

Influences of Online Delivery on Developmental Writing Outcomes

By Trudy G. Carpenter, William L. Brown, and Randall C. Hickman

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ABSTRACT: Four years of data on the academic performance of 256 students who self-selected online developmental writing rather than a face-to-face section (about 10% of the 2,275 students enrolled in the course overall) are examined in this empirical study. The research controls for self-selection effects related to demographic variables, student status, and academic preparedness. Resulting analysis of the data suggests that instructional delivery method—asynchronous or face-to-face—has a significant impact on student outcomes. The researchers summarize findings related to the influences of various factors on the retention and success of students in the online course. Based on these findings, the researchers offer suggestions for improving or creating a new online developmental course and discuss implications for future research.

The rapid growth of online education across the nation is producing a challenge for many developmental education programs. For various reasons, perhaps primarily due to a reticence to create more hurdles for a population already facing many, developmental writing faculty and administrators are often reluctant to offer online (asynchronous) versions of traditional face-to-face developmental writing courses. Recognizing that reluctance, we do not know whether it is truly justified.

Two main concerns faculty and administration often express about creating online versions of developmental courses are fears about retention and students' ability to handle the technology. However, a study by Jennings (2002) of the computer attitudes of developmental students concluded that developmental students “reported generally more positive attitudes toward computers than did nondevelopmental students” and speculated that this positive attitude “may enhance the probability for advancement into the mainstream college curricula” (p. 5).

Saxon and Boylan (2003) emphasized the importance of “research on the impact of online and other distance learning methodologies for developmental education” (p. 3). Bailey (2002) also noted that “Most colleges

are in the early stages of offering web-based courses...” and “have not yet systematically investigated students' reasons for dropping online courses” (p. 5). Morris (2001) researched factors that affect student retention in online writing courses, and emphasized that “in general literature (including education-specific literature) perceptions of attrition are fraught with vagueness and potentials for inadequate understanding.” He stated further that “attrition in online classes frequently is reported to be higher than in matching face-to-face classes, but the data is mixed, derives from different and incompatible measuring methods, is contradictory, and suggests research difficulty because of multiple variables” (p. 5).

In support of online instruction, the Michigan Community College Association (2004)—in cooperation with the Michigan Virtual University (MVU)—has created a virtual learning collaborative among the state's 28 community colleges, listing online courses and allowing students to take them at any Michigan community college while maintaining academic record and residency status at the home college. A Fall 2003 review of the online courses offered through MVU and subsequent visits to the college websites have indicated that, although 19 colleges (70% of those offering online writing) offered freshman writing online, only one listed developmental writing online.

Before more colleges will be interested in offering developmental writing online, many instructors and administrators need to know whether it is as productive of desired student outcomes as traditional, face-to-face instruction. The researchers conducted the following study to help address these concerns.

Methodology

Developmental Writing Placement

This study involved an urban, Midwestern community college with 9,000 full-time-equivalent students. Several years ago, the college established basic skill “levels” as prerequisites for taking courses that lead to a degree or transfer. For both reading and writing, skill levels are established primarily

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through reviewing student scores on the College Board's *ACCUPLACER™ Computerized Placement Tests* (CPT; College Board for Educators, 2004); students with extremely low English language skills are tested with the *Levels of English Proficiency* (College Board for Educators, 2004). Students whose scores fall below the required cut-score range raise their skill levels primarily through taking developmental courses with "exit competencies." Currently, a CPT writing score of 65-85 (and a reading score of 59-77) would place a student in Lansing Community College's developmental Writing 117, and a student completing the course with a grade of 2.5 or higher (on a 4.0 scale) would earn an automatic level 6 (i.e., "college-ready" in writing), enabling the student to take freshman composition or any other course with a level-6 writing prerequisite. Though Writing 117 is taught by many faculty members, all sections use a common syllabus, text, and exit portfolio (which must be "passed" by two external readers). For the past 4 years the college has offered Writing 117 asynchronously. Any student who is placed into Writing 117 can register for an online section of the course, and, over the 4 years of this research (academic records from Fall 1999 through Summer 2003), 256 students chose that option, approximately 10% of the total number enrolled in the course.

Participants

The participant profile indicated that of the 256 students taking online Writing 117, 33.3% were over age 25 (compared to 18.2% of those in face-to-face sections); 68.2% were female (compared to 54.2% in face-to-face sections); 33.3% were full time (compared to 52.2% in face-to-face sections); 26.7% were minorities (compared to 41% in face-to-face sections); 56.1% already had a college-level reading score, that is, 78 or higher on the *ACCUPLACER™ Reading Test* (College Board for Educators, 2004); compared to 44% for face-to-face sections); 22.2% had a college-level writing score, that is, 86 or above on the *ACCUPLACER™ Writing Test* (College Board for Educators, 2004 (compared to 11.6% in face-to-face sections). In summary, the students who self-selected for online tended to be older, female, white, and part time, with higher reading and writing placement scores.

Design and Procedure

Although there is clearly a sense in which the student who withdraws from a course did not have a "successful" experience in the course, we have observed that many of the reasons students withdraw from courses are unrelated to their ability to master successfully the academic challenges of the course.

Given the goal of improving student success, there is a clear need for researchers and practitioners to distinguish between students who withdraw and those who are retained but are unable to meet the academic demands of the course successfully. Educators cannot afford to assume that the forces influencing retention are identical to those influencing success.

Since we recognized differences between reasons for noncompletion, data on completion status were used to construct two binary student outcome variables: retention to course completion (whether or not the student withdrew), and, for those students that were retained and received a grade, whether or not the student was successful, with "success" defined as receiving a grade of 2.5 or higher for the course. Students who received an "incomplete" were excluded from the analysis since, although they were retained, there was no way to measure their level of success.

Initial analysis showed that online and face-to-face sections differed significantly with

The factors that influence success are not identical with the factors that influence withdrawal.

respect to retention ($p < 0.0001$) and success ($p < 0.0001$) rates, with online sections having a greater withdrawal rate but also a higher success rate for those who completed the course. However, since developmental writing students were not randomly assigned to online versus face-to-face instructional delivery methods, but rather self-selected a delivery method, a simple comparison of these two methods with respect to student outcomes was insufficient. A simple comparison would not isolate the impact of delivery method due to the lack of control for potentially confounding variables associated with self-selection. Analysis revealed that the online and face-to-face students also differed significantly with respect to demographic, student status, and preparedness variables: ethnicity (relatively more whites and fewer minorities in online, $p < 0.0001$), sex (relatively more females and fewer males in online, $p < 0.0001$), age (relatively more older and fewer younger students in online, $p < 0.0001$), credit load (relatively more part-time and fewer full-time students in online, $p < 0.0001$), and preparedness (relatively more students with high reading and writing CPT scores in online, $p < 0.0001$ for reading and $p < 0.01$ for writing). Late-registering students were often forced into online sections after face-to-face sections filled up; although this led to a higher proportion of late-registering

students in online sections, the difference was not statistically significant.

Given that the students in online sections differed significantly from students in face-to-face sections with respect to some demographic, student status, and academic preparedness variables, there was a clear need to control for the influence of these variables in any analysis directed at identifying the impact of delivery method. Consequently, sex, ethnicity (coded as white or minority), age, load (full time or part time), time of registration (early or late, with late defined as registration the week classes began or later), and reading, writing, and math computerized placement test scores were included in the models as control variables in addition to the predictor of chief interest: delivery method (online or face-to-face).

Since both student outcomes were binary variables, and the model included both discrete and interval-level variables, logistic regression was used to model the student outcomes. Odds ratios, the typical association measures in categorical data analysis, were used as effect size indicators because of their relatively simple and direct relationship to parameter estimates (Agresti, 1990, pp. 91-92).

The data concerning the completion and success of the students in the course used to construct the outcome variables were clustered, since student outcomes occurred in particular course sections. Observations within clusters are often more alike than observations between clusters, leading to correlation of observations within clusters. Hence, underestimation of standard errors, with corresponding overestimation of significance levels, can result with clustered data (Angeles & Mroz, 2001, pp. 2, 5-8; Huber, 1967) since standard estimation procedures assume independence of observations. To address this, generalized estimating equations were used to produce robust standard error estimates. This estimating procedure modifies the standard iteratively re-weighted least squares algorithm for generating maximum likelihood estimates by replacing the standard weight matrix with a weight matrix having nonzero off-diagonal elements that reflect the correlations among the observations at the cluster level.

Since the models that were estimated included continuous as well as categorical variables, the conditions for the standard goodness-of-fit tests were not met because of insufficiently large expected frequencies for each combination of the explanatory variables. We chose the Hosmer-Lemeshow "deciles-of-risk" test as the preferred alternative in this case, which compares model-predicted frequencies with actual frequencies in

Table 1
Effects (Success as Outcome)

Effect	Adjusted Odds Ratio	95% Confidence Interval
Delivery method (online vs. face-to-face)	4.17**	1.37 - 12.50
Sex (females vs. males)	2.00**	1.53 - 2.63
Ethnicity (white vs. minority)	1.64**	1.25 - 2.13
Time of registration (late vs. early)	1.16	0.79 - 1.72
Credit load (full time vs. part time)	1.12	0.86 - 1.45
Age	1.02	0.99 - 1.04
Writing CPT score	1.02**	1.01 - 1.04
Math CPT score	1.01**	1.003 - 1.018
Reading CPT score	1.01*	1.001 - 1.025
* $p \leq 0.05$ ** $p \leq 0.01$		

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10 groups ordered by estimated probabilities on the outcome variable. In the case of the Hosmer-Lemeshow test (sometimes called a "lack-of-fit" test), a statistically insignificant result is desired, indicating insufficient evidence to conclude that the model does not fit the data adequately.

Models with interaction terms involving delivery method and the control variables were fitted to the data to test for the presence of interaction effects involving delivery method, though no reliable evidence of interaction effects was found. Since no significant interaction effects were detected, the results presented and interpreted were derived from main effects models.

Finally, it should be noted that the measurement of the outcomes—retention and success—occurred after measurement of the predictor variables. The nature of the predictor variables was such that it made it difficult to conceive of any causal mechanisms that would cause them to be subject to be influenced by the outcomes. Consequently, any association between variables in the model and the outcomes could not reflect any causal influence of the outcomes on values of the predictor variables, but rather demonstrated an influence of student characteristics reflected in the predictors on the outcomes.

Results

Success as Outcome

The model produced an acceptable fit with the data, with a p -value of 0.37 for the Hosmer-Lemeshow (HL) goodness-of-fit test. Table 2 contains the effect size measures (odds ratios) and 95% confidence intervals. The effect size, as reported in odds ratios, refers to the magnitude of associations; for example, the odds ratio of 2.0 reported for sex reveals that the sex of the student had a stronger as-

sociation with success than did credit load, which produced an odds ratio of 1.12 (see Table 1). Delivery method remained a significant predictor of success even after adjusting for demographic and student status variables and placement test scores, with online students being significantly more likely than face-to-face students to suc-

ceed in the course (odds ratio 4.17, $p < 0.0001$).

Of the demographic variables independent of delivery method, only sex and ethnicity were significant predictors of success. The adjusted odds ratio of success for females was significantly higher than for males. In the case of ethnicity, the adjusted odds ratio of success for white students was significantly higher than for minority students. Concerning preparedness, CPT scores were shown to be significantly and positively related to success, with writing placement score the most important predictor. Somewhat surprisingly, math placement test score was also significantly positively related to success.

Retention as Outcome

Results for the HL goodness-of-fit test ($p = 0.21$) indicated no significant lack-of-fit with the data. The effect size measures (odds ratios) and 95% confidence intervals for retention as the outcome measure were also calculated (see Table 2).

After adjusting for demographic differences, student credit load, time of registration, and preparedness level, the delivery method remained a strong predictor of retention, with face-to-face students being significantly more likely than online students to finish the course (odds ratio 4.76, $p < 0.0001$). Full-time students were significantly more likely than part-time students to be retained (odds ratio 1.96, $p < 0.001$), and fe-

males were more likely to be retained than males (odds ratio 1.72, $p < 0.01$).

Discussion

A key result of this research is the significance of delivery method as a predictor of student outcomes after adjusting for any self-selection effects associated with the demographic, student status, and preparedness variables. Assuming that all important self-selection effects have been controlled, this result suggests that there is something about the dynamics of online instruction, construed broadly (by comparison with traditional, face-to-face instruction), which has an impact on student outcomes. More specifically, it suggests that there are some things about online instruction as a delivery method that lead to greater withdrawal rates but that may ultimately lead to success rates for those students who finish the course that are comparable to, if not greater than, success rates in traditional, face-to-face instruction.

Of particular value for researchers and practitioners is the finding of evidence suggesting that the factors that influence success are not identical with the factors that influence withdrawal. Particularly noteworthy here is the significance of placement test scores as predictors of success (but not of withdrawal) and the significance of credit load as a predictor of withdrawal (but not of success).

Consideration should be given to the possibility that the greater withdrawal rate in online sections may be indirectly causally related to the greater success rate in those sections. Students in online sections who completed the course had a higher mean writing CPT score than students in face-to-face sections who completed the course, 78.9 versus 77.2. An analysis, stratifying on delivery method, found that, although students with lower writing CPT scores withdrew from

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Table 2
Effects (Retention as Outcome)

Effect	Adjusted Odds Ratio	95% Confidence Interval
Delivery method (face-to-face vs. online)	4.76**	2.70 - 8.33
Credit load (full time vs. part time)	1.96**	1.30 - 3.03
Sex (females vs. males)	1.72**	1.18 - 2.50
Ethnicity (white vs. minority)	1.33	0.93 - 1.91
Time of registration (early vs. late)	1.14	0.72 - 1.82
Age	1.02	0.99 - 1.05
Math CPT score	1.01	0.98 - 1.02
Reading CPT score	1.01	0.99 - 1.02
Writing CPT score	0.99	0.97 - 1.00
** $p \leq 0.01$		

online sections in greater proportions than students with higher writing CPT scores (odds ratio of withdrawal, low vs. high CPT scores = 1.47, $p = 0.34$), exactly the reverse association existed in face-to-face sections: students with higher writing CPT scores withdrew from face-to-face sections in greater proportions than students with lower writing CPT scores (odds ratio = 1.35, $p = 0.19$), although the difference did not reach statistical significance.

A similar pattern of results was found for reading CPT score. Students in online sections who completed the course also had a higher mean reading CPT score than students in face-to-face sections who completed the course, 81.3 versus 76.1. Employing the same stratified analysis that controls for delivery method, whereas students with low reading CPT scores withdrew at rates essentially similar to those with high reading CPT scores in face-to-face sections (odds ratio 0.99, $p = 0.93$), students with low reading CPT scores withdrew at higher rates than those with high reading CPT scores in online sections (odds ratio 1.48, $p = 0.18$), although the difference did not reach statistical significance.

Although neither pattern of results was statistically significant, the relatively low power of the tests for online students ($N = 227$ and 256 , respectively, for writing and reading CPT scores) raises the question whether these findings might be indicative of something in the dynamics of online instruction (by contrast with face-to-face instruction) that signals more clearly to students whether their level of preparedness is adequate to the demands of the course.

Limitations

An important limitation of this study flows from the fact that virtually all (96%) of the students in the online sections were taught by the same instructor, who also taught fewer than 2% of the students in the face-to-face sample. Therefore, a strong association between this instructor and delivery method exists, which makes it difficult to unambiguously distinguish the effects of delivery method from the effects of this particular instructor on student outcomes. The results of additional analysis, however, failed to provide good reasons for thinking that we have an instructor effect masquerading as a delivery method effect.

Analysis of the subsample of face-to-face students revealed that, al-

though this particular instructor's face-to-face students showed higher rates of success than the face-to-face students of other instructors (72.7% versus 64.3%), the difference was not statistically significant. The associations between delivery method and success for students of this instructor and for students of the other instructors were comparable in magnitude: odds ratios (online versus face-to-face students) of 3.78 for this instructor and 3.33 for the students of the other instructors, a difference that was not statistically significant ($p = 0.91$).

The same analysis with respect to retention also failed to provide strong evidence of an instructor effect. The nature of the association between delivery method and withdrawal status differed little between the students of this particular instructor and the students of the other instructors: odds ratio (of withdrawal, online versus face-to-face) of 4.40 for this particular instructor and an odds ratio of 4.67 for students of other instructors. This difference was not statistically significant ($p = 0.94$). However, the very small number of online students taught by other instructors and the very small number of face-to-face students taught by this particular instructor resulted in tests of relatively low power.

A relevant question concerns whether all the important variables related to self-selection have been controlled. For example, stu-

dent expectations are not controlled in the analysis. It is conceivable that students selecting online instruction may be more likely than students selecting face-to-face instruction to have unreasonable expectations about the difficulty of such courses (e.g., are unduly influenced by the fact that online sections are more accessible and convenient than face-to-face sections), and this may well lead to higher withdrawal rates in online courses after exposure to the level of difficulty of the coursework. Although there may be other variables associated with self-selection of delivery method that are also associated with student outcomes, it is reasonable to conclude that delivery method may have at least some influence on student outcomes—particularly concerning retention, where the effect of delivery method was particularly strong. The results suggest that there may be something different in the dynamics of online instruction in developmental writing which leads to higher rates of withdrawal.

Implications for Pedagogy

The findings of this study suggest some implications for pedagogy. The following table highlights suggestions that might be helpful for improving an existing online developmental writing course or for creating a new one.

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Table 3
Findings and Implications for Pedagogy

Finding	Implications	Suggestions
"Withdrawal" rate is higher in online than in face-to-face sections.	Implement strategies to increase retention.	<ul style="list-style-type: none"> - require an online orientation - require students to complete tasks online at the start of the course (e.g., sending an e-mail, attaching a document) - make expectations for workload clear - make expectations for technology clear - be liberal with "incomplete" grades
Reading level and writing level (CPT scores) affect success.	<p>Make written communication and assigned readings accessible.</p> <p>Continue to use the CPTs.</p>	<ul style="list-style-type: none"> - test readability of instructor-generated text and course packs - provide study guides, tips, summaries - make course sites easy to navigate
Full-time students are more likely to complete the course.	Implement strategies to increase part-time student retention.	<ul style="list-style-type: none"> - create a student questionnaire to study environmental distractions and their relationship likely to success - inform counseling staff that part-time students are more at-risk - form online support groups for part-time students - create an online "Question & Answer" document for access to college and community support services
Students who complete online tend to be as successful as (or more successful than) students who complete face-to-face.	Continue offering online developmental writing.	<ul style="list-style-type: none"> - present at conferences - create listserv for faculty teaching developmental writing online - publish outside the institution

Implications for Future Research

- Investigate current cut-score for college-level reading (ACCUPLACER, 78-120) in relation to success in developmental writing. (Do we need to have students reach college level in reading before they take developmental writing?)
- Explore results of college reading level and success in online courses overall. (Is the current reading level adequate for online courses? Could it be set too low and contributing to course withdrawal?)
- Use this research as a base line and create a study for succeeding years. (Can we identify trends?)

Conclusions

Our effort to adjust the study results for possible self-selection effects and to control for a possible instructor effect has resulted in a picture that is not substantially different from the initial unadjusted comparison of online and face-to-face developmental writing students. However, it did result in a weaker association between delivery method and retention and a stronger association between delivery method and success when compared with the unadjusted results. Although an aspect of the data set (very limited variation in instructors in the online sample) limits our ability to be definitive, the results provide good reasons for thinking that, when it comes to student outcomes of retention and success, delivery method matters. Although online students who are retained are more likely to be successful than retained face-to-face students, the online, asynchronous delivery method appears less successful than the face-to-face method in retaining students to course completion.

Although we found evidence that online and face-to-face sections differ in the production of student outcomes, the absence of significant interaction effects with delivery method leads us to conclude that at least some of the forces influencing student outcomes are the same in online and face-to-face developmental writing. Identifying these common forces is important for efforts to increase the proportion of developmental writing students that have successful experiences.

Perhaps equally important, our results also suggest that the dynamics producing student outcomes—retention to course completion and success—are not identical. Improving student success in developmental writing requires attention to factors that differ to some extent from those factors that appear impor-

tant for improving student retention. We have found that, although placement test scores appear significantly and positively related to the odds of success, they are not significantly related to retention. On the other hand, although credit load has not been found to be significantly related to success, it has proven to be a significant predictor of the odds of retention, with full-time students significantly more likely to be retained than part-time students.

Paradoxically, though, online developmental writing may loom as an obstacle in the perspective of many developmental educators, even though it has the potential to knock down many of the hurdles developmental students often face such as problems with child care, transportation, and parking; scheduling class times around family and work responsibilities; feeling part of the academic community; and becoming more proficient with current technology. Furthermore, if online education continues its rapid growth pattern, it is possible that developmental students may be disadvantaged by limiting online access as an option at the beginning of their academic work and thus limiting their full preparation for access and success in subsequent community college and university work.

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