

**Comparing student success between developmental math courses
offered online, blended, and face-to-face.**

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Abstract

Community colleges are increasing their enrollment faster than four-year universities and have also had the highest growth rate in online learning enrollments in higher education. This increase in community college enrollment and specifically in online and developmental courses, leads to a need for research with this population; sadly, very little research focuses on online students in community colleges. The purpose of this paper is to present a research study which compared student success in a Developmental Math course offered in three different learning environments (online, blended, and face-to-face). Using quantitative instruments, data from 167 participants was collected including, demographic information, unit test grades and standardized Intermediate Algebra Competency Exam scores. Results of a one way ANOVA showed that there were significant differences between learning environments with the students in the blended courses having the least success. Additional analysis was done to address issues of attrition since attrition rates are high for community college students and online students. Data analysis with the attrition adjusted sample showed that the face-to-face students performed most poorly. The findings of this study contradict the current research findings of no significant difference in success based on learning environment.

Over the past 15 years Institutions of Higher Education (IHE), including both community colleges and four-year schools, have seen continued increases in enrollment. During the 1990s, four-year colleges saw a growth of 9%, while community colleges experienced 14% growth (ACE, 2004). In the decade following (1999 – 2009), community colleges were projected to have an even greater increase in enrollment growth (22%; NCES – Participation in Education, 2008). Most recently, many community colleges have seen 10 – 20% increases in enrollment (Hoover & Wilson, 2009). Community colleges are increasing their enrollment faster than four-year universities, thereby increasing the percentage of all undergraduates (two-year and four-year institutions) from 41% (ACE, 2004) to 46% (AACC, 2008). However, even though community college student populations are growing faster than four-year schools, the resources and budget at these institutions, like at many, has not increased. This has led institutions to find alternative ways to meet the needs of their students.

Following in line with growth in higher education over the past decade, there has been growth in online learning across all of academia. In one year (2005 – 2006), enrollment in face-to-face courses increased 2% while enrollment in online courses increased 10% (Allen & Seaman, 2007). Students that were taking traditional face-to-face courses in past years are moving to the online environment. According to a study on online enrollments sponsored by The Sloan Consortium (2007), community colleges have had the highest growth rate in online learning and account for over 54% of all online enrollments in higher education (Allen & Seaman, 2007), but students entering these IHEs are often distinctly different.

With their open-door admission policy, community colleges serve a population with diverse needs and a wide range of skills. In order to prepare this diverse population for college-level courses, community colleges offer non-credit developmental courses in math, reading, and writing. Seventy nine percent (79%) of students entering community colleges will need these developmental courses (Jenkins & Boswell, 2002). While the number of students needing developmental coursework continues to grow, research on this population and their success rate, is very limited (Barnett, 2008; Esch, 2009). Moreover, community colleges continue to create online courses and enroll students in these courses who may or may not be technically and educationally experienced enough to succeed. Growing community college enrollment, specifically in online and developmental courses, invites the need for research with this population; sadly, very little research focuses on online students in community colleges. Consequently, the purpose of this research was to compare community college student success in a Developmental Math course offered in three different learning environments (Online, Blended, and Face-to-face).

While the focus of this research was on student success, the impact attrition has had on the results of the study are also discussed. The developmental student population begins at an older age (Burley, Butner, & Cejda, 2001); is juggling work, family, and school (Edgecombe, 2011; Rutschow, Richburg-Hayes, Brock, Orr, Cerna, Cullinan, Kerrigan, Jenkins, Gooden, & Martin, 2011); and tends to have multiple learning deficiencies (Burley et al., 2001; Rutschow et al., 2011) as compared to the university student population and these differences impact student success in distance-based learning environments. Current research findings of no significant difference in success based on learning environment are commonplace (Chernish, DeFranco, Lindner, & Dooley, 2005; Dutton, Dutton, & Perry, 2002; Frederickson, Reed, & Clifford, 2005; Herman & Banister, 2007; Hodge-Hardin, 1997; Kromrey & Purdom, 1995; Neuhauser, 2002; Sauers & Walker, 2004; Scheetz & Gunter, 2004), but again this research used a traditional student population. Two-year college students have attrition rates over 67% (Mohammadi, 1994; Rendon, 1995) during the first year. The rate rises to over 80% after two years (Mohammadi, 1994). The increase in attrition rates has been attributed to lower high school GPAs and to ethnicity (Feldman, 1993; Murtaugh, Burns, & Schuster, 1999). These characteristics are common in the developmental population at community colleges. By offering developmental courses in distance learning environments, the challenges inherently increase. Students taking distance education courses have a 10 – 20% increase in attrition rate over their face-to-face classmates (Angelino, Williams, & Natvig, 2007). Recent research has shown that the learning environment does have an effect on developmental students' completion rates (Zavarella & Ignash, 2010). The challenges that developmental students face cause many to drop out of college. Further, adding the options of online and blended courses only increases these challenges. Research must be conducted to ensure that we are providing learning opportunities and environments that support the success of students enrolled in these classes.

Research Setting

Following a pilot in the spring semester, the research took place during the summer and fall semesters of an Intermediate Algebra course at a large Mid-Atlantic Community College offered in three different learning environments (Online, Blended, and Face-to-face). The Intermediate Algebra course is the third in a series of three developmental math courses offered at the institution. Success in this course (grade of 70% or higher) means that a student has the necessary pre-requisite knowledge to register for college-level math courses. The course content includes factoring, functions, rational expressions, radicals, quadratics, conic sections, and exponential and logarithmic functions. Intermediate Algebra has the highest enrollment of the three levels of developmental math courses offered at the community college.

Since the learning environment was the variable being measured in this study, every effort was made to ensure that the classes in each environment were the same, except for the medium used to communicate and complete assignments. Two instructors taught one or two sections in each of the learning environments. Both instructors had worked to create the online materials. The methods for solving problems provided online were the same methods used in all the learning environments. All three groups used the same syllabus, course content, and deadlines to complete each unit. All unit tests were drawn from the same set of topics and questions and all tests were timed. Online testing was implemented in the blended and fully online classes, while traditional paper and pencil tests were provided for the face-to-face classes. In order to accommodate students with technical difficulties, test make-ups were offered for online students during Final Exam week. This same opportunity was available for the traditional and blended students. A description of each learning environment follows.

Face-to-face environment. The traditional class met for three hours (either two days or three days of class) a week. Two of the face-to-face sections were in the middle of the day and the third section was early evening. No online materials were provided to the traditional students and no part of their grade required the use of online technology. If needed, the instructors used office hours, emails, and phone calls to work with students that needed extra assistance outside of class. The instructors taught using the same procedures, instructions, and examples in all of the face-to-face classes. After each objective the students were given a five question self-assessment to take home. The answers were provided on the self-assessment. The beginning of each class was used to address student questions from the self-assessment or the textbook. Towards the end of the unit, the instructors passed out a practice test, including answers, to the students in order to assist them in preparing for the unit test. Each unit test was completed in class, then graded and returned to students the following class session.

Online environment. Students enrolled in the online course accessed all materials through the course management software, never meeting face-to-face. There was an online orientation that covered the technical knowledge necessary for the course as well as course procedures. Each unit was arranged with all its materials in a folder, listing all the objectives, the unit quiz, and unit test. Each objective had several learning activities to assist students: a lecture, transcript, handout, practice problems, and answers. The lectures were slide show-based with audio that mimicked instruction and examples that were used in the face-to-face classes. Students were also provided a transcript for the audio part of the lecture along with examples and practice problems focusing on the lesson objectives. At the end of the lecture, students were given a five-question assessment. This self-assessment provided feedback to the students but no grades were sent to the instructor. In addition, there was a practice test for the entire unit that students could

use as an additional self-assessment. Each unit ended with a test. The unit tests were timed, just as they were for the face-to-face students. Prior to this research, the online class was certified by Quality Matters, a nationally recognized peer-review process designed to endorse quality online courses.

Blended environment. Students in the blended class had access to all course materials online as well as in weekly face-to-face class meetings. When registering for the course, it was listed as a blended course with meetings on Tuesdays and Thursdays. On the first day of class, students were told that class would meet every Tuesday and online work would replace the Thursday sessions. The Thursday sessions were held in a computer lab with an instructor present. The Tuesday sessions covered most of the topics for the entire week of the face-to-face sections, but fewer examples within each topic were covered as the students were able to review the examples online. Attendance on the lab days was optional and minimal, as most students chose to take advantage of the freedom of schedule that online learning provides. The students that did attend either brought questions with them to ask or worked independently on the material, asking questions of the instructor when needed. The same procedures, instructions, and examples used in the face-to-face (and online) sessions were used in the face-to-face portion of the blended sessions. The practice tests and unit tests were also the same as in the online class.

Method

This study used quantitative research methodologies to compare student success in different learning environments. The following research questions were used to guide this study:

1) Does the type of learning environment relate to successful course performance as measured by test, final exam, and course grade?

2) Does the effect of course performance depend upon attrition?

For the purposes of this study, student success is defined as passing the course (course grade of 70% or higher), thereby making the student eligible for college-level math courses. Learning environment comparisons were thus made under two conditions: comparing all students regardless of course completion, and comparing students after accounting for attrition.

Participants

This research study used a convenience sample. A total of 167 students agreed to participate in this research study. All participants in this study were enrolled in an Intermediate Algebra class at a Mid-Atlantic community college. Students in this study had either passed the previous developmental course or placed directly into this course based on the scores of their placement test; for some students, this was not their first time taking the class, having been previously unsuccessful in the course (19% of face-to-face students, 26% of the blended students, and 30% of the online students).

The sample varied in demographic and academic characteristics. Students ranged from recent high school graduates to non-traditional age students returning to school with the average age being 25.5 years old. The sample consisted of 97 females (58%) and was predominantly Caucasian (49%) and African-American (43%) students. There was a combination of full-time students (48%) and part-time students (52%).

The students self-selected into one of three learning environments, with 35% enrolling in the face-to-face classes, 28% enrolling in the blended classes, and 38% enrolled in the online classes. There was a significant difference in age by learning environment, $F(2, 164) = 8.19, p <$

0.001, with the online students ($M = 28.75$, $SD = 8.19$) being the oldest group. There was also a significant difference in gender, $\chi^2(2, N = 167) = 8.04$, $p = 0.018$, with the online class having the largest percentage of females (71%), over both the face-to-face (47%) and blended (54%) environments. Specific demographic information is provided in Table 1.

Attrition adjusted sample. As noted earlier, attrition rates are high for community college students. By adding distance education (which increases attrition), these students faced a greater challenge in just remaining in the course for the entire semester. Knowing that this issue existed, this research could not overlook the fact that all students did not complete all the unit tests and final exam, referred to as the Intermediate Algebra Competency Exam (IACE), for the course. Each learning environment had students who did not take at least one test or exam. All students were given opportunities to make up tests that were missed during the semester, but the rate of missing grades varied by learning environment. The test average was 70% of the course grade and the final exam was the remaining 30%. Missing grades for any item would have a large impact on the student's grade. For the face-to-face environment, five students did not complete at least one of the unit exams and four students did not take the IACE, resulting in 5% missing grades. For the blended environment, 15 students did not complete at least one of the unit exams and 14 students did not take the IACE, resulting in 23% missing grades. For the online environment, 19 students did not complete at least one of the unit exams and 15 students did not take the IACE, resulting in 18% missing grades.

Table 1
Demographics

Demographics	Face-to-face (n = 58)	Blended (n = 46)	Online (n = 63)
Gender*			
Male	31	21	18
Female	27	25	45
Race			
Caucasian	22	25	34
African-American	30	18	24
Hispanic	2	0	1
Asian	2	2	1
American-Indian	1	0	0
Other/Multi-racial/ Unknown	1	1	3
Age Range*			
Under 20	31	13	6
20 – 24	17	18	20
25 – 29	1	5	12
30 – 34	3	3	9
35 – 39	4	3	9
40 – 44	0	2	4
45 – 49	1	1	3
50 and older	1	1	0

Note. *These categories have statistically significant differences across the learning environments, $p < 0.05$.

Data Collection

Several instruments were used to collect data about student demographics and student success, including seven course unit tests and a standardized Intermediate Algebra Competency Exam (IACE). Demographic information was obtained from the college's database. Students were informed of this prior to any decision to participate in the study. Information was only collected on the students that agreed to participate.

The unit tests covered Factoring, Functions, Rational Expressions, Radicals, Imaginary and Complex Numbers, Quadratic Equations, and Parabolas and Circles. These tests were created by the Developmental Math Coordinator and piloted for level of difficulty and length of time to complete. In order to discourage cheating, each individual test was created from a pool of questions that had been evaluated for difficulty and alignment with the unit objectives. This pool of questions was then used to create the tests for all the learning environments. Time limits for each test were enforced in all three learning environments and the same grading rubric was used across all sections. The face-to-face students took paper-and-pencil versions of the unit tests in class while the blended and online students took online versions of the unit tests. The online and blended tests were not proctored, but a time limit was imposed for completing the test as was the case in the face-to-face environment. Since they were not proctored, the test grades in the distance learning environments were correlated to their final exam grades which were proctored. For all but the first test in the blended environment there was a medium to high correlation ($r = 0.59, 0.73, 0.72, 0.78, 0.82, 0.86, 0.87$ for blended tests and $r = 0.53, 0.69, 0.554, 0.60, 0.65, 0.70, 0.65$ for online tests). These compare favorably to the same relationships in the face-to-face class ($r = 0.54, 0.51, 0.59, 0.65, 0.78, 0.67, 0.75$). The only pair of correlation coefficients that were different from each other were those for quadratic equations and the final exam for blended ($r = 0.86$) and for face-to-face ($r = 0.67$), which was statistically significant, $Z = 2.37, p = 0.02$. Overall, the correspondence between unit tests and final examination performance was very similar between face-to-face and the blended/online environments. The tests were scheduled within a three day period for all students, to allow for different class meeting patterns. The Intermediate Algebra Competency Exam (IACE) is a 48 item summative assessment created by faculty in a Mid-Atlantic community college Math Department and has been in use for over four years. The exam was externally validated by experts in the field. The questions were created based on the Intermediate Algebra curriculum, covering all of the objectives of the course. Student scores are reported as percent correct.

The IACE is a proctored examination; students are permitted to use a calculator and scrap paper, but notes and books are not allowed. The face-to-face and blended students took the final exam in the classroom with their instructor while the online students took the final exam in the proctored environment of the College Testing Center. In all cases, the exam was taken during Final Exam week and the same time limit of two hours was enforced for all students. Means for raw scores and percent correct for the IACE by group and overall are presented in Table 2.

Table 2
IACE Scores for All Participants by Learning Environment

	N	Number Correct	SD for Number Correct	Percentage	SD for Percentage
All Subjects	167	25.3	14.72	52.6%	30.69
Face-to-face	58	28.9	10.83	60.2%	22.61
Blended	46	22.0	16.61	45.8%	34.59
Online	63	24.3	15.83	50.7%	33.02

Note. The N column lists the number of subjects in the group. The number correct is out of 48 problems. For Fall 2009, the success rate across all 104 Intermediate Algebra courses at this institution was 54.7%. The standard deviation (SD) for both the number correct and percentage is provided.

Data Analysis

Comparisons between learning environments on continuous outcomes (unit tests, final exam, course average) were made using one-way ANOVA, with learning environment as the factor, with three levels (Face-to-face, Blended, and Online). Tukey's HSD was applied following significant main effects to identify pairwise differences. Differences between environments in categorical variables were analyzed using Chi-square tests of significance. The significance level (α) for all statistical tests was 0.05.

Results

The purpose of this research was to see if there were significant differences in student success between three different learning environments. As mentioned previously, success was defined as a course grade of 70% or higher, making the student eligible for college-level math courses. Since the last data collection tool used in the course was the IACE, course completion was defined as having taken the IACE during final exam week. To examine issues of attrition, further analysis was done with the attrition-adjusted sample which included only data from those participants who completed the IACE. Conducting analyses with both the overall and the attrition-adjusted samples is analogous to using Intent to Treat (ITT) and as-treated analysis in randomized controlled trials in psychiatric and medical research. Estimates of effects from ITT samples are considered unbiased estimates of treatment (Pocock & Abdalla, 1998) because all available data are included. Estimates from the as-treated samples exclude individuals lost to follow-up or who were non-compliant, but yield positively biased estimates of effects, which may nevertheless be informative about the potential effects under conditions of complete compliance. Although this study is not a randomized trial, the attrition-adjusted sample is analogous to an as-treated sample because students missing the final exam are excluded.

When evaluating data from the entire sample, including scores earned on unit tests, IACE, and the Course Average, results of the one-way ANOVA revealed that there were significant differences between learning environments on the IACE, the Course Average, and four of the seven unit tests: Functions, Rational Expressions, Imaginary and Complex Numbers, Parabolas and Circles. Means, SDs, ANOVA, and post-hoc testing results are presented in Table 3. Students in the blended learning environment had the lowest mean scores on all assessments.

For illustrative purposes, effect sizes were calculated for the Course Average comparisons. The effect size for the face-to-face vs. online difference was 0.17 favoring the face-to-face environment. For the face-to-face vs. blended comparison, the effect size was 0.53, also favoring the face-to-face environment. The online vs. blended comparison effect size was 0.31, favoring the online environment.

Table 3

Mean and Standard Deviation Percent Correct on Unit Tests, IACE, and Course Average by Learning Environment (Complete Dataset N = 167)

	Face-to-face (N = 58)	Blended (N = 46)	Online (N = 63)	F(2, 164)	p	Pairwise tests of significance ^h
Unit Test #1^a	70.1 (21.4)	67.9 (32.1)	77.6 (24.6)	2.21	0.113	
Unit Test #2^b	88.7 (14.7)	69.5 (34.5)	75.0 (32.5)	6.54	0.002*	F>B;F>O
Unit Test #3^c	50.4 (23.1)	45.4 (32.2)	59.3 (30.3)	3.39	0.036*	O>B
Unit Test #4^d	67.3 (22.7)	55.6 (33.5)	64.2 (34.1)	2.00	0.138	
Unit Test #5^e	83.4 (20.2)	62.2 (41.1)	78.2 (35.4)	5.68	0.004*	F>B; O>B
Unit Test #6^f	63.8 (26.9)	52.8 (38.4)	64.7 (37.7)	1.82	0.165	
Unit Test #7^g	75.5 (27.0)	54.4 (43.3)	65.0 (43.5)	3.86	0.023*	F>B
IACE	60.2 (22.6)	45.8 (34.6)	50.7 (33.0)	3.13	0.046*	F>B
Course Average	68.1 (18.7)	54.5 (32.0)	63.9 (28.5)	3.40	0.036*	F>B

Note. * $p < 0.05$ for main effect of Learning Environment. ^aFactoring, ^bFunction notation and operations, ^cRational Expressions, ^dRadicals, ^eComplex and Imaginary Numbers, ^fSolving Quadratic Equations, ^gParabolas and Circles, ^hPairwise significance tests via Tukey's HSD, $p < 0.05$.

Age and gender differed between the learning environments indicating that differences in performance between men and women, or between different age groups, may have accounted for the observed learning environment differences. Factorial ANOVAs were run including age and gender as additional factors to learning environment. Results were identical, with p-values

equivalent to two decimal places, to what is reported in Table 3. Age and gender do not appear to be plausible explanations for the differences found between learning environment.

The number of students earning passing grades was not significantly different between the three learning environments: Face-to-face 59%, Blended 48%, and Online 65%, $\chi^2(2, N = 167) = 3.26$; $p = 0.20$. Until a student has successfully completed the Intermediate Algebra class, he or she is not eligible to enroll in a college-level math class. The final exam was 30% of the course grade and was necessary for the student to be successful. However, not all of the students took the final exam. Some students stopped attending the course without officially withdrawing; others attended through the last week of classes but failed to take the exam. In either case, these students experienced a negative impact on their course grade (grades of 0 for all missed unit tests and IACE). Of the original 167 participants, 58% ($n = 97$) were successful, but these individuals represent 72% of the 134 who completed the course.

Attrition adjusted sample. Removing the students that did not complete the course (i.e., did not take the IACE) and re-analyzing the data changed the results so that there were no longer significant IACE score differences between learning environments, $F(2, 131) = 0.13$, $p = 0.88$. For the unit tests, statistically significant differences were found between learning environments, but students in the blended course no longer earned the lowest test scores for the assessments, once non-completers were removed. On the Factoring, Rational Expressions, and Solving Quadratic Equations unit tests and for the Course Average the students in the face-to-face environment performed significantly worse than students in the online environment. The full results excluding students that did not take the IACE can be found in Table 4.

Table 4

Mean and Standard Deviation Percent Correct on Unit Tests, IACE, and Course Average by Learning Environment (Attrition Adjusted Dataset N=134)

	Face-to-face (N = 54)	Blended (N = 32)	Online (N = 48)	F(2, 131)	p	Pairwise tests of significance ^h
Unit Test #1^a	72.2 (19.5)	79.3 (21.1)	85.7 (11.4)	7.53	0.001*	O>F
Unit Test #2^b	90.7 (8.8)	86.6 (12.8)	88.4 (10.4)	1.63	0.200	
Unit Test #3^c	52.7 (21.5)	59.8 (26.1)	70.4 (21.5)	7.71	0.001*	O>F
Unit Test #4^d	70.4 (19.0)	72.2 (20.7)	78.2 (20.1)	2.07	0.130	
Unit Test #5^e	87.5 (13.3)	83.9 (20.4)	92.4 (15.3)	2.84	0.062	
Unit Test #6^f	67.2 (24.1)	73.9 (22.6)	81.6 (21.7)	5.04	0.008*	O>F

Unit Test #7^g	80.6 (19.7)	78.2 (28.3)	81.4 (31.9)	0.14	0.869	
IACE	64.7 (16.0)	65.8 (19.4)	66.5 (19.1)	0.13	0.878	
Course Average	71.6 (13.3)	73.1 (15.8)	78.1 (10.1)	3.37	0.038*	O>F

Note. * $p < 0.05$ for main effect of Learning Environment. ^aFactoring, ^bFunction notation and operations, ^cRational Expressions, ^dRadicals, ^eComplex and Imaginary Numbers, ^fSolving Quadratic Equations, ^gParabolas and Circles. ^hPairwise significance tests via Tukey's HSD, $p < 0.05$.

As with the complete data, differences between learning environments in age and gender were observed. Analyses were re-run, including age and gender as additional factors, and again results were almost identical (p-values were similar to three decimal places) to the one way ANOVA results. One discrepancy among the age and gender controlled analyses was that the Online vs. Face-to-face difference was no longer statistically significant after control of multiple comparisons by Tukey's HSD (difference = 5.3 SE = 2.8, $t = 1.93$; adjusted p-value = 0.135).

Among those students who completed the course, the number of students earning a passing course grade was significantly different between the three learning environments: Face-to-face 63%, blended 69%, and online 85%, $\chi^2(2, N = 134) = 6.69$; $p = 0.04$. However, more students in the face-to-face environment completed the course (93%) compared to students in the blended (70%) and online (76%) courses, $\chi^2(2, N = 167) = 10.01$; $p = 0.007$. It is not known why students missed exams and it is beyond the scope of this study to assess reasons for course absence. However, differences in course completion between environments suggest that processes for selection into and out of the courses vary by learning environment.

Considering these results, one can argue that the learning environments are not equally effective. Students enrolled in the blended environment had the lowest IACE grade and course average, and were least likely to be successful in the Intermediate Algebra course. However, these results include students in the blended environment who were assigned failing grades because they missed tests. When looking at only the students who completed the course, the face-to-face environment had the lowest success rate. This difference is due to the online and blended classes having higher attrition rates, and therefore higher rates of failing exams, over the course of the semester.

Based on these findings, we believe that learning environment has an impact on success for the developmental math student. There was a statistically significant difference on four of the unit tests, the Intermediate Algebra Comprehensive Exam (IACE), and overall course average based on the learning environment. The blended students had the lowest average score on the IACE and overall course average with only 48% of them being successful in the Intermediate Algebra course. While this research did not study attrition per se, there was a statistically significant difference in the completion rates of the course based on the learning environment; the online and blended classes had significantly fewer students complete the course (76% and 70% respectively). The learning environment that produced better student performance depended on whether dropouts (the attrited) were excluded or not.

Conclusion

The developmental student population has been shown to be different than the traditional university student population with attendance rates of 56 – 81% and passing percentages of 29 – 64% (Waycaster, 2001), as well as higher percentages of minority students (Russell, 2008). It seems that these differences impact student success in distance-based learning environments as well. The findings of this study contradict the current research which shows learning environments are equally effective (Chernish et al., 2005; Dutton et al., 2002; Frederickson et al., 2005; Herman & Banister, 2007; Hodge-Hardin, 1997; Kromrey & Purdom, 1995; Neuhauser, 2002; Sauers & Walker, 2004; Scheetz & Gunter, 2004). In this study, distance-based and blended students performed worse than the traditional face-to-face developmental math students when not taking attrition into account, however considering only students who completed the course, face-to-face students performed worse; of course the issue of student retention cannot be disregarded. Future research must be conducted to further examine success rates of developmental students in online and blended learning environments.

The completion rates for this sample were significantly different, with 93% of the face-to-face students completing the course compared to 70% of the blended students and 76% of the online students. Our results highlight the dual nature of academic outcomes, retention, and successful performance. Because retention, and successful performance both appear to differ between community college and traditional student settings, we believe that research conducted with university populations should not be used to identify best practices with community college students, especially those enrolled in developmental courses. With only about three-quarters of the students in the distance-based environments completing all assignments, the problem with attrition is evident and had an observable impact on student outcomes. Among students that completed all assignments, the online students had the highest success rate (85%). Academic and other contextual factors affecting retention and attrition in distance education courses needs to be addressed in future research efforts, especially considering the growth of online courses in community colleges and developmental coursework.

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