Online Learning:
Does It Help Low-Income and Underprepared Students?

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Abstract

Advocates of online learning are optimistic about its potential to promote greater access to college by reducing the cost and time of commuting and, in the case of asynchronous approaches, by allowing students to study on a schedule that is optimal for them. This goal of improved access has been one of the top motivators for postsecondary institutions to expand their distance education offerings, which has in turn helped drive a strong increase in online course enrollments over the last decade. A series of technology-based classroom initiatives has also attracted strong attention from postsecondary educators. The enthusiasm surrounding these and other innovative, technology-based programs has led educators to ask whether the continuing expansion of online learning could be leveraged to increase the academic access, progression, and success of low-income and underprepared college students.

This paper examines the literature for evidence regarding the impact of online learning on these populations. First, a research review strongly suggests that online coursework—at least as it is currently and typically implemented—may hinder progression for low-income and underprepared students. Second, the paper explores why students might struggle in these courses, discusses current access barriers to online education, and offers suggestions on how public policy and institutional practice could be changed to allow online learning to better meet its potential for these students.

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1. Introduction

Advocates of online learning are optimistic about its potential to promote greater access to college by reducing the cost and time of commuting and, in the case of asynchronous approaches, by allowing students to study on a schedule that is optimal for them. This goal of improved access has been one of the top motivators for postsecondary institutions to expand their distance education offerings (Parsad & Lewis, 2008), which has in turn helped drive the strong increase in online course enrollments over the last decade (from 10% of enrolled students in 2002 to 29% in 2009; see Allen & Seaman, 2010).

Meta-analyses comparing academic outcomes between online and face-to-face courses have typically indicated that there is no overall difference between the two formats but that there is large variation in effects, with some online courses having much better outcomes than face-to-face courses and other online courses having much worse outcomes (e.g., Bernard et al., 2004; Zhao, Lei, Yan, Lai, & Tan, 2005). A recent meta-analysis of the most high-quality studies (U.S. Department of Education, 2009) suggested that online learning results in similar or better outcomes than does face-to-face learning, although the authors cautioned that the positive effect for online learning outcomes was stronger when contrasting hybrid-online courses to face-to-face courses than when contrasting fully-online courses to face-to-face courses. In addition, they noted that the positive effect was stronger when the hybrid-online course incorporated additional materials or time on task, which were not included in the face-to-face course.

At the same time, a series of technology-based classroom initiatives—such as Western Governors University, Carnegie Mellon's Open Learning Initiative, and the National Center for Academic Transformation's course redesign process—has attracted strong attention from postsecondary educators. The enthusiasm surrounding these and other innovative, technology-based programs has led educators to ask whether the continuing expansion of online learning could be leveraged to increase the academic access, progression, and success of low-income and underprepared college students. To provide an evidence-based perspective on these questions, the current review examines the literature for information regarding the impact of online learning on these populations.

In academic and policy discussions, sometimes little distinction is made between fully online courses, partially online courses, and courses that are essentially face-to-face but which incorporate some resources online; yet each of these types of courses may have very different implications for access, progression, and student learning. Following Allen and Seaman (2010), this paper uses the term "online" for fully online courses (80% or more of the course is conducted online) and "hybrid" for partially online courses (30%–79% of the course is conducted online). As noted above, online learning is thought to have strong potential to increase student access. In contrast, many hybrid courses require students to attend a substantial proportion of time on campus;[1] thus, scaling up hybrid course offerings is unlikely to improve access for low-income students who have work, family, or transportation barriers to attending class in a physical classroom at specified times. Perhaps in part due to community colleges' strong emphasis on access, online courses are much more prevalent than hybrid courses in the community college setting: 75% of community colleges offer online courses, while only 15% offer hybrid courses (Instructional Technology Council, 2010). Institutions providing hybrid courses may also offer fewer sections of hybrid than online courses; for example, in a recent study of Virginia's 23 community colleges, first-year students took 9% of their courses online but only 3% of their courses via a hybrid mode (Jaggars & Xu, 2010).

Given the much higher prevalence of online versus hybrid learning in community colleges, combined with online education's strong promise of improved student access, this paper focuses on online courses. I begin with a research review that strongly suggests that online coursework—at least as currently and typically implemented—may hinder progression for low-income and underprepared students. I then explore why students might struggle in these courses, discuss current access barriers to online education, and offer suggestions on how public policy and institutional practice could be changed to allow online learning to better meet its potential for these students.

[1] For example, Jaggars and Bailey (2010) note that of the 23 hybrid courses examined in a U.S. Department of Education (2009) meta-analysis, 20 required the students to physically attend class for the same amount of time that students in a face-to-face course would attend; the online portions of these courses were either in on-campus computer labs or were supplemental to regular classroom time.

2. Review of the Research

This review of the literature focuses on the extent to which low-income and underprepared students may have a more successful college experience by taking advantage of online courses. As little research focuses explicitly on this target population, the review includes studies on all postsecondary students, including graduate students, with an eye to how the overall postsecondary results may or may not be generalized to low-income and underprepared students. The postsecondary inclusion criterion distinguishes this review from other recent analyses of the online learning literature, which each included studies from a mixed variety of settings, including K-12, college, and work-based employee training contexts (Bernard et al., 2004; Zhao, Li, Yan, Lai, & Tan, 2005; U.S. Department of Education, 2009).

This review includes studies that compared online (80% or more of the course conducted online) and face-to-face courses (less than 30% of the course conducted online) in terms of students' course enrollment, completion, performance, or subsequent academic outcomes. Student satisfaction was not included as one of the outcomes, largely because the relationship between student satisfaction with a particular course and subsequent academic success is not clear. Given the larger cultural and economic sea change surrounding Internet usage around the turn of the 21st century, studies published prior to 2000 may not be relevant to today's online context; thus, studies published prior to 2000 were discarded. Also discarded were studies that focused on short educational interventions (e.g., Beyea, Wong, Bromwich, Weston, & Fung, 2008, who tested a 15-minute intervention; or Erickson, Chang, Johnson, & Gruppen, 2003, who tested a one-hour intervention). Such short interventions cannot address the challenging issues inherent in maintaining student attention, learning, motivation, and persistence over a course of several months. Also discarded were studies that allowed students to self-select into either online or face-to-face courses without attempting to control for any potential differences between the student groups. Finally, this paper considers only studies conducted in the United States and Canada.[2] Overall, this paper looks at 34 papers (some including multiple studies, resulting in a total of 36 studies) that met the review criteria.

[2] While the scope of the paper initially also included English-speaking countries with similar demographic and educational contexts (e.g., the United Kingdom, Ireland, and Australia), this did not yield any additional studies that matched the remaining criteria.

In the discussion below, studies are grouped according to the outcomes examined: access (increasing enrollments that would not otherwise occur), completion (finishing the course), learning outcomes (typically the final grade or exam score in the course), and progression (movement into or performance in subsequent courses and semesters).

As a preview to the summary of the research literature, I note at the outset that:

- Few studies focused explicitly on the potential for online learning to support the success of low-income or academically-underprepared students;
- No studies explicitly addressed the extent to which online learning options increase college enrollment rates in comparison to face-to-face learning options;
- Fewer than half of the studies compared course completion rates between the online and face-to-face format;
- Most studies compared student learning outcomes, such as assignment grades, final exams, and final course grades, between the online and face-to-face settings; and
- Only two studies compared online and face-to-face courses in terms of outcomes subsequent to the online course.

The 36 studies included in this paper are summarized in Table 1 (Appendix).

2.1 Courses Studied

This section begins with a brief description of the types of online courses studied. Of the 36 studies, 21 (58%) focused on university courses, 10 (32%) on community college courses, four (11%) on graduate-level courses, and one on a course in a for-profit institution. Approximately one third focused on math, statistics, computer science, and other science-oriented courses; another third on professionally-oriented areas such as health, law, business, and education; and the final third on liberal arts areas including economics, English, and critical reasoning. A few studies examined courses across an entire institution and thus provided no relevant information on specific course subjects or instructional characteristics. Many studies of specific courses also did not provide full information regarding the features of the online course. However, even the partial

information included in each study demonstrates that the courses varied widely in their instructional features (see Table 1, column 4).

Instructional delivery method. Of the 19 studies that specified the method by which instructional material was delivered to students, 10 (53%) used a text-based or slideshow-based presentation, which was sometimes supplemented with short video or audio clips, or with self-test exercises. Video or audio of the instructor's full lecture was the next most popular instructional method, used in five (26%) of the studies. Three studies (16%) specified using tutorial software programs to deliver content, along with a fourth study that offered students both lecture notes and interactive tutorials.

Student interaction. It was difficult to determine the degree to which student-student and student-instructor interactivity tools were incorporated into courses, as most studies did not mention this component. Six studies noted that asynchronous discussion or synchronous chat was available to students, but these studies either specified that students were not required to participate or did not specify whether participation was required as part of the course grade. Eight other courses required participation; of these, six used asynchronous discussion and two used synchronous chat sessions. Finally, one paper studied an online course that incorporated interaction via face-to-face discussion sessions (Scheines, Leinhardt, Smith, & Cho, 2005). This study is of particular interest, as the course was developed by the Carnegie Mellon Open Learning Initiative, which is often cited as an exemplary online course development program.[3] The Scheines et al. (2005) paper includes five separate studies. In the first two studies, face-to-face discussion attendance was not required, and student attendance at these sessions was quite low: in study 1, online students attended an average of 20% of the sessions (compared to 85% attendance by face-to-face students), and in study 2, attendance was less than 9% for online students (85% for face-to-face students). Given that this version of the online course did not require face-to-face discussions, the first two studies met this review's inclusion criterion in terms of examining a "fully online" course. In the subsequent studies in the paper, however, discussion attendance was required, and online

[3] Other studies conducted by the Open Learning Initiative are not included, as they concern hybrid courses (see Lovett, Meyer, & Thille, 2008, in which students were required to meet with an instructor at least once a week) or examine online courses without comparing them to face-to-face courses.

student attendance at these sessions rose to 71%. I considered these courses to be hybrid courses and excluded them from this review.

Student supports. Nine studies noted that the course under examination required an initial face-to-face orientation session for online students; these orientations were viewed as helpful in assisting students to understand the academic demands of the course, as well as the technical features of the web-based interface. One study noted that a face-to-face orientation was available but that some students did not take advantage of it, and recommended that the orientation be mandatory in the future (Rosenfeld, 2005). Only three studies explicitly mentioned the provision of other non-instructional supports (e.g., technical support, library service support) for students in the online course. Navarro and Shoemaker (2000) noted that technical support was available by email within 24 hours; Rosenfeld (2005) studied a community college that offered free Internet access to students enrolled in online courses and provided technical support 14 hours per day, 6 days per week (though the method of support provision was unclear); and Vroeginday (2005) noted that library resources and technical support were integrated into the online course platform.

Typical online courses. It is not clear the extent to which the courses examined in these studies are representative of the "typical" online course, as there is no comprehensive survey of online course features in postsecondary education. Of the studies of specific courses included in this review, most were conducted by the instructor or by departmental colleagues. It seems likely that these courses were selected for study because they were thought to be high-quality examples of online learning. In contrast, institution-wide or system-wide studies (e.g., Rosenfeld, 2005; Jaggars & Xu, 2010) should capture the effects of typical online courses in that institution or system.

Having provided an overview of the online courses included in this review, I move on to compare student outcomes between online and face-to-face courses. This section begins with studies that examine course completion rates, followed by those that examine learning outcomes, and then those that examine student progression. Given that I found no studies that examined student access, the paper postpones further discussion of that issue until a subsequent section of the paper.

2.2 Course Completion

Course completion is a fundamental measure of student success, as many students are lost from the postsecondary pipeline when they attempt but fail to complete courses. Underprepared students who withdraw from a course mid-semester run the very real risk of never returning to successfully complete the course, thereby prohibiting progression to the next course in the sequence (see, e.g., Bailey, Jeong, & Cho, 2010). Since underprepared students must complete developmental courses before progressing into courses at the college level, low completion rates in remedial courses are especially problematic.

Online courses, like other forms of distance education, clearly have higher mid-semester withdrawal rates than do face-to-face courses (Beatty-Guenter, 2003; Carr, 2000; Chambers, 2002; Moore, Bartkovich, Fetzner, & Ison, 2003). This difference may be particularly pronounced among underprepared students. For example, one study of community college students in developmental mathematics observed that 73% of face-to-face students completed the course with a grade of A, B, or C, while only 51% of online students did so (Summerlin, 2003). However, some practitioners and researchers argue that high online withdrawal rates are due not to the course format, but to the characteristics of online students (Howell, Laws, & Lindsay, 2004; Hyllegard, Heping, & Hunter, 2008). Thus, for this review of the literature, I looked particularly for studies that compared online and face-to-face completion rates while controlling for student characteristics. Ten of the studies in this review did so, and their results fell into two sets: (1) Four studies found no significant difference in withdrawal rates and (2) six studies found higher withdrawal rates for online students.

Studies showing no difference in course withdrawal rates. One randomized and three controlled studies showed no difference between online and face-to-face student completion rates. Waschull (2001, study 2) examined an introductory psychology course at a non-selective technical college. Forty-one students enrolled in one of two sections of a course taught by Waschull; she then randomly selected one section to be conducted online. While participants in this study were not strictly randomized, it is reasonable to assume that student selection of a given course was independent of the

assignment of sections to the online condition. Attrition was fairly low (11% in online, 9% in face-to-face) and did not significantly differ between the two courses.

The remaining three studies were conducted by Dutton and colleagues (J. Dutton & M. Dutton, 2005; J. Dutton, M. Dutton, & Perry, 2001, 2002), who examined a C++ programming course and a business statistics course at a selective university. These studies are problematic, because the analyses of completion included controls for student behaviors that occurred *after* the online course began; thus, these behaviors could have been caused, at least in part, by the online course mode itself. In all three Dutton studies, raw data indicated that the online group had substantially higher withdrawal rates (e.g., in the 2001 study, 21% online versus 6% face-to-face). However, after controlling for homework grades, these differences disappeared. The authors argued that the homework measure captured preexisting student motivation, given that students were allowed to re-do their homework several times, such that a motivated student could receive a perfect score on every assignment. However, it is possible that the online course format adversely affected student motivation and engagement, which in turn led to both poor homework grades and eventual student withdrawal. Thus, one valid interpretation of these studies' results might be that the online format of the course indeed contributed to higher withdrawal rates.

Studies showing higher course withdrawal rates for online students. All six of the controlled studies showing higher withdrawal rates for online courses dealt with community college students. These studies are especially relevant to this paper, since community colleges disproportionately serve low-income and academically-underprepared students (Adelman, 2005). Four studies dealt explicitly with developmental students, and the remaining two dealt with students in introductory "gatekeeper" college-level courses (such as first-year English).

The six studies controlled for a wide array of variables, including psychological characteristics such as locus of control, math anxiety, learning style, or reasons for choosing the course (Blackner, 2000; Zavarella, 2008); prior achievement, including academic placement test scores, credits accrued, or GPA (Carpenter, Brown, & Hickman, 2004; Jaggars & Xu, 2010; Rosenfeld, 2005; Xu & Jaggars, 2010; Zavarella, 2008); basic demographics such as gender, ethnicity, age, or marital status (Carpenter et al., 2004;

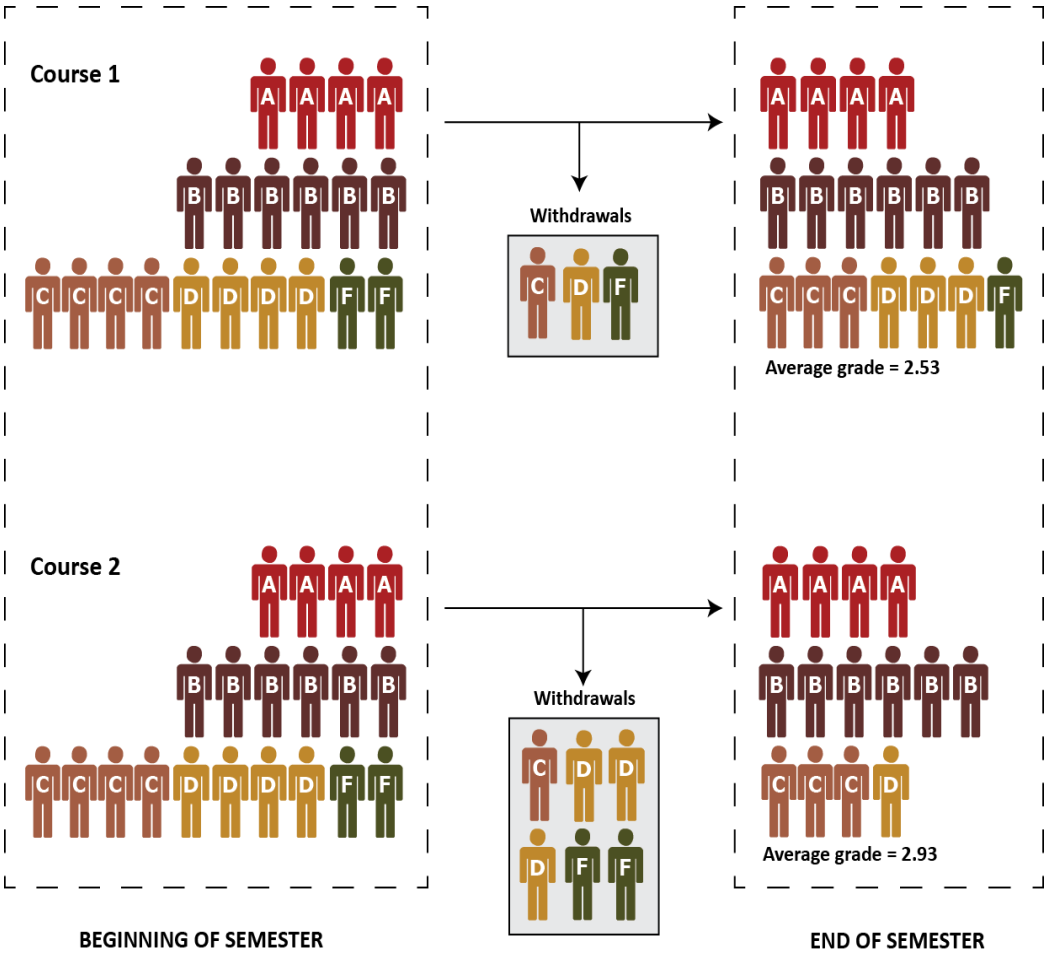
Jaggars & Xu, 2010; Rosenfeld, 2005; Xu & Jaggars, 2010; Zavarella, 2008); federal financial aid eligibility (Jaggars & Xu, 2010; Xu & Jaggars, 2010); semester-specific variables such as credit load and timing of registration (Carpenter et al., 2004; Jaggars & Xu, 2010; Xu & Jaggars, 2010); and instructor characteristics or effects (Carpenter et al., 2004; Jaggars & Xu, 2010). Across the studies, online students tended to have estimated course withdrawal rates that were 10 to 15 percentage points higher than those of face-to-face students.

Overall, the 10 studies examining student course completion suggest that students are less likely to complete courses if they take them online, although this tendency may be particularly pronounced among community college students, who tend to be disproportionately low-income and academically underprepared.

2.3 Student Learning Outcomes

The paper next turns to the literature on learning outcomes to assess whether students who *complete* online courses have equally successful academic outcomes in comparison to those who complete face-to-face courses. As a general experimental research principle, when comparing outcomes between two groups who persist to the end of a study, it is particularly important to examine whether the two groups had relatively equal levels of attrition. To illustrate the importance of this principle, consider two courses, Course 1 and Course 2, each with similar students at the outset (Figure 1).

Figure 1
An Illustration of Unequal Withdrawal Rates



At the outset of the semester, each course has a similar mix of students: each has four students who are typically "A students," six that are typically "B students," and so on. Over the course of the semester, some students with poorer academic preparation withdraw from each course. However, something is different about Course 2, which causes twice as many poor-performing students to withdraw. The remaining students perform at their usual level of academic success in each course. If the two courses are then compared in terms of the academic performance of the *completers*, Course 2 will appear to be the superior course.

Given the importance of establishing whether two groups have equal rates of withdrawal before comparing their outcomes, together with the fact that online courses

typically have higher withdrawal rates, it is curious that of the 33 studies that examined learning outcomes, only 18 even mentioned course completion rates. This omission is particularly perplexing given that all articles were published after a much-cited review of online learning effectiveness (Phipps & Merisotis, 1999), which criticized the literature for failing to adequately address the issue of withdrawal rates. Of the 18 learning outcomes studies that mentioned withdrawal rates, nine were discussed in the section above; the remaining nine compared learning outcomes while ignoring completion. Six of these nine dealt with fairly well-prepared students and appropriately noted that overall course withdrawal rates were negligibly low or equivalent between groups (Caldwell, 2006; Figlio, Rush, & Yin, 2010; Partrich, 2003; Scheines, Leinhardt, Smith, & Cho, 2005, studies 1 and 2; Y.-C. Wang, 2004); two noted that online dropout rates were significantly higher (Carey, 2001; Summerlin, 2003); and one did not explicitly test what appeared to be substantially higher withdrawal rates among online students (Piccoli, Ahmad, & Ives, 2001).[4]

In terms of other methodological characteristics of the 33 learning outcomes studies, 8 were randomized studies, and 5 more were relatively well controlled, but the remainder raised methodological concerns about the handling of control variables. The paper discusses each of these three sets of studies in more detail below.

Randomized studies of learning outcomes. I found eight studies of learning outcomes that randomized students into online versus face-to-face conditions. In general, these studies were reasonably well designed with fairly equivalent student groups and similar curricula between the online and face-to-face sections of each course. Five showed no significant difference between groups (Caldwell, 2006; Piccoli, Ahmad, & Ives, 2001; Scheines, Leinhardt, Smith, & Cho, 2005, studies 1 and 2; Waschull, 2001, study 2). One showed no overall differences between groups but noted that among Hispanics, males, and students with low prior GPAs, students in the online condition scored significantly lower on in-class exams (Figlio, Rush, & Lin, 2010). Another study

[4] In Piccoli et al. (2001), from the course's first week to the final, online retention rates were 74% and face-to-face were 94%; a comparison of these proportions yields a highly significant difference, $\chi^2 = 13.15$, $p < .001$. The authors noted that online students became significantly less satisfied with the course when they encountered more difficult material in the second half of the semester while face-to-face students did not. Dropout rates from the midterm to the final reflect this dissatisfaction: online retention rates during this period were 86% and face-to-face rates were 96%, $\chi^2 = 5.43$, $p < .05$.

showed a negative effect for online learning, primarily because online students were less likely to complete their homework (Mentzer, Cryan, & Teclehaimanot, 2007). Finally, one study showed a positive effect for online learning, which the authors admitted might be due to the small class size for online students, in comparison to the very large lecture-hall class for face-to-face students (Poirier & Feldman, 2004).

Overall, then, the eight randomized studies suggest no strong positive or negative effect of online learning in terms of exam or course grades. These results, however, are not readily generalized to low-income and underprepared students: most of the studies had small sample sizes, were conducted at selective or highly-selective universities, and either had negligible student withdrawal or did not mention withdrawal at all. Only Figlio et al. (2010) explicitly examined impacts among less-prepared students, finding that such students perform significantly more poorly in online courses.

Well-controlled studies of learning outcomes. Of the 25 studies of learning outcomes that attempted to adjust for student self-selection into online courses using control variables, five were relatively well controlled, while the remaining 20 manifested methodological limitations with regard to their inclusion of controls. Of the five relatively well-controlled studies, three showed negative effects for online learning, one showed positive effects, and one showed no significant difference. Two of the five studies focused on economics students at selective universities, while three focused on community college students in developmental or gatekeeper courses. Each of these studies provides interesting insights when explored in more detail.

Studies of university economics courses. Brown and Liedholm (2002) examined online ($N = 89$) and face-to-face ($N = 363$) sections of a microeconomics course, using a regression controlling for gender, ethnicity, previous math coursetaking, ACT score, prior GPA, and previous credits accrued. Students in the online courses were significantly better prepared at the outset, with significantly higher ACT scores and accrued college credits; after controlling for these factors, however, students in the online course performed more poorly than those in the face-to-face course. The authors extended their regression model to predict online student outcomes if online students had instead chosen to enroll in a face-to-face course and note that online students' course grades "would

have risen by a significant 5.79 percentage points" if they had taken the course face-to-face.

A study of online ($N = 59$) and face-to-face ($N = 67$) economics students across three universities (Coates, Humphreys, Kane, & Vachris, 2004) administered a common post-test to students at the end of the semester. The model comparing post-test scores between groups included an impressive array of covariates, including SAT, hours employed, commuting time to campus, financial aid status, age, an economics pre-test, and instructor effects. In addition to traditional regression, the authors also used more advanced techniques (2SLS and endogenous switching) to control for student self-selection effects. Similar to Brown and Liedholm (2002), they concluded that online students performed more poorly than face-to-face students. For example, a typical economics student who took the course online rather than face-to-face would score 18 percentage points lower on the final; moreover, underclassmen seemed particularly vulnerable to this effect, leading the authors to note that teaching economics courses online in community colleges is probably not a good policy. Contrary to Brown and Liedholm, however, their endogenous switching model suggested that students who self-selected into the online class performed better than students with similar characteristics who chose the face-to-face class. Thus, while the *average* student performed more poorly in an online class, the *type of student who was most likely to choose an online class* performed better in that setting.

Neither study mentioned student withdrawal, and in general the students were well prepared. As Coates et al. (2004) noted of their sample: "The typical student carried a 2.8 GPA on a 4 point scale, scored about 1100 on the SAT and considered himself to be good at math" (p. 537). Both studies reach the same general conclusion that the typical student does more poorly in online courses. However, it is difficult to judge the extent to which these studies apply to low-income and underprepared students.

Studies of community college students. As noted in the discussion of course completion in an earlier section, Carpenter et al. (2004) controlled for a variety of factors and found that developmental writing students were significantly more likely to withdraw from an online course than from a face-to-face course. However, students who completed the course were more likely to earn a good grade (2.5 or higher) in the course, net of

controls. The authors acknowledge that this effect could be due to the substantially higher withdrawal rates in the online sections. To further explore this possibility, they examined the reading and writing placement test scores of students who withdrew from each section and found that students with *lower* placement scores were more likely to withdraw from the online section, while students with *higher* scores were more likely to withdraw from the face-to-face section, leaving the online section with students who were better prepared at the outset. This pattern gives weight to the notion, discussed at the beginning of this section, that differential withdrawal rates can result in misleading comparisons between students who complete online and face-to-face courses.

Summerlin (2003) focused on a developmental mathematics course, and compared a sample of online students ($N = 79$) to a randomly-drawn sample of face-to-face students ($N = 143$) in terms of their end-of-semester scores on a state mathematics exam. Across the college, observed withdrawal from the online sections was substantially higher; but among those students in the author's subsample who completed the course, exam scores were similar between the groups after controlling for reading ability, age, gender, and ethnicity.

Finally, Xu and Jaggars (2010) examined students across 23 Virginia community colleges who took the system's introductory college-level English course either online (N = 1,052) or face-to-face ($N = 12{,}921$). As noted in the completion section above, that study found that online students were much more likely to withdraw from the course. In order to eliminate the potential confounding effect of unequal withdrawal in the analysis of learning outcomes, the authors used a propensity score method that matched each student who completed the English course online with an otherwise extremely-similar student who completed the English course face-to-face. This analysis represents the *only* study in this review that explicitly addressed and removed the potential influence of unequal attrition, and it found that online students who completed the course were significantly less likely to earn a good grade (C or above) than were face-to-face students.

Less well-controlled studies. Students who choose online coursework are often quite different from those who choose face-to-face courses. In conjunction with a comparison of course completion or learning outcomes, several studies included in this review compared demographic or academic characteristics between online and face-to-

face students and found distinct patterns of differences. For example, the study of Virginia community college students (Jaggars & Xu, 2010) found that students who chose to take online courses were significantly more likely to be female, White, English-fluent, independent of their parents, and above 25 years old; they were also more likely to have applied for financial aid, been involved in a college-credit dual-enrollment program in high school, and been academically prepared at college entry. Similarly, Carpenter et al.'s (2004) study of developmental community college students found that online course takers were more likely to be female, White, older, part-time students, and to have higher reading and writing placement exam scores. Differences between online and face-to-face students are also apparent in the university environment: in Brown and Liedholm (2002), online students were significantly less likely to be Black or student athletes, and had significantly higher ACT scores and accrued credits; in Coates et al. (2004), online students were significantly less likely to be underclassmen, traditional-age, non-employed, living on campus, or receiving financial aid.

Among the studies of learning outcomes, 20 were classified as "less well controlled." These studies typically included only one or two controls—often without any reflecting the distinct characteristics of online students discussed above—raising the strong possibility that their results are driven merely by pre-existing differences between online and face-to-face students. Approximately half used either a pre-test[5] or a learning styles assessment as their primary control, but typically failed to mention whether the measure was a *useful* control. For example, Schoenfeld-Tacher, McConnell, and Graham (2001) compared final exam scores between online and face-to-face students in an upper-division tissue biology course at a state university, controlling for pretest scores. Yet the pre- and post-test scores were not related (with $\eta^2 = .000$). Accordingly, including only this variable in the model was equivalent to including no control at all. Similarly, studies that included learning or cognitive style as a control typically found little or no relationship between styles and learning outcomes.

Overall, across the 20 studies in this set, nine used only a single control; three collected an array of student information but analyzed each characteristic in a separate analysis, an approach that is insufficient to ensure comparability between groups on the

[5] Or, similarly, compared groups in terms of a gain score between pre- and post-test.

set of observed characteristics (Navarro & Shoemaker, 2000; Sankaran & Bui, 2001; Vroeginday, 2005); and five used only two or three controls, with little information as to the efficacy of the controls in reducing self-selection bias. Finally, as noted in a previous section, three papers by Dutton and colleagues (J. Dutton & M. Dutton, 2005; J. Dutton, M. Dutton, & Perry, 2001, 2002) committed the error of controlling for student behaviors that arose *subsequent* to enrollment in the online course.

In terms of results, several studies included multiple outcomes that showed mixed results, and some studies' statistical results were unclearly reported. Taking the broad view across studies, however, most showed either positive effects or no effects for online learning. Yet given the methodological weaknesses of the studies, it is difficult to interpret these results. Relatively poor controls raise the question of whether results were driven in part by student self-selection, and the fact that few studies examined withdrawal raises the question of whether results are driven in part by differential attrition. Moreover, almost all the studies were conducted with university or graduate-level students, which makes unclear their relevance to low-income or underprepared students.

2.4 Student Progression

For low-income and underprepared college entrants, retention into subsequent semesters, as well as progression to the next course in the program sequence, are critical issues. As several other papers in this series point out, many underprepared students do not complete their initial developmental education courses. Those who fail to exit the developmental sequence and progress to introductory college-level "gatekeeper" courses are unlikely to successfully transfer or earn a credential (Bailey, Jaggars, & Cho, 2010). Given the importance of progression, it is surprising that only two of 28 studies explored whether students who complete an online course are on equal footing with their classroom-based equivalents in terms of subsequent success. The first study (Summerlin, 2003), discussed in more detail in the learning outcomes section, noted that students taking developmental math online were less likely to subsequently pass college-level algebra, but the study provides no further controls in that analysis. The second study was the analysis of 23 Virginia community colleges (Jaggars & Xu, 2010), which controlled for a wide array of student characteristics and found that:

- Students who took online coursework in early semesters were less likely to return to school in subsequent semesters. For example, among the 2004 cohort, those who took one or more online courses in the first fall semester were significantly less likely to return in the spring, with adjusted retention rates 5 percentage points lower than those of students who took a fully face-to-face curriculum (69% vs. 74%).

- Students who took developmental math and English courses online were much less likely to subsequently succeed in college-level math and English. For example, adjusted enrollment rates into college-level English among the 2004 cohort were almost 30 percentage points lower among those who took their developmental English course online compared to those who took their developmental course face-to-face. Among those who moved on to college-level English, those who took the developmental course online had success rates 9 percentage points lower than those who took the developmental course face-to-face.

- Students who took a higher proportion of credits online were less likely to attain a credential or to transfer to a four-year institution. For example, in the 2004 cohort, those who took only a few credits online had award/transfer rates that were six percentage points higher than those who took a substantial number of credits online.

While this evidence is limited to community colleges in one state, it does suggest that online learning may undercut student progression among underprepared students who may be struggling with learning difficulties or other problems that interfere with student success.

2.5 Summary of the Research

Overall, it seems that community college students who take online courses are more likely to withdraw from them and that this tendency toward withdrawal is not due to the measured characteristics of those students. Moreover, tentative evidence suggests that taking online courses may discourage students from returning in subsequent semesters and moving on to subsequent courses in their program sequence.

The findings in terms of learning outcomes among students who *complete* online and face-to-face courses are more equivocal. Randomized studies of student learning outcomes (primarily conducted at selective institutions with low course withdrawal rates) suggested that students who complete online and face-to-face courses have similar end-of-semester learning outcomes. Studies that allowed for self-selection between delivery methods and included few controls in the analysis (many of which were performed with university students) tended to find no effect or positive effects for online learning. Other studies with stronger statistical methodologies (more than half of which were conducted with community college students) tended to find negative effects for online learning.

The variation in results across the three sets of learning outcomes studies could spring from two different causes. First, online learning may be more effective among university students than among community college students. Second, when considering the non-randomized studies, the discrepancy between the results of less-controlled and more-controlled analyses is not necessarily surprising, as several studies suggested that students who select online learning tend to have superior academic characteristics. Thus, studies that do not control for these characteristics will tend to find that online students perform better. Moreover, if weak students are more likely to withdraw from online courses, then the students who remain in the online course may outperform those in the face-to-face section simply on that basis.

Taking all of these points into account, it is difficult to judge whether students who complete online courses perform similarly to those who complete the equivalent course face-to-face. The evidence suggests, however, that colleges that are focused on improving student success should proceed cautiously in expanding online course offerings. Until more evidence is gathered, the results of Coates et al. (2004) suggest that online coursework may not be optimal for less skilled students, but may instead be most useful to well-prepared students who need the flexibility of an online course to complete their program of study.

3. Why Are Online Course Completion Rates Lower?

The body of research evidence discussed above suggests that lower online completion rates are not simply due to the characteristics of students who choose to enroll in those courses. That is, independent of students' prior skills, the online format of the course itself might pose difficulties for students. What, then, might be the characteristics of the online course itself that would induce students to withdraw? The theoretical and research literature suggest at least three possibilities: technical difficulties, increased "social distance," and a relative lack of structure inherent in online courses.

3.1 Technical Difficulties

Technical difficulties can be particularly frustrating for students who are working under time pressure to turn in homework, complete quizzes and exams, participate in discussion sessions, take notes from streaming video lectures, or participate in a myriad of required web-based activities. When researchers talk to students about their online course experience, technical problems (both unavoidable system-based problems and difficulties caused by the user's lack of familiarity with the system) surface as a frequent complaint (e.g., Bambara, Harbour, Davies, & Athey, 2009; El Mansour & Mupinga, 2007; Hara & Kling, 1999; Mupinga, Nora, & Yaw, 2006; Navarro & Shoemaker, 2000; Rivera, McAlister, & Rice, 2002; L. Wang, 2008). For example, in one study (Zavarella, 2008) the predominant reasons for student withdrawal from online courses were technical problems, computer-based learning issues, or other factors explicitly related to the online nature of the course.

3.2 Social Distance

As Karp (2011) discusses in her paper in this series, numerous educational theorists argue that in order to improve retention rates, institutions need to build students' sense of belonging and commitment; this might be accomplished by encouraging social relationships through communities of learning and by otherwise helping students feel that the institution "cares." Similarly, distance education theorists argue that in order to engage and motivate students, distance courses must explicitly build social or emotional

connections between students and instructors, as well as among students (e.g., Fontaine, 2010; Garrison, Anderson, & Archer, 2003). And indeed, a sense of "social presence," or the projection of an authentic persona that connects to others involved in the course, correlates strongly with online student course satisfaction, performance, and retention (Boston et al., 2009; Gunawardena & Zittle, 1997; S. Y. Liu, Gomez, & Yen, 2009; Picciano, 2002; Richardson & Swan, 2003).

Studies of students' experiences, however, suggest that many online courses lack a sense of social presence. A study of online courses in the Virginia community college system noted that 43% of students complained of inadequate levels of feedback and interaction in their online courses (Virginia Community College System, 2001). A qualitative study of online university students reported that many felt "lost in cyberspace," without a personal connection to the instructor or other students (El Mansour & Mupinga, 2007, p. 247). Similarly, in a qualitative study of online students enrolled in four high-risk community college courses (HRCs), students' primary complaint was a sense of isolation in their online course (Bambara et al., 2009). As the authors noted in terms of student-instructor interaction:

> HRC participants did not see anyone, and they did not have a sense that anyone was present. David explained, "I don't feel like there was an instructor presence. ... I don't feel like there was anything that I was learning from the instructor. The instructor was simply there as a Web administrator or as a grader." (pp. 224–225)

Students also felt a lack of interaction with one another:

> What our participants found was aptly described by Samantha as follows: "No interaction between the students, student interaction is nonexistent! I know nothing about these people!" They had no sense of community within the HRCs, no peer interaction. Geraldine remarked, "I was just sort of on this island, all by myself." David echoed her sentiments when he said, "I felt like, specifically in that [HRC] class, I was alone and adrift." (p. 225)

The lack of social presence and interaction in some online courses may be due to a lack of instructor time and training. In a study of audio/video technology, many instructors seemed unaware of how these technologies could be effective tools for student

collaboration (S. Liu, 2005). In another study of teachers' online discussion facilitation (Zhai & Liu, 2005), approximately half of the instructors rarely moderated the discussion, while only a few participated extensively through "questioning, prompting responses, probing discussion with more questions, redirecting the flow of discussion, recognizing good posts, summarizing discussion, and modeling social presence" (p. 2). Instructors said that several issues affected their degree of presence: not knowing effective moderation strategies, having too little time, and worrying about being too authoritarian. Dillon and Greene (2003) note that teachers are correct to worry about unintentional messaging when they interact with students online:

> Online communication can be easily misinterpreted, due in part to the lack of visual and facial cues. Online teachers are encouraged to provide timely and detailed feedback. However ... they often do not have any information about how the student responds to this feedback. In fact, students may misinterpret a high level of feedback as negative feedback when in reality a teacher is merely posing questions to stimulate student thinking. (p. 241)

Savvy teachers are all too aware of the possibility of online miscommunication. And unless they are explicitly trained in how to manage positive online communications in a time-effective way, they may default to a psychologically safe and time-saving position of minimal presence.

3.3 Lack of Structure

Beginning with correspondence courses, distance learning has traditionally been a less-structured alternative to the face-to-face classroom. Although the typical postsecondary online course has specific assignment due dates and exam dates, it remains less structured than the typical on-campus class. Most online courses are asynchronous (Parsad & Lewis, 2008), allowing students to access course materials and work on assignments at times that are most convenient to them, and to use idiosyncratic strategies to access, navigate, digest, and apply the material. While this flexibility is a boon to some students, there is also suggestive evidence that the relative lack of structure in online courses leads some to procrastinate or fall behind on assignments. In the studies reviewed in the first section of this paper, online students were less likely to complete their

homework (Mentzer et al., 2007) and had lower participation grades (Grayson, MacDonald, & Saindon, 2001). Two studies also noted that online students were more likely to turn in assignments late with the excuse of (often unverifiable) technical difficulties (Dutton et al., 2001; Ferguson & Tryjankowski, 2009). Another study commented that several online students expressed dissatisfaction with the course because they felt that they had to teach the material to themselves; as the authors put it, students struggled with the "high degree of learner control" (Piccoli et al., 2001).

In a recent study of students' perceptions of important instructor behaviors in online courses (Sheridan & Kelly, 2010), the most important element of online instructor behavior was the clear communication of expectations, requirements, due dates, and course activity instructions. Such teacher behavior may benefit students by providing a strong structure of timeframes and explicit instructions that help keep students on track across the semester.

Distance education theorists argue that a low-structure approach is more appropriate for some learners than others. Moore and Kearsley (2004) note that some students have a strong capacity to structure their own learning and thrive when they are able to take control, while others need much more guidance in order to succeed. For example, perhaps the university economics students in Coates et al. (2004) who explicitly chose online learning were making an appropriate choice because they thrived in a low-structure setting, while in contrast, the typical student was not prepared to succeed in that setting.

The observation that some students perform poorly without a strongly structured environment does not imply that students should never have to learn to succeed in a less-structured context. On the contrary, as Dillon and Greene (2003) argue,

> The most important goal of all education, including distance education, is to help learners learn how to learn ... in a variety of situations and under a variety of conditions, because that is the nature of the learning society in which we live. (p. 238)

However, rather than expecting that students will automatically adapt to a new and perhaps confusing low-structure online environment, online instructors may need to scaffold students to succeed in that environment by providing clear expectations and

instructions, as well as by using activities and processes that explicitly teach metacognition, system knowledge, and self-efficacy (Hannafin, Hill, Oliver, Glazer, & Sharma, 2003).

3.4 Lack of Student Supports

As the foregoing discussion suggests, most online students are not getting the supports they need to help them succeed in the online context. Mixed-offering institutions (those who provide both on-campus and online courses) often have a support infrastructure that is centered on the campus environment. Online students may have difficulty accessing library support, financial aid services, the technical help desk, advising and counseling, or tutoring. For example, Compora's (2003) survey of six Ohio institutions found that none had a formal hotline or system to assist distance-education students with problems; to the extent that institutions had any system of assistance, it was either informal or passive (e.g., student-to-student e-mail discussion, faculty assistance, or instructions on the syllabus). In a study of online remedial math courses at a Florida community college, Zavarella (2008) found that students had access to tutoring only at the on-campus math lab; moreover, office hours were primarily offered on campus. Unsurprisingly, both services were poorly utilized by online students. As one student who withdrew from the online math class complained, "I could not get the support/help I needed!" (Zavarella, 2008, p. 85). Finally, while almost all campuses provide some type of technical support service for students, such services are not always open at the hours when students may be working online: A recent survey estimates that only 33% of two- and four-year institutions offer round-the-clock technical support (Green, 2010).

When institutions do not explicitly provide non-instructional supports for online students, instructors are forced to take on these support roles (Compora, 2003; Kinser, 2003), which is problematic for two interrelated reasons. First, instructors are not trained to be librarians, counselors, or technical support providers. Thus they are unlikely to provide students with the detailed, accurate, and timely responses that high-quality support services in these areas should provide. Second, to the extent that instructors attempt to provide these non-instructional services, they will necessarily spend less time on critical instructional responsibilities.

3.5 Online Completion Rates in Context

The conclusion that online courses have higher withdrawal rates than face-to-face courses does not imply that face-to-face courses are an ideal standard for comparison. Community college administrators estimate face-to-face course completion rates to be approximately 76% (Instructional Technology Council, 2010), which certainly leaves room for improvement. In his 1999 book, *Honored but Invisible*, Grubb pointed out that community college instructors are often instructionally isolated, with few resources and supports to help them systematically improve their teaching. More recent research suggests that this situation has changed little over the past decade (Grubb, 2010). Moreover, as detailed by other working papers in this series (particularly Scott-Clayton's [2011] paper on institutional complexity and Karp's [2011] paper on non-instructional support), institutions have much more work to do to support underprepared students—whether in online or in face-to-face courses—to succeed. Section 5.2 of the paper makes several recommendations to help institutions improve online completion rates. It is worth nothing that many of these recommendations apply to face-to-face coursework as well.

4. Low-Income and Underprepared Student Access

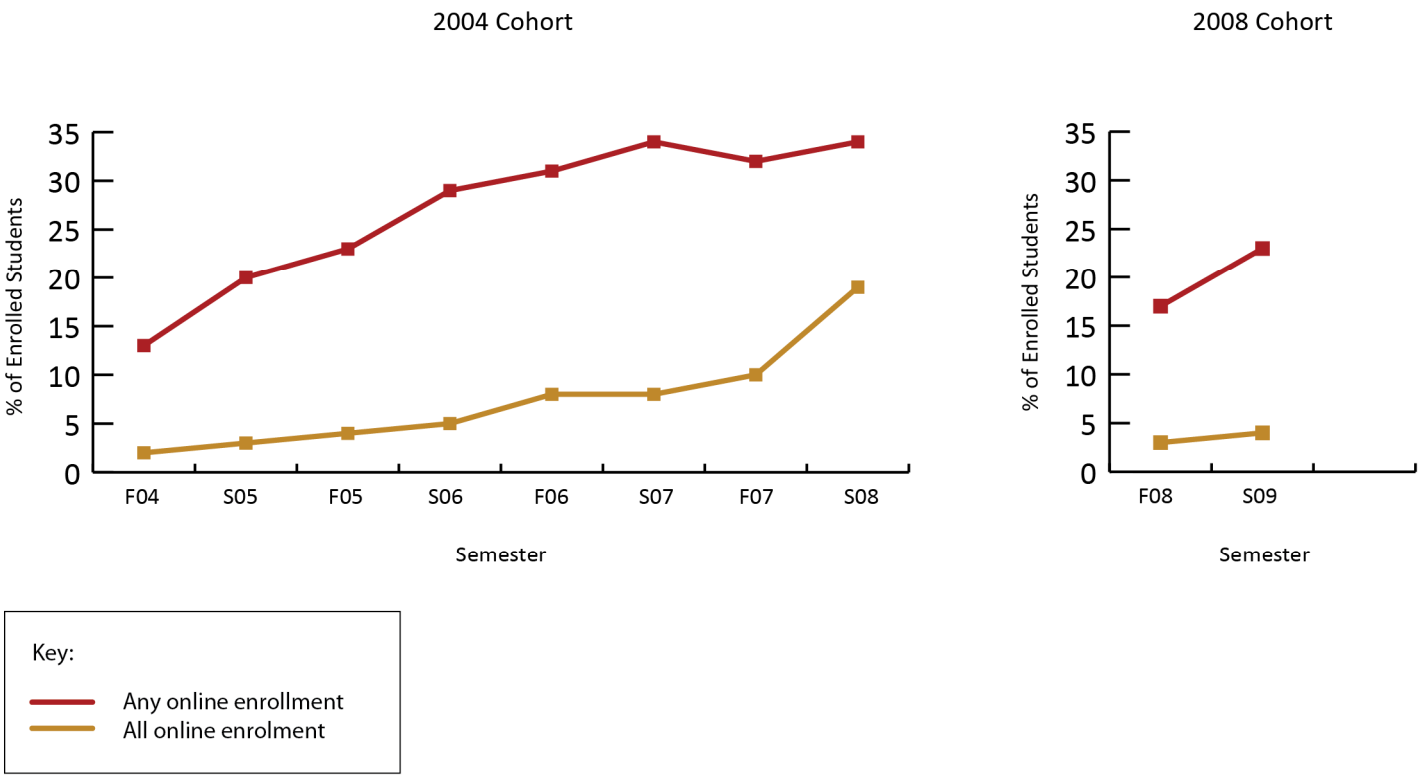
A primary assumption underpinning the increase in online course offerings is that they increase educational access (Allen & Seaman, 2010; Cox, 2005; Epper & Garn, 2003; Kuenzi, Skinner, & Smole, 2005; Parsad & Lewis, 2008). And indeed, there is no question that online learning improves access to college coursework on at least two fronts. First, in response to nearly every researcher who asks, students cite flexibility and convenience as primary advantages of online learning. These features make online courses particularly valuable to adults with multiple responsibilities and highly scheduled lives; thus, online learning can be a boon to workforce development, helping busy adults to return to school and complete additional education that otherwise could not fit into their daily routines. Second, online or hybrid modalities can allow colleges to offer additional courses or course sections to their students. A lack of available seats in key introductory courses can pose a barrier to student progression; freedom from the constraint of physical classroom space allows administrators to create as many course

sections as they can find qualified instructors for, which may lower the availability barrier. In addition, small colleges do not have the resources to offer certain highly-specialized courses to their students; an online partnership among institutions can allow these students to enroll in such courses via a partnering college. Finally, some colleges have leveraged the flexibility of online learning to redesign the nature of postsecondary education. Western Governors University's entirely-online competency-based programs provide a personalized and flexible education, allowing students to forgo formal courses and potentially accelerate their completion of a degree. The Indiana Wesleyan University College of Adult and Professional Studies uses a cohort model, in which "weekly online classes are organized to begin when cohorts fill" (Auguste, Cota, Jayaram, & Laboissière, 2010, p. 13), a strategy that is thought to contribute to the college's relatively high graduation rate.

Given the convenience and flexibility of online learning, there is little doubt that it has induced many adults to return to school, particularly among the well-prepared and relatively high-income adult population for whom online learning was originally designed and implemented in continuing education departments across the country. Yet it is unclear whether online learning has induced new college enrollments among the low-income population. This review found no studies focusing on low-income or underprepared populations and whether their postsecondary enrollment has expanded as a result of the past decade's explosion in online learning. Jaggars and Xu's (2010) analysis of online course data across 23 colleges in the Virginia Community College System, however, suggests that the availability of online courses does not necessarily induce new enrollment. As part of a larger analysis, my colleague and I first examined the course-taking behaviors of students who initially enrolled in the fall of 2004 (see Figure 2). That fall, 13% of these students enrolled in online courses, but only 2% took *all* their credits online. Over time, students who persisted in school were increasingly more likely to take online courses; by the spring of 2008, 34% of the remaining students took at least one course online, and 13% took all their credits online. Next, we examined students who initially enrolled in fall 2008, expecting their online course-taking to be at a similar or higher rate than was the 2004 cohort's spring 2008 numbers. Instead, we found that only 17% took any course online and only 3% took all their credits online. The low online

course-taking rates among new students suggest that online coursework was not a strong inducement for new students to enroll in college. Rather, ongoing students were more likely to take advantage of the flexibility of online learning.

Figure 2
Virginia Community College Online Enrollments, 2004 and 2008 Student Cohorts



Note. Calculated from Tables 3.1, 3.3, 6.7, and 6.9 of Jaggars & Xu (2010).

It may seem intuitive that online learning would encourage new college enrollments among low-income populations, who could take advantage of its flexibility to juggle school, work, and family responsibilities. And yet the realities of college access can be counterintuitive; for example, consider the case of Pell grants. Studies of the Pell grant program (Hansen, 1983; Kane, 1996) found that it had no impact on new college enrollments among low-income populations. As Scott-Clayton (2011) discusses in her paper in this series, financial aid researchers suspect that the complexity of the Pell eligibility and application process obscures its benefits and prevents the program from reaching the individuals who need it most. Similarly, several factors may discourage low-income young adults from leveraging the flexibility of online coursework as an entry point into college. First, in order to make an investment in college, some students may seek online *degree plans* rather than online *courses*, and the supply of online degrees is limited. Second, technological infrastructure may pose a significant barrier to low-income students. And third, online courses typically do not substantially lower cost barriers to college.

4.1 Online Courses Versus Online Degrees

Most institutions feel that making more courses available is an important reason to offer online learning. However, fewer feel that making more degree programs available (55%) or certificate programs available (34%) is an important factor, and only a third of institutions offer at least one degree program entirely online (Parsad & Lewis, 2008). Moreover, the range of degrees offered online is rather limited. For example, Western Governors University offers degrees in only four areas: Teacher Education, Business, IT, and Health Professions; and the range of majors within each degree is narrow. The University of Phoenix also offers a fairly narrow selection of online degrees.

There may be a variety of reasons why institutions feel that offering a wide range of online degrees is not an important strategy, but one of the strongest reasons may be cost-effectiveness. It is far more cost-effective to design and deploy a single course with thousands of student enrollments per year (although these may be divided among many different instructors and sections) than to design a course with a few student enrollments per year (Jung, 2003). Rumble (2003) observes that:

> For any given student population, the more courses on offer, the lower the average course population. However, students will rarely if ever be distributed equally across the courses. It is much more likely that in 80:20 rule will apply, with 80% of the students enrolled on something like 20% of the courses, so that one can expect a few courses have very high student populations and a large number to have relatively few students in them. Planners thus need to consider the likely student population on each course and bear this in mind in selecting the media to be used on each course. (p. 711)

That is, while large-enrollment courses may be deployed more cheaply online (although that is not a foregone conclusion; see Inglis, 2003; Jung, 2003; Rumble, 2003), small-enrollment courses may be deployed more cheaply face-to-face. Given that most degrees require a mixture of large-enrollment introductory courses and small-enrollment advanced courses, offering an entire degree plan online may be cost effective only if: (1) the institution has a wide geographical reach and large base of potential enrollees for the degree, as the University of Phoenix Online does; and (2) the institution offers a fairly limited range of highly-popular degrees online, such that even relatively small courses have large aggregate enrollments each year.

4.2 At-Home Technology Barriers

While the "digital divide" has perhaps disappeared in terms of overall Internet use, low-income households are still at a significant disadvantage in terms of the relatively sophisticated infrastructure required to participate in online learning. In 1999, the cost of an up-to-date computer was still a problem for 20% of community college students (Phillippe & Valiga, 2000).[6] In 2009, only 42% of households with incomes less than $30,000, 46% of adults who had at most a high school degree, 52% of African-Americans, and 47% of Hispanics had high-speed Internet access at home (Rainie, 2010). These numbers have not grown substantially since 2006 (cf. Rainie, Estabrook, & Witt, 2007). This may be because low-income groups, particularly African Americans,

[6] Although the cost of a computer has decreased in the last decade (Bureau of Labor Statistics, 2010), there is still reason to believe that many low-income students cannot afford an up-to-date computer: in a recent study (Fairlie & London, 2009), the simple treatment of providing at-home computers to community college students who were on financial aid resulted in increased academic success.

disproportionately access the Internet via handheld devices rather than through at-home broadband (Horrigan, 2009).

Students with outdated at-home computers or dial-up Internet access will experience agonizing delays when attempting to interact with most course delivery platforms. Those with insufficient infrastructure at home might go to a friend's house, an Internet café, the library,[7] or to a local satellite campus to work on an online course. (Anecdotally, administrators have reported to CCRC researchers that they see students drive to the college parking lot, where wireless is available, to do coursework with their laptop in the car.) Given the juggling of schedules, transportation, and costs associated with these various options, an online course may be no more convenient to these students than would be an evening or weekend course at the local community college. Indeed, one study in the Dallas Community College District suggests that night and weekend classes are preferred over distance classes by Hispanics, which represent a large proportion of the district's population (Borcoman, 2004).

4.3 Other Cost Barriers

When asked to choose from a list the option that would most help them return to school (Johnson & Rochkind, 2009), only 7% of college dropouts said that putting classes online would help the most—far below the proportion of those who selected cutting the cost of college by a quarter (25%), providing more loans (14%), or allowing part-time students to qualify for financial aid (13%). While online learning can help ameliorate access barriers in terms of scheduling and location and may reduce some transportation and child care costs, it does not reduce educational tuition and fees. These costs are a particularly substantial barrier for lower-income working adults, who often cannot qualify for financial aid (Chao, DeRocco, & Flynn, 2007).

Proponents of online learning have argued that it is more cost effective to institutions, and presumably those cost savings should trickle down to online students. However, it is far from established that offering online sections saves money to institutions (Campus Computing Project, 2009; Compora, 2003; Rumble, 2003), and some argue that online courses can only be designed and distributed more cheaply than

[7] Public library closures and budget cuts across the country are increasingly limiting the option of accessing the Internet for free at the local library (e.g., Brodsky, 2010).

face-to-face courses if their quality is sacrificed (Hanna, 2003; Maeroff, 2003). Even if online course provision is more cost effective for institutions, those savings are not currently passed to students; rather, 40% of community colleges charge students *additional* fees for online education (Instructional Technology Council, 2010).

5. Recommendations to Improve Access and Progression

5.1 Improving Low-Income Student Access

The following recommendations may help online learning fulfill the promise of expansion of access to postsecondary education for low-income and underprepared students.

Reduce direct costs to low-income students. In order for expanded online learning to translate to increased access, the cost to students must be dramatically reduced, both in terms of tuition and at-home technological infrastructure. For example, to implement an online workforce development program for low-income single mothers, program administrators provided students with an at-home computer, printer, Internet access, and skills training at no cost for a year (Gatta, 2005). To reduce student costs on a larger scale, initiatives to expand education through freely-available online courses may be a step in the right direction,[8] particularly if paired with a low-cost provision of high-speed Internet access and laptops to low-income students (for example, see Fairlie & London, 2009). However, it is not yet clear how quality instruction and effective student support services, discussed in more detail below, could be maintained in a tuition-free environment. In order to reduce students' out-of-pocket technology costs, some colleges have also experimented with techniques to cover these costs through financial aid. For example, if a high-speed Internet card is a course requirement, students may be able to purchase it at their campus bookstore using financial aid.

[8] For example, the Next Generation Learning Challenge, a collaborative partnership among Educause, the League for Innovation in the Community College, the International Association for K-12 Online Learning, and the Council of Chief State School Officers with funding from the Bill & Melinda Gates Foundation, is supporting the development of open courseware for a core set of common postsecondary courses. More information is available at http://nextgenlearning.com/the-challenges/open-core-courseware

Revise financial aid structures. Costs to students can also be decreased through changes to the financial aid structure. Chao, DeRocco, and Flynn (2007) recommend that Pell grant restrictions be loosened to allow year-round college attendance, no reduction in aid for attendees of low-tuition community colleges, and distance education programs leading to one-year or shorter certificate programs. Some states also place restrictions on financial aid for students in online degree programs, and perhaps it is time for these rules to be re-examined. Perhaps even more importantly, these potential cost decreases should be part of a legislative package that clarifies and simplifies eligibility rules, in order to encourage more low-income students to apply for grants in the first place (Dynarski & Scott-Clayton, 2006).

Create more fully-online programs. If community colleges and other institutions that predominantly serve low-income and underprepared students wish to draw new enrollees via online coursework, they may need to consider how to design and fund fully-online degree programs. For some institutions, cost-effective provision of an entire degree program may require a partnership with other schools or organizations that provide online learning. It is also imperative to gain faculty support, and in general, faculty will be hesitant to support a new online program unless they are confident of its quality and feel assured that students in the program have a chance of success equal to that of their face-to-face peers. That is, the institution's ability to expand access may be in part dependent on whether it can first solve the challenges of online course completion and progression.

5.2 Improving Online Completion and Progression

This review of the literature suggests that community college students are much less likely to complete online courses than face-to-face courses and also may be less likely to progress to subsequent courses after taking an online course. To improve student completion and progression, it is recommended that colleges:

Assess student ability to succeed. In order to reduce high online course withdrawal rates, many colleges recommend online courses only to students whom they feel are prepared to succeed in those courses (e.g., S. Y. Liu, Gomez, Khan, & Yen, 2007; Millward, 2008). These assessments should be used to communicate the expectations of online coursework and to improve students' self-awareness of how their

academic assets match (or do not match) the features and challenges of online learning. Similarly, some technology-related problems can be reduced by limiting enrollment to students who have the appropriate technology skills and at-home infrastructure. These measures, however, are not always effective, as they rely on student self-assessment (Millward, 2008). Moreover, they reduce online dropout simply by restricting the population of students who enroll in online courses, which could inadvertently undercut the institution's access agenda. Accordingly, it is recommended that in addition to the use of assessments and advisories, colleges also concentrate on improving the success of *all* students who choose to enroll online, using assessments to help inform the programming and supports discussed below.

Teach online learning skills. Colleges can assist students in building requisite skills prior to taking an online course, such as through a prerequisite computer literacy course (e.g., Erlich, Erlich-Philip, & Gal-Ezer, 2005). Such policies, however, have two potential drawbacks. First, if a computer literacy or similar course is merely recommended and not required, some students will ignore that recommendation. Second, if the recommendation is enforced as a requirement, it may inadvertently undercut access to online courses by discouraging students who feel they cannot spend time or money on an extra course. In order to support both access to *and* success in online courses, institutions could either: (1) provide incentives to students to build their skills prior to online course enrollment, for example, by offering reduced fees in subsequent online courses; or (2) provide struggling students with the scaffolding and supports they need within the framework of entry-level online courses.

Enhance non-instructional supports. To remove the burden of non-instructional support from the shoulders of instructors and improve the level of supports offered to students, colleges should more seriously consider how to provide high-quality and easy-to-access online learning supports. For example, Western Governors University online students work with a dedicated mentor throughout their college program, following an individually-tailored Academic Action Plan. Similarly, at the online community college Ivy Bridge College, each student is assigned a coach, who checks on the student's progress on a weekly basis (Moltz, 2011). University of Phoenix Online provides its online students with an online library, a math resource center, a writing resource center,

and a "graduation team" consisting of a finance advisor, enrollment advisor, and academic advisor.[9]

Most institutions cannot afford to provide online students with individual coaches who will provide guidance on a regular basis. And at first blush, it may also seem prohibitively expensive for institutions to provide a full range of round-the-clock support services to its online students. However, in their respective papers in this series, Scott-Clayton (2011) and Karp (2011) discuss promising solutions to this quandary. Applying their discussions to this particular issue, I would make three suggestions.

First, in order for students to use support services, they must be seamlessly integrated into the spaces in which students already live and work (Neal & Jaggars, 2010). At a minimum, links to traditional on-campus support services should be displayed prominently on the course's web interface, with information about how students can access these services via e-mail, chat, or telephone. Students will be even more likely to take advantage of support services if they are explicitly incorporated into class activities. For example, in an online introductory history class, the instructor could require students to consult with the writing center on the course's first writing assignment. To make this vision a reality, campus administrators would need to orchestrate collaboration between support providers and academic departments, with the aim of creating a set of support-oriented academic activities that would be systematically built into the curricula of the most common introductory courses taught online.

Second, with assistance from practitioners and researchers who can help identify the most important components and characteristics of non-academic support, stakeholders in the field should design and test automated systems that could dynamically provide those key components, without the need for round-the-clock human staffing. Unusual problems could then be handled by well-trained support staff during regular working hours.

Third, to cost-effectively expand service availability (whether through an extension of traditional service hours or through the provision of a sophisticated dynamic

[9] Of course, such supports are not inexpensive. Like most private for-profit institutions (Bailey, 2006), the University of Phoenix charges substantially higher tuition than public two-year institutions, and it also charges higher tuition for online than on-ground courses, presumably to maintain their wrap-around support services (University of Phoenix, n.d).

online system), colleges should consider partnering with other institutions or organizations to capitalize on economies of scale, providing a single set of support systems to multiple campuses. Of course, this option is feasible only if the set of partnering institutions is willing to agree on a consistent set of systems; for example, campuses would need to share the same web-based platform (for technical support), course numbering and program requirements (for course selection support), course curricula (for tutoring support), and information resource systems (for library support), and would also need to share policies in certain areas (for example, guidelines for appropriate writing-center support). Accordingly, the shared-support strategy may be most feasible within large districts or state systems wherein all colleges share similar infrastructures and policies. Creating consistent infrastructure and supports across a state or district would also reduce confusion and support needs among students who take courses from multiple colleges.

Enhance instructional supports. To overcome the social distance inherent in distance learning, engaging students and motivating them to succeed in the class, it is recommended that colleges:

Intentionally design online courses. To create consistently high online retention rates, instructors may need to spend substantial amounts of time designing and implementing "scaffolding" activities, moderating discussion, and encouraging struggling students. As face-to-face courses are translated into online courses, these elements need to be explicitly built into the course. The support of instructional technology professionals is key in building effective online courses; however, course design should not be relegated entirely to individuals who will not be teaching the course. Koehler and colleagues (Koehler, Mishra, Hershey, & Peruski, 2004) argue persuasively that in order to appropriately marry content, technology, and pedagogy, instructors need to be integral to course design. Moreover, course designers should be aware that simply adding technical bells and whistles (such as embedded video or online quizzes) to online courses is unlikely to result in improved student outcomes (U.S. Department of Education, 2009). Such tools will be effective only to the extent that they promote mechanisms that may be important to student retention and learning, such as enriching interaction (Bernard et al., 2009), helping students reflect on their own learning (U.S. Department of Education,

2009), or improving system knowledge and self-efficacy (Hannafin et al., 2003). For example, as Grubb (2010) points out, many computer-based tutoring programs are based on "the dismal practices of remedial pedagogy" (p. 28); before incorporating computer-based tutoring into an online course, then, course designers need to carefully evaluate the quality of the program's pedagogical design.[10]

Support faculty development. To provide high-quality curricula and instruction, faculty need strong support from the institution. Well-regarded online courses are often designed through a team-based approach, with faculty collaborating with an instructional designer, and often with additional support staff (e.g., Alvarez, Blair, Monske, & Wolf, 2005; Hawkes & Coldeway, 2002; Hixon, 2008; Knowles & Kalata, 2007; Puzziferro & Shelton, 2008; Thille, 2008; Xu & Morris, 2007). Yet CCRC's national field study of 15 community colleges (Cox, 2006) found that most faculty were left to design online courses on their own and that training for online instructors was primarily focused on technical aspects of the online course management system. None of the colleges offered faculty the degree of expert support they needed to redesign curricula and pedagogical strategies for the online context. Worse, some institutions had policies that actively undercut faculty engagement in online learning, such as not counting online courses as part of a normal teaching load, or enrolling twice the number of students in online as compared to face-to-face sections. As a result, one college's online coordinator said:

> Probably the same range of practices that we have in our face-to-face courses is being replicated online, when that might have been an opportunity not just to teach people technology, but to have them think about engaging students and what kinds of things you can do better online, rather than just post your lecture, or whatever it is that might be happening. (p. 125)

Similarly, a recent survey of community college English teachers (Millward, 2008) found that while most colleges offer training to online instructors, faculty were dissatisfied with the training programs' focus on technology rather than pedagogy. Moreover, 43% indicated that they received no compensation for the time they spent on training. Overall, the survey found, as Millward summarizes, that online instructors "are

[10] For more on pedagogical elements that may improve student learning, see working papers in this series by Hodara (2011) and Perin (2011).

asking for more access, more training, more time for innovation and implementation, and more research."

Koehler et al.'s (2004) study illustrates a relatively cost-effective way to engage instructors in online course development: Faculty enrolled in a semester-long educational technology course, in which they designed a new online course in concert with two graduate students. The faculty received a new laptop and a $1,000 stipend for course development, but received no course buyout or overload pay. Anecdotally, some community colleges require faculty to participate in intensive online course development and pedagogical training before they are considered qualified to teach online. These approaches seem promising, although as yet there is no solid evidence as to their effectiveness.

Engage in continuous improvement efforts. As Jenkins (2011) discusses in his paper in this series, an institution is unlikely to substantially improve student success unless it engages in a systematic long-term improvement process. It may not always be clear exactly which instructional designs, practices, and supports will improve online student success at a given institution. However, institutions can begin to identify and refine successful practices through a process of continuous quality improvement. Dietz-Uhler and colleagues (Dietz-Uhler, Fisher, & Han, 2007–2008) provide one example of how to begin such a process using the well-known Quality Matters framework. Like other online quality frameworks (see Parker, 2004), Quality Matters offers a set of general guidelines and principles, but does not specify exactly what institutions or instructors should do to meet those guidelines. Through a careful approach of peer review, outcome measurement, and subsequent adjustments, departments and colleges can begin to develop specific practices to meet quality guidelines and improve student outcomes. In this process, institutions may wish to supplement general quality guidelines with measurements that are more specific to instruction and online interaction. For example, the American Public University System engages in continuous quality improvement of its online courses using a course-based student survey built on the Community of Inquiry framework (see Boston et al., 2009; Arbaugh et al., 2008; Ice, 2009). Using survey outcomes, the system identifies programs and instructors with significantly higher scores and examines their work for innovative or exemplary practices that could potentially be

implemented by lower-scoring programs and instructors. Perhaps most importantly, program directors review individual faculty outcomes with each instructor, constructively discuss potential ways to improve scores, and incorporate these reports into quarterly audits. Finally, in addition to assessing quality through peer review and student surveys, it will be most helpful for departments to set ambitious standards for course learning outcomes and to continuously assess and improve the extent to which students meet these outcomes (Jenkins, 2011).

Of course, a quality improvement process should not be limited to online courses alone. Face-to-face courses would also benefit from continuous assessment and revision. Online program administrators, however, may have an advantage in terms of pushing a continuous improvement agenda for two reasons. First, online learning is relatively new to many faculty, and their experience with it is still evolving. Moreover, according to a recent survey (Green, 2010), a vast majority of colleges have either recently completed or expect to soon implement a reorganization of online learning. It may be more politically viable to introduce a new quality improvement approach within the still-shifting context of online learning than within the relatively traditional context of face-to-face learning. And second, online course management systems offer the possibility of far more advanced learner analytics than is possible in face-to-face learning, and these sophisticated data might feed more readily into a continuous improvement approach. For example, the Open Learning Initiative captures transactional data on all student learning activities and uses the resulting data to revise each course for the following semester (Thille, 2008).

Conduct further research. In order to provide institutions and individual faculty with more specific research-based guidance on how to improve online success rates, foundations and governmental organizations should also:

Fund research to clearly define key elements of quality instruction. Despite suggestive themes from theory and research, the specific characteristics and measurements of "high-quality curricula and pedagogy" remain elusive. The research literature lacks a consistent set of measurements and definitions for assessing curricular and pedagogical elements of online coursework (see Kirschner, Strijbos, Kreijns, & Beers, 2004; Strijbos, Martens, Prins, & Jochems, 2006). As a result, studies tend to

focus on elements that are easy to measure. For example, many studies of online interaction focus on frequency of interaction, rather than on the quality of that interaction (Hull & Saxon, 2009). Similarly, many studies compare learning outcomes between a group that used a specific technological tool meant to facilitate interaction versus a group that did not use it (i.e., a measurement of "tool versus no tool"), without measuring the patterns of instructor and student behaviors evoked by the tool (for a review, see Bernard et al., 2009). If researchers do not have consistent definitions for elements of interaction and other key instructor and student behaviors across studies, they cannot explain why particular tools or strategies seem effective or ineffective, nor can they extrapolate to create guidelines for designing more effective instruction.

Foster collaborative research activities. To move forward, practitioners and researchers need to work closely together. Practitioners can begin by developing online curricular and pedagogical interventions that are well grounded in theory. For example, Strijbos and colleagues (Strijbos, Marten, & Jochems, 2004) use theoretical principles of group communication to set forth a framework for designing computer-supported group-based learning activities. Their framework does not specify how a given activity should be structured, but instead provides a basis for clearly and consistently measuring the elements of that structure, as well as how the structure impacts changes in group interaction. Researchers can then subject these well-measured and clearly-understood elements to rigorous empirical testing in terms of their impact on student retention and learning. In addition, qualitative research that examines not only online student engagement and motivation (e.g., Bambara et al., 2009) but also how specific curricular and pedagogical elements affect those psychological constructs may be particularly helpful in terms of guiding course design.

6. Conclusion

Online learning affords flexibility and convenience to students and also allows institutions to be more flexible in their approach to education, in both narrow ways (e.g., offering more sections of course than can be accommodated by the college's physical classroom space) and very broad ways (e.g., enrolling new students each month into

competency-based programs, à la Western Governors University). Yet students also encounter challenges in online coursework as it is typically implemented—including technical difficulties, a sense of isolation, a relative lack of structure, and a general lack of support—that may contribute to low completion rates, particularly among community college students. To help ameliorate these problems while still allowing for increased flexibility, some educators advocate the expansion of hybrid coursework, which is thought to provide students with the "best of both worlds." For example, most courses redesigned under the National Center for Academic Transformation process are modified to become hybrid courses or technology-assisted face-to-face courses, rather than to become online courses (Twigg, 2003). Unlike online courses, however, hybrid courses do not offer complete freedom from geographic and temporal constraint, and thus do not hold out the same promise for dramatically improved access to postsecondary education. Accordingly, online learning has an important role in community college education—a role that will likely continue to grow in scope and consequence.

In order for online learning to meet its promise of improving postsecondary access and success among low-income and underprepared students, this paper recommends a two-pronged strategy of practical investments and research investments. In terms of policy and practice, this paper recommends reducing the cost of online learning by offering low-cost computers and high-speed Internet to aspiring students; restructuring financial aid to allow students to pay for the remaining costs of enrollment; providing integrated and high-quality non-instructional supports into the online course management system; providing online instructors with the resources and training they need to implement high-quality online curricula and pedagogies; and implementing peer-review-driven continuous quality improvement processes.

In terms of research, we need more information on how online learning can improve low-income student access, as well as the extent to which new policies and practices to reduce the cost of online education could further improve access. Further, researchers need to work to isolate the key elements and mechanisms of effective non-instructional supports, and to identify the instructional behaviors and activities that encourage student engagement, motivation, retention, and learning. To accomplish this end, foundations and governmental research organizations will need to strongly promote

and support the creation of theoretically-driven frameworks and research designs that make use of clear and consistent measures of student and instructor behavior and that explicitly link those patterns to student academic outcomes.

Many of these recommendations will require a substantial investment of new resources into online learning. There is still very little concrete information as to the real cost-effectiveness of online coursework under the current set of practices; there is also very little information on whether online learning can provide savings to institutions without compromising student success. Further research in this important area is certainly needed. It is clear, however, that in order improve the output of online courses, it is necessary to improve the inputs into the system, which may threaten current cost models for online education. Thus, any substantial improvements to the effectiveness of online learning may require new cost models, designed in collaboration among educational foundations, state and federal government, and college systems.

Appendix

Table 1
Summary of Studies

First Author (Year)	Study Design	Controls	Online Course Characteristics & Sample Size	Outcomes Examined	Summary of Findings
Blackner (2000)	Comparison using controls (regression)	Math anxiety, locus of control, learning style	Community college developmental math courses (N = 42)[a]	Completion, exam score, course grade	Grades similar but online withdrawal rates higher
Block (2008)	Comparison of gain scores	None	University health & wellness course (N = 19)[h]	Exam score	Gain scores similar
Brown (2002)	Comparison using controls (regression)	Female, Black, math coursetaking, ACT score, GPA, previous credits	University microeconomics course (N = 89)[g]	Exam score	Online exam scores lower
Caldwell (2006)	Randomized	None	Historically Black university, introductory C++ course (N = 20)[b]	Assignment & exam scores	Assignment & exam scores were similar
Carey (2001)	Comparison of gain scores	None	University management information systems course (N = 103)[a, h]	Exam score	Gain scores similar (did not take into account observed higher online withdrawal rates)
Carpenter (2004)	Comparison using controls (regression)	Gender, ethnicity, registration timing (late vs. early), credit load, age, placement exam scores	Community college developmental writing course (N = 256)[x]	Completion, Course grade	Online withdrawal rates higher; but among those who completed, online grades higher
Coates (2004)	Comparison using controls (regression)	30 controls (e.g., SAT, hours employed, commuting time to campus, age, pre-test, major)	University economics, 3 courses (N = 59)[b (course 2), d (course 1)]	Exam score	Online exam scores lower
Dutton (2001)	Comparison using controls (regression)	Undergraduate status, homework grades	University C++ course (N = 141)[e, h]	Completion, exam score, course grade	Completion similar; online exam scores & course grades higher
Dutton (2002)	Comparison using controls (regression)	Homework grade, undergraduate status, experience with computing, employment, age, commuting time, has childcare responsibilities, female, hours enrolled	University C++ course (N = 89)[e, h]	Completion, exam score, course grade	Completion, course grades similar; online exam scores higher
Dutton (2005)	Comparison using controls (regression)	Prior GPA, homework grade, commuting time, computer experience, female (learning outcomes); prior GPA (completion)	University business statistics course (N = 48)[a, h]	Completion, exam score, course grade	Completion similar; online exam scores & course grades higher

First Author (Year)	Study Design	Controls	Online Course Characteristics & Sample Size	Outcomes Examined	Summary of Findings
Ferguson (2009)	Comparison using controls (ANCOVA)	GRE scores	Graduate education course (*N* = 44)[x]	Assignment scores, exam score	First assignment scores similar; online second assignment scores lower; online final exam scores lower
Figlio (2010)	Randomized (from a pool of volunteers)	Ethnicity, gender, prior GPA (one at a time)	University microeconomics course (*N* = 215)[g]	Exam scores	Exam scores similar overall, but online exam scores lower among Hispanics, males, and low-prior-GPA students
Grayson (2001)	Comparison using controls (ANCOVA)	Prior grades, learning style	University critical reasoning course (*N* = 35)[b]	Participation scores, assignment & exam scores, course grade	Online students' participation scores lower, online course grade marginally lower, other outcomes similar
Herman (2004)	Comparison using controls (ANCOVA)	Prior GPA, pretest	University computer basics course (*N* =18)[h, f]	Exam score, course grade	Similar exam scores (using both controls); online course grade higher (using only GPA control)
Jaggars (2010)*	Comparison using controls (multilevel regression)	20 controls (e.g., age, female, ethnicity, ESL student, financial aid eligibility, credit load, prior GPA)	Community college courses (2004 cohort *N* = 10,244; 2008 *N* = 7,665)[x]	Completion, retention, transfer/graduation	Online completion rates, next-semester retention, and eventual graduation/senior-college transfer rates lower
Mentzer (2007)	Randomized (from a small pool of volunteers)	None	University education course (*N* = 18)[c, d]	Exam scores, course grade	Similar exam scores; online course grades lower
Musgrove (2002), study 1	Comparison using controls (ANOVA)	Learning style	Community college nursing courses (*N* = 65)[a]	Course grade	Course grades similar
Musgrove (2002), study 2	Comparison using controls (ANOVA)	Group embedded figures test	Community college nursing courses (*N* = 53)[a]	Course grade	Course grades similar
Navarro (2000)	Comparison using controls (ANCOVA)	Prior GPA, gender, ethnicity, class level, major (one at a time)	University macroeconomics (*N* = 49)[a, g]	Exam score	Online exam scores higher
Parkhurst (2008)	Comparison of gain scores	None	University engineering (*N* = 84)[c, g]	Exam score	Online gain scores higher
Partrich (2003)	Comparison using controls (ANOVA)	Learning style	Graduate theology courses (*N* = 62)[x]	Course grade	Course grades similar
Peterson (2004)	Comparison using controls (ANOVA)	Pretest	Graduate education courses (*N* = 38)[b, d, i]	Project grades	Project grades similar

First Author (Year)	Study Design	Controls	Online Course Characteristics & Sample Size	Outcomes Examined	Summary of Findings
Piccoli (2001)	Randomized	Gender, instructor	University management information systems course (*N* = 94)[a, f]	Exam scores	Exam scores similar (did not take into account seemingly higher online withdrawal rates)
Poirier (2004)	Randomized (from a small pool of volunteers)	None	University psychology course (*N* = 12)[b, h]	Assignment & exam scores	Online exam scores (4 exams over entire semester) higher; assignment scores similar
Rosenfeld (2005)	Comparison using controls (ANOVA)	Course subject, age, race, gender, previous credits accrued (one at a time)	Community college English, math, history courses (*N* = 402)	Completion (with C or better)	Online completion rates lower
Ross (2000)	Comparison using controls (ANCOVA)	Pretest, cognitive learning style	University 'law and disability' course (*N* = 36)[g]	Exam score	Online exam scores higher
Sankaran (2001)	Comparison within each level of each control	Learning strategy, general motivation (one at a time)	University accelerated (4-week) business computer course (*N* = 46)[x]	Exam score	Similar exam scores
Scheines (2005), Study 1	Randomized (from volunteers wanting online course)	Pretest	University critical reasoning course (*N* unclear, approx. 60, or 180/3)[e, h]	Exam scores, discussion attendance	Similar exam scores (controlling for pretest); online discussion attendance lower (no control)
Scheines (2005), Study 2	Randomized (from volunteers wanting online course)	Pretest	University critical reasoning course (*N* unclear, approx 43, or 130/3)[e, h]	Exam scores, discussion attendance	Similar exam scores (controlling for pretest); online discussion attendance lower (no control)
Schoenfeld-Tacher (2001)	Comparison using controls (ANCOVA)	Pretest	University science course (*N* = 11)[e]	Exam scores	Online exam scores higher
Summerlin (2003)	Comparison using controls (regression)	Reading ability, age, gender, ethnicity	Community college developmental math course (*N* = 79)[a, f]	Exam score	Similar exam score (did not take into account higher online withdrawal rates)
Vroedingay (2005)	Comparison using controls (ANOVA)	Gender, marital status, child & employment information, highest education level, proficiency scores (one at a time)	Private for-profit college environmental science course (*N* = 80)[b,h]	Exam score, course grade	Similar exam score, similar course grades
Wang (2004)	Comparison using controls (ANOVA)	Pretest, learning style	Graduate education courses (*N* = 31)[x]	Exam score	Similar exam scores
Waschull (2001), Study 2	Randomized	None	Community college psychology course (*N* = 18)[h]	Completion, exam scores	Completion, exam scores similar

First Author (Year)	Study Design	Controls	Online Course Characteristics & Sample Size	Outcomes Examined	Summary of Findings
Xu (2010)	Comparison using controls (multilevel regression/PSM)	22 controls (e.g., age, female, ethnicity, ESL student, financial aid eligibility, credit load, prior GPA)	Community college 'gatekeeper' English course (*N* = 1,052)[x]	Completion, course grade	Online completion rates and course grades lower
Zavarella (2008)	Comparison using controls (regression)	Age, gender, ethnicity, marital status, learning style, reason for format choice, placement exam score	Community college developmental math course (*N* = 56)[a, f]	Completion	Online completion rates lower

Notes. "Controls" refers only to those used when analyzing the outcomes examined in this table. Stratification variables included in the analysis of an outcome are considered equivalent to controls. "Sample size" refers to the N of the online group. Some studies analyzed more outcomes than those listed here. The table includes access, completion, performance, and progression outcomes that were compared either between randomized groups, or between groups taking into account at least one control variable. Comparison of gain scores from pre- to post-test is considered equivalent to a comparison of post-test while controlling for pre-test. Each superscript *a* though *i* is omitted if it was not explicitly noted in the study's description of the online course(s). For example, if a study's authors note that asynchronous discussion was provided as part of the online course platform, but do *not* explicitly note that participation was a course requirement, superscript *b* is omitted.
*Jaggars & Xu (2010).
[a] Initial face-to-face session required. [b]Asynchronous discussion participation required. [c]Synchronous discussion participation required. [d]Student collaboration/ group work required. [e]"Virtual laboratory" incorporated in online courseware. [f]Tutorial software was primary teaching tool. [g]Video/audio of lectures was primary teaching tool. [h]Text-based or slideshow-based material was primary teaching tool (some supplemented with video/audio clips). [i]Course explicitly designed to meet specific quality standards. [x]No relevant information provided.

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