Survey

13. In what college are you enrolled?

- [ ] College of Architecture
- [ ] College of Computing
- [ ] College of Engineering
- [ ] College of Sciences
- [ ] Ernest Scheller Jr. College of Business
- [ ] Ivan Allen College of Liberal Arts

Comments

14. What is your gender?

- ○ Male
- ○ Female

15. What is your ethnicity? (Check all that apply)

- [ ] African American
- [ ] Asian
- [ ] Hispanic/Latino
- [ ] Native American/Alaskan Native
- [ ] White
- [ ] Other

If Other, please specify

Thank you for completing our survey!

Distance Calculus Engagement Survey (April)

Your responses in this survey will help us learn about the distance calculus recitations, what you get out of them, and how to improve them. Your responses will be kept confidential.

1. Please rate your agreement for the following items based on your experiences in the distance calculus recitations.

	Strongly Disagree	Disagree	Agree	Strongly Agree
The TA talks more than he than listens.	○	○	○	○
The class is made up of individuals who don't know each other well.	○	○	○	○
I look forward to taking part in recitations.	○	○	○	○
It is important to me that I am able to make friendships among students in recitation.	○	○	○	○
Students put effort into what they do in recitations.	○	○	○	○
Each student knows the other members of the class by their first names.	○	○	○	○
Students are dissatisfied with what is done in the recitations.	○	○	○	○
It is important to me that students in recitations know each other well.	○	○	○	○
Students "clockwatch" in recitations.	○	○	○	○
Friendships are made among students in recitations.	○	○	○	○
After recitations, students have a sense of satisfaction.	○	○	○	○
It is not important to me to be able to get to know other students in recitation.	○	○	○	○
Students in recitations pay attention to what others are saying.	○	○	○	○
Students don't have much chance to get to know each other in recitations.	○	○	○	○

Distance Calculus Engagement Survey (April)

Recitations are a waste of time.				
It is important to me to get to know each other student in recitation by their first name.				
Students seldom present their work to other students.				
It takes a long time to get to know everybody by his/her first name in recitations.				
Recitations are boring.				
There are opportunities for students to express opinions in recitations.				
Students in recitations get to know each other well.				

2. How often do you prefer to have group work in recitations?

- I'd prefer that none of the recitations include group work
- I'd prefer that roughly 20% of the recitations include group work
- I'd prefer that roughly 40% of the recitations include group work
- I'd prefer that roughly 60% of the recitations include group work
- I'd prefer that roughly 80% of the recitations include group work
- I'd prefer that roughly 100% of the recitations include group work

3. What suggestions do you have for helping students in a course like ours get to know each other and work together?

Page 2: Benefits & Improvements

Distance Calculus Engagement Survey (April)

4. Please indicate your agreement with the following statements about your Distance Calculus experience. "Distance Calculus has been helpful for me because it..."

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Offered me the opportunity to earn college credit while still in high school.	○	○	○	○	○
Introduced me to college academic expectations and college-level study.	○	○	○	○	○
Made my studies in high school more relevant to my career goals.	○	○	○	○	○
Helped me to get into the college that I wanted to attend.	○	○	○	○	○
Accelerated my progression to college degree completion.	○	○	○	○	○
Provided greater academic challenges that did other courses available at my school.	○	○	○	○	○
Made more effective use of my senior year in school.	○	○	○	○	○

5. Please indicate your level of agreement with the following statements. "By taking Distance Calculus, I..."

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Improved my study skills.	○	○	○	○	○
Improved my time management skills.	○	○	○	○	○

6. How could recitations be improved?

Distance Calculus Engagement Survey (April)

7. If there's anything else you'd like us to know about the course, please write it here.

Thank you so much for your help!