Online Credit Recovery and the Path to On-Time High School Graduation

Jordan Rickles[1], Jessica B. Heppen[1], Elaine Allensworth[2], Nicholas Sorensen[1], and Kirk Walters[1]

Many high schools use online courses to allow students to retake failed classes in an effort to help get students back on track and graduate. However, there is limited evidence available on the effectiveness of online credit recovery in improving students' long-term outcomes compared with traditional face-to-face credit recovery courses. In this paper, we examine longer term outcomes for ninth graders who failed Algebra I and were randomly assigned to an online or face-to-face algebra credit recovery course. In particular, we look at math credits earned through four years of high school and rates of on-time graduation. We find no statistically significant differences in longer term outcomes between students in the online and face-to-face courses. Implications of these null findings are discussed.

Keywords: at-risk students; experimental design; high schools; instructional technologies; mathematics education

Despite high school graduation rates reaching an all-time high of 83% in 2014–2015 (The White House, Office of the Press Secretary, 2016), nearly one in five students still fails to earn a diploma, and geographic, racial/ethnic, and economic gaps persist. For example, while about 88% of White high school students graduate within four years, only 75% of Black and 78% of Hispanic high school students graduate on time (The White House, Office of the Press Secretary, 2016). The individual and collective costs of not completing high school are well documented. For example, a high school dropout is estimated to miss out on about $133,700 of lost wages over his or her lifetime (Alliance for Excellent Education, 2011), and dropouts cost the nation billions in public health, crime and justice, and public assistance (Levin, Belfield, Muennig, & Rouse, 2007).

The path to graduation can be arduous for many students, and failing core academic courses during the first year of high school is a strong signal of trouble to come. Research indicates that academic performance in core courses during the first year of high school is the strongest predictor of eventual graduation (Allensworth & Easton, 2005, 2007). The stakes for students who fail courses have become even higher as districts around the country adopt college and career readiness standards and more rigorous high school graduation requirements. Students who fail key academic courses need effective opportunities to learn the content they did not master the first time around and recover credits required for graduation.

Many states, districts, and schools use online courses to allow students to retake failed classes in an effort to help get students back on track and keep them in school (Powell, Roberts, & Patrick, 2015). Schools and districts report that they perceive online courses to be a flexible and cost-effective option for credit recovery (Picciano & Seaman, 2009), whether they are offered during the regular school day or at other times during the school year. Proponents of online learning contend that online courses are a convenient, flexible, and effective way to broaden access to opportunities to retake failed courses. For students who have failed a course, an online course may offer another chance to learn the content in a different format and with a potentially more individualized approach (Archambault et al., 2010).

With these promises in mind, district and school practitioners generally believe that expanding credit recovery options through online courses can help more students get back on track toward graduation (e.g., Atkins, Brown, & Hammond, 2007; Gemin, Pape, Vashaw, & Watson, 2015). As a result, states and districts are investing significant resources to offer online credit recovery courses. As the *Los Angeles Times* Editorial Board observed in an editorial published in June 2016, "[Online credit recovery] courses, which have helped boost graduation rates locally and across the country, have grown quickly from a barely

[1]American Institutes for Research, Washington, DC
[2]University of Chicago Consortium on School Research, Chicago, IL

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known concept a decade ago to one of the biggest and most controversial new trends in education."

Despite the belief that online courses can and have boosted graduation rates, there is limited evidence available to show whether online credit recovery is as effective, or even more effective, for improving students' long-term outcomes as traditional face-to-face credit recovery courses. The only rigorous evaluation of an online credit recovery course to date found that in the short term, students are better off recovering credit in a traditional face-to-face (f2f) course than in an online course (Heppen et al., 2017). No studies, however, have sought to determine whether there are longer term differences (e.g., improved graduation rates) in outcomes among students who used online credit recovery versus a f2f class. Without evidence of online credit recovery's effects over a student's high school career, it is not possible to determine whether the short-term effects persist or fade out (Bailey, Duncan, Odgers, & Yu, 2017) or whether there are delayed effects that are not captured in the short-run analyses.

In this paper, we extend the Heppen et al. (2017) study to compare longer term outcomes, including graduation, for students in online and f2f credit recovery. In the sections that follow, we review what is currently known about online credit recovery, including the short-term evidence from the Heppen et al. randomized controlled trial (RCT) comparing an online and f2f course in Algebra I. We then present new evidence from the same study about longer term outcomes, including total math credits earned through four years of high school and rates of on-time graduation.

Background

Online Courses and Credit Recovery

Over the past decade, online learning has expanded rapidly in secondary schools around the country (Greaves & Hayes, 2008; Picciano & Seaman, 2009). Yet online courses are delivered in varying formats. Some are fully online and completely self-paced; others are hybrid or blended models that combine online learning with f2f teacher support (Staker & Horn, 2012; Watson & Ryan, 2006).

Among school districts, providing credit recovery options is the most often cited reason for the use of online courses (Queen & Lewis, 2011). The promise of online courses for credit recovery lies in features afforded by the technology that may meet the specific needs of academically at-risk students who failed a previous attempt at the course. These features may include diagnostic assessments to "personalize" content to match a student's ability level; simulations, animations, and interactive tools to promote engagement and support learning; and flexibility that allows students to progress through course material at their own learning pace (Archambault et al., 2010; Bakia et al., 2013; Blackboard K–12, 2009; Dynarski et al., 2008; Kemple, Herlihy, & Smith, 2005; Mayer, 2011; Mayer & Moreno, 2003; U.S. Department of Education, 2009). In practice, the specific combination and quality of features can differ widely from model to model.

Although many espouse online courses for credit recovery and online courses are used for credit recovery throughout the country (Gemin et al., 2015; Queen & Lewis, 2011), rigorous evidence about the effectiveness of online courses for credit recovery is lacking. Almost all research on online learning focuses on postsecondary or professional learning. For example, a meta-analysis by Means, Toyama, Murphy, and Bakia (2013) reviewed 45 experimental, quasi-experimental, and crossover design studies of online and blended learning. On average, Means et al. found that purely online instruction yielded equivalient effects relative to f2f instruction. However, only 7 of the 45 studies examined K–12 education, and none of these studies examined online courses used for credit recovery.

Research specifically about online credit recovery for high school students is mostly descriptive. Some studies focused on the widespread use of online credit recovery (Clements, Pazzaglia, & Zweig, 2015; Clements, Stafford, Pazzaglia, & Jacobs, 2015) and described the different ways high schools implement online learning for credit recovery (Frazelle, 2016). Other studies examined the passing rates of students who enrolled in online credit recovery courses (Stevens & Frazelle, 2016) or compared the academic outcomes of students who recover course credit through online or traditional f2f courses (Hughes, Zhou, & Petscher, 2015; Levine, Johnson, Malave, & Santaniello, 2017; Stallings et al., 2016). A recent report describing online credit recovery programs in 24 Massachusetts high schools acknowledged the potential benefits online learning may offer students who need to recover course credit—including accessing the course outside of the regular school day or covering only material they failed previously—while at the same time noting the wide array of socio-emotional, behavioral, and academic supports students with prior academic struggles may need to be successful (Levine et al., 2017).

A Randomized Controlled Trial of Online Versus F2F Credit Recovery in Algebra I

The Heppen et al. (2017) study comparing online and f2f credit recovery for Algebra I in the Chicago Public Schools (CPS) is the only experimental study of online credit recovery to date. The study included 1,224 students who failed second-semester Algebra I in their first year of high school and sought to recover the credit over the summer (in 2011 or 2012). Within 17 schools, students were randomly assigned to recover the Algebra I course credit in an online course (treatment) or f2f course (control). Both courses were offered in a summer session lasting three to four weeks and a total of 60 classroom hours for the one-semester course.[1] The study focused on second-semester Algebra I because it has one of the highest failure rates among ninth graders and covers content students typically need to master to succeed in other courses in math (e.g., Algebra II) and science (e.g., physics).

The online course was provided by Aventa Learning/K12 (Aventa), which is now FuelEducation. At the time of the study, Aventa operated online courses in every state, and its Algebra I credit recovery course was used in an estimated 500 schools. The Aventa course offered in the study was designed for students to take at school in a supervised setting. The course included Aventa's complete Algebra I (second semester) curriculum, Web-based course software, and an online teacher hired and trained by Aventa. The online teacher could communicate individually

Table 1
Comparison of Key Features in the Online and Face-to-Face (f2f) Courses

Feature	Online Course	Face-to-Face Course
Mode of delivery	Online, with some f2f support: different from what students experienced when they took (and failed) the course the first time	F2f: same format students experienced when they took the course the first time
Presentation of material	Digital, interactive, and graphically rich: standardized across classes	Teacher-created (e.g., writing on whiteboard or creating a handout) or teacher-selected (e.g., textbook or other published printed materials): varied across classes
Content	Second-semester Algebra I: standardized across classes	Second-semester Algebra I, with leeway to cover other math content: varied across classes
Sequencing and coherence	Traditional ordering of second-semester Algebra I topics within and across units: some flexibility in how students progressed through topics but strongly encouraged to move sequentially	Depended on teacher-created curriculum: varied across classes
Pacing and progression	Individually paced: students able to spend as much time as they need on a particular topic; progression based on mastery	Whole-class progression: class moved through the same set of course topics as a group and at the same pace; progression not necessarily based on mastery
Staffing intensity	Two adults: (1) online teacher certified to teach secondary math and (2) in-class mentor to provide technical support, behavior monitoring, proctoring, and optional instructional support (math certification not required)	One adult (secondary math certified)
Communication	Primarily asynchronous for online teacher and student; some synchronous student-to-student options	Synchronous
Grading procedures	In-class mentors translated student's online test scores into final grades; mentor had some discretion (e.g., incorporating student behavior)	Teacher determined grading criteria (tests, quizzes, participation, behavior, etc.)

with students through the learning management system, online chats, and online "whiteboard" demonstrations. Most of the communication was asynchronous, meaning that online teachers and students were not necessarily online at the same time. However, the online course also had a platform that allowed teachers to talk to students and students to talk to other students in real time.

Students in the online course sections also had an in-class mentor, which is recommended and strongly encouraged by many online course providers (Stewart, Goodson, Miertschin, Norwood, & Ezell, 2013). Mentor responsibilities included helping students navigate the curriculum, proctoring online assessments, troubleshooting technological issues, and communicating with online teachers about students' progress. Although certified mathematics teachers could serve as online mentors, this was not required by Aventa. For the study, the participating schools identified staff to serve as in-class mentors. On average, the mentors in the study had 13 years of teaching experience, and 53% were certified to teach mathematics. Aventa provided training to the mentors on how to use the online course, monitor student progress, and communicate with the online teachers.

The f2f classes were taught by district teachers who were certified to teach high school mathematics. Unlike the online classes, which shared a common curriculum, teachers in the f2f classes had discretion about what to teach and how to teach it. Because the f2f course had only one in-class teacher and the online course had both an in-class mentor (paid the same rate as the f2f teacher) and the cost of Aventa, offering the f2f course actually cost less than the online course. This is in contrast to the common perception that online courses are a cheaper alternative to traditional f2f courses.

Table 1 outlines the key features of the online course tested in the study compared to the f2f course. The contrast between the online course and the f2f course tested in this study is about more than just the mode of delivery. Rather, the study is about the comparison between the bundle of features facilitated by implementation of the online course versus the f2f course, which includes aspects of the course that may not necessarily be associated with online instruction (e.g., content coverage and grading procedures). In addition, teacher quality may differ between the online and f2f courses. The study was designed so that the two types of courses were implemented under natural conditions, including using teachers typically teaching the online course and using teachers schools would typically employ for summer credit recovery. Both the Aventa online teacher and the school's f2f teachers were certified to teach Algebra I, but the online teacher had, on average, 5 years of teaching experience compared to 14 years for the f2f teachers. As mentioned earlier, the in-class mentors had, on average, 13 years of teaching experience, and about half were certified to teach math. Because the online and f2f conditions encompass more than just the mode of delivery, one cannot directly attribute effects of the online course to just online instruction or any single feature that goes into implementing the online course.

Heppen et al. (2017) found that by the end of the course, students who were randomly assigned to the online summer credit recovery course fared worse than students assigned to the f2f course. Students in the online course were significantly less likely to pass and thereby earn the Algebra I credit than students in the f2f course (66% vs. 76%; $p < .001$). Students in the online course also had significantly lower scores on an end-of-course algebra assessment ($d = -0.19$, $p = .002$). Differences in students' experiences in the two courses help explain these findings. Compared with students assigned to the f2f course, students assigned to online credit recovery reported (at the end of the summer session) finding the course significantly more difficult ($d = -0.51$, $p < .001$). They also reported lower confidence in their math ability, liking math less ($d = -0.18$, $p = .007$) and less clarity about what they needed to do to succeed in the course ($d = -0.64$, $p < .001$). In addition, a supplemental analysis of the online and f2f course content found that the online course focused, by design, exclusively on second-semester Algebra I content, while the f2f course included content typically covered in prealgebra and first-semester Algebra I courses (Walters et al., 2016).

However, the two groups had similar academic performance during the second year of high school. About half the students in the online and f2f Algebra I credit recovery classes earned credit in a geometry (or higher) mathematics course the following year (53% for online and 54% for f2f; $p = .772$). They also had similar scores on a Grade 10 mathematics standardized test (the PLAN or pre-ACT). By the end of their second year, about a quarter of the students in both groups were considered on track for graduation by the district (28% of online students and 25% of f2f students; $p = .403$).

The null effects on second-year performance may be an indication that the short-term negative effects of online credit recovery (relative to f2f) decay over time. If so, the decision to use online or f2f credit recovery should not affect longer term outcomes like high school graduation. However, one should not draw such a conclusion without empirical evidence of the longer term effects. The similar academic standing of the treatment and control groups a year after the credit recovery course may be a sign of some delayed benefits to taking the online course. Such delayed benefits could materialize as students progress into their third and fourth years of high school. For example, greater exposure to advanced Algebra I topics in the online course versus the f2f course may provide students a sense of familiarity when taking Algebra II in their third year of high school. Alternatively, the negative effects students experienced in the online course, such as poorer mastery of Algebra I content and lower confidence in math, may reemerge as students tackle Algebra II and other advanced math content in their third or fourth year of high school.

Research Questions

To determine whether the short-term negative effects of online credit recovery relative to f2f actually had longer term implications for students' progress to high school completion, this paper examines whether the Algebra I online credit recovery course affected students' academic performance by the end of their fourth year of high school relative to the f2f Algebra I course. In particular, we address the following two research questions focused on two academic outcomes of signifant importance for college and career preparation:

Research Question 1: What was the relative impact of online and f2f Algebra I credit recovery on students' accumulation of math course credits through four years of high school?

Research Question 2: What was the relative impact of online and f2f Algebra I credit recovery on students' probability of graduating from high school within four years?

Our main analysis focuses on the overall average effect for both research questions. Because students reported that the online credit recovery course was more difficult than the f2f course, we also examined whether the impact differed based on the student's prior performance in ninth grade.

Methods

Research Design

Our analysis of longer term academic outcomes is an extension of the Heppen et al. (2017) study, using the same students who were randomly assigned to online or f2f Algebra I credit recovery in CPS (as described in the previous section). The study used within-school randomization to assign students who failed second-semester Algebra I to either an online or f2f Algebra I class during the summers of 2011 and 2012.[2] Overall, 1,224 first-time ninth graders from 17 schools were included in the study. The characteristics of the study sample are described in a later section. The study followed students for three years after the summer credit recovery course (through the end of what would be their senior year of high school if they were promoted each year).

Data Sources and Measures

The analyses reported in this paper utilize extant data provided by the district for student characteristics and outcomes. Variables representing student race, gender, neighborhood poverty and social status measures,[3] school attendance and suspension in ninth grade, whether the student passed the first semester of Algebra I in ninth grade,[4] and a Grade 9 mathematics assessment score were included in the models to improve the precision of treatment effects. For longer term student outcomes, we focused on the number of math course credits earned and on-time high school graduation.

Earned math course credits were defined as the cumulative number of semester-long math courses a student passed from the beginning of high school through the student's second, third, and fourth years of high school. The number of credits included course credits earned during the summer, with the summer term considered part of the prior school year. For example, the number of math credits earned by the end of a student's third year of school included credits earned during the summer between the student's third and fourth years. Students needed to complete six semesters of math (three year-long math courses) to meet CPS graduation requirements. Since students who transferred to a charter school or out of the district during high school had incomplete course records in the district data, we only analyzed math course credits for the 855 of 1,224 students in the study who did not transfer to another school district or a charter school (69% of treatment group students and 70% of control group students; $p = .690$). Students who were no longer enrolled in a CPS school and had no record of transferring to a non-CPS school (e.g., dropouts) were included in the analysis, with their math credits based on the number of credits they had earned prior to leaving CPS. By the end of what would be their fourth year of high school, 11% of the treatment group students and 14% of the control group students in the course credits analysis ($p = .097$) were designated as having dropped out of school in the district administrative data.[5] Students who transferred from one school to another were included in the analysis as long as they did not leave the district or enter a charter school. By the end of four years, the cumulative number of math course credits ranged from 0 to 10, with an average of 4.6 credits for our sample of students. As part of our analysis of math credit accumulation, we also looked at whether students passed both semesters of the district's trigonometry/Algebra II course within four years, which is typically students' third and final math course.

On-time high school graduation was defined using the district's graduation exit code at the end of the student's fourth year of high school (including the summer following the fourth year). Students who were still enrolled in the district after four years or who dropped out of high school were coded as a "nongraduate." Graduation status was considered unknown/missing for students whose last known status was having transferred to a school outside the district, and these students were excluded from our analysis of on-time graduation. A total of 963 of the 1,224 students in the study were included in our analysis of on-time graduation (77% of treatment group students and 80% of control group students).[6]

Student Sample

Of the 1,224 students who participated in the study, 38% were female, 57% were Hispanic, 33% were African American, 8% were White, and 2% were of other races/ethnicities. Most (86%) were eligible for free or reduced-price lunch, 12% were eligible for special education services, and 47% spoke Spanish as their home or native language. In addition to having failed second-semester Algebra I in their first year of high school, study students generally had low academic performance overall; on average, they failed 4.5 semester courses during their first year of high school, and their prior mathematics scores were 0.29 standard deviations below the district average. Study students also showed signs of disengagement during their first year of high school: 40% were suspended at least once during the year, and the students missed an average of 30 days of school during the year.

The random assignment created treatment and control groups that were not significantly different on any measured characteristics at baseline ($p > .05$). Student attrition, due to transfer out of the district (or to a charter school for the analysis of credits), had the potential to result in nonequivalent treatment and control groups for the follow-up analyses of longer term outcomes. However, the online and f2f students with observed long-term outcome data are similar across all of the observed background variables. Student background characteristics for the sample of students included in the analysis of graduation are provided in Table 2. (A similar table for math course credits is available in the Appendix.) The standardized mean difference for each characteristic is less than 0.10 standard deviations, and none of the differences are statistically significant. These minimal group differences provide some reassurance that group equivalence holds for these longer term outcomes. In addition, the rates of overall attrition and differential attrition for both the math credit outcome and the graduation outcome fall within the What Works Clearinghouse criteria for "low attrition" and an "acceptable level of bias" (What Works Clearinghouse, 2014).

Analytic Strategy

Since students were randomly assigned to the online or f2f course, mean outcome differences between the online and f2f groups can be attributed to the effect of being assigned to one course versus the other. To estimate the effect of taking an online versus f2f Algebra I credit recovery course, we used a regression model with fixed effects for school of attendance in ninth grade, cohort (2011 or 2012), and summer session (1 or 2) to account for the blocked randomization design. The regression model also included the student-level characteristics shown in Table 2 to improve precision. All predictors, with the exception of the treatment indicator, were centered on their grand mean. For the cumulative math course credit outcome, we used a linear regression model.[7] For the high school graduation outcome, we used a logistic regression model. To test whether the effect of online versus f2f differed based on student performance in ninth grade, we included an interaction term between treatment condition and one of three dichotomous markers of ninth-grade performance (described in the findings section) in the regression model. We only included one moderator in the model at a time.

For cases with missing covariate data, we included missing data indicators in the impact models. Less than 2% of students were missing covariate data, with the exception of prior achievement (Grade 9 EXPLORE scores), where 14% of students had missing values. Since treatment assignment was randomized, missing covariate data were not associated with treatment condition (e.g., the percentage of students missing prior achievement data was almost identical in the treatment and control groups), and the missing covariate data should not bias impact estimates (Jones, 1996).

For cases with missing outcome data, we applied inverse probability weights to the impact models to improve our ability to generalize results to the original study sample and account for potential attrition bias (Ridgeway, McCaffrey, Morral, Griffin, & Burgette, 2013; Wooldridge, 2007). As discussed in the earlier section on the measures, the online and f2f groups had similar rates of missing outcome data, so any potential treatment effect bias due to differential attrition should be minimal. The use of inverse probability weights provides an additional safeguard against such bias. The weights were based on students' predicted probabilities of having data for a given outcome, where predicted probabilities were estimated with a generalized boosted regression (McCaffrey, Ridgeway, & Morral, 2004). A separate boosted regression was run for each student cohort and outcome.

Table 2
Student Characteristics for the Graduation Outcome Analytic Sample, by Condition

	Online			Face-to-Face				
Characteristic	*N*	*M*	*SD*	*N*	*M*	*SD*	SMD	*p*
Percent female	473	0.40	0.49	490	0.37	0.48	0.06	.335
Percent passed Algebra 1A	473	0.42	0.49	490	0.42	0.49	–0.01	.851
Percent unknown Algebra 1A	473	0.21	0.41	490	0.21	0.41	0.00	.970
Percent 2012 cohort	473	0.59	0.49	490	0.60	0.49	–0.02	.748
Percent summer session 2	473	0.67	0.47	490	0.69	0.46	–0.05	.470
Mean EXPLORE math score	419	13.70	2.87	423	13.56	2.98	0.05	.469
Mean concentrated poverty[a]	472	0.04	0.83	488	0.10	0.74	–0.08	.239
Mean social status[b]	472	–0.41	0.86	488	–0.49	0.85	0.08	.201
Percent special education	473	0.12	0.33	490	0.11	0.32	0.03	.617
Percent Black/African American	473	0.36	0.48	490	0.33	0.47	0.07	.282
Percent Latino	473	0.55	0.50	490	0.57	0.50	–0.05	.455
Percent other race	473	0.09	0.29	490	0.10	0.30	–0.03	.637
Percent native Spanish speaker	473	0.44	0.50	490	0.47	0.50	–0.04	.506
Percent suspended	464	0.36	0.48	480	0.39	0.49	–0.07	.284
Percent moved schools	464	0.05	0.22	480	0.05	0.23	–0.02	.750
Percent absent 0–4 days	464	0.09	0.29	480	0.09	0.28	0.02	.781
Percent absent 5–9 days	464	0.15	0.36	480	0.13	0.33	0.08	.250
Percent absent 10–14 days	464	0.11	0.32	480	0.09	0.28	0.08	.209
Percent absent 15–19 days	464	0.12	0.33	480	0.14	0.34	–0.05	.499
Percent absent 20–29 days	464	0.16	0.37	480	0.18	0.39	–0.06	.374
Percent absent 30+ days	464	0.36	0.48	480	0.38	0.49	–0.04	.544

Note. Sample includes 17 schools and a total student sample of 963 first-time freshmen. The *p* values are based on an unconditional ordinary least squares regression for continuous covariates and an unconditional logistic regression for dichotomous covariates. SMD = standardized mean difference.
[a]Concentrated poverty is a standardized measure of poverty for the census block group in which the student lives. A large positive number indicates a high level of poverty concentration; a large negative number indicates a low level of poverty concentration. This measure is calculated from census data (the percentage of adult males employed and the percentage of families with incomes above the poverty line) and is standardized such that a 0 value is the mean value for census block groups in Chicago.
[b]Social status is a standardized measure of educational attainment/employment status for the census block group in which the student lives. A large positive number indicates a high social status; a large negative number indicates a low social status. This measure is calculated from census data (mean level of education of adults and the percentage of employed persons who work as managers or professionals) and is standardized such that a 0 value is the mean value for census block groups in Chicago.

Findings From Impact Study

The analyses of short-term outcomes reported in Heppen et al. (2017) suggest that students in the f2f course were more likely than students in the online course to successfully recover algebra credit during the summer between their first and second years of high school, but this effect did not translate into a significant difference in math course credit accumulation by the end of students' second year of high school. Our analysis of total math credits earned through students' third and fourth years of high school similarly show no statistically significant difference between students who took the online and f2f Algebra I credit recovery courses (see Figure 1). By the end of their fourth year, students in the online and f2f groups were still an average of approximately one to two semesters short of the six semester math credits (three year-long math courses) required for high school graduation: 4.6 credits for the online group and 4.7 credits for the f2f group (effect size = –0.07; p = .295).[8] Just over half the students in both the online and f2f groups passed both semesters of the district's trigonometry/Algebra II course within four years (55% vs. 58%; effect size = –0.08; p = .413). Ultimately, the online and f2f groups had identical on-time high school graduation rates (see Figure 2). In both groups, just under half (47% in the online group and 47% in the f2f group) of the students graduated from high school within four years (effect size = 0.01; p = .926).[9]

We also examined whether the effects of online versus f2f differed based on students' academic struggles in ninth grade, particularly because students reported that the online credit recovery course was more difficult than the f2f course (Heppen et al., 2017). Therefore, we tested potential treatment effect moderators based on three ninth-grade performance markers: performance on the ninth-grade math assessment (dichotomized based on whether the score was above the sample median or not), absenteeism in ninth grade (dichotomized based on whether the student was absent for fewer than 20 days or not), and whether first semester of Algebra I was passed or not. There were no statistically significant treatment effect differences based on students' ninth-grade performance.

Findings From Broader Descriptive Analysis

While the impact findings suggest average longer term outcomes do not differ between online and f2f credit recovery

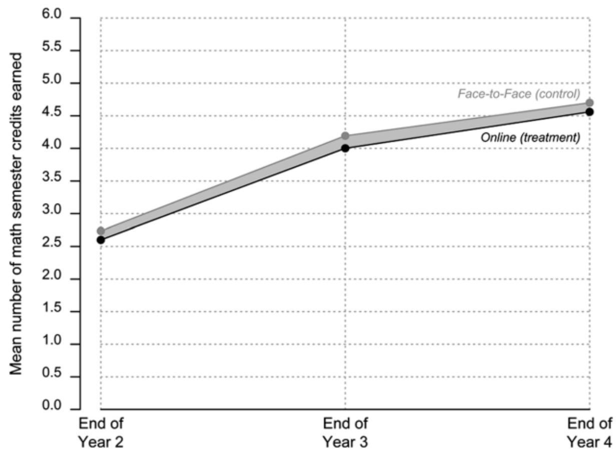

FIGURE 1. *Math course credits earned through four years of high school, by condition.*
Note. Means reported for students in the online course are observed means. Means reported for students in the face-to-face (f2f) course are model-adjusted, calculated by subtracting the effect estimate from the observed online group mean. None of the online versus f2f differences are statistically significant at the 95% confidence level. The analysis was based on 425 online students and 430 f2f students.

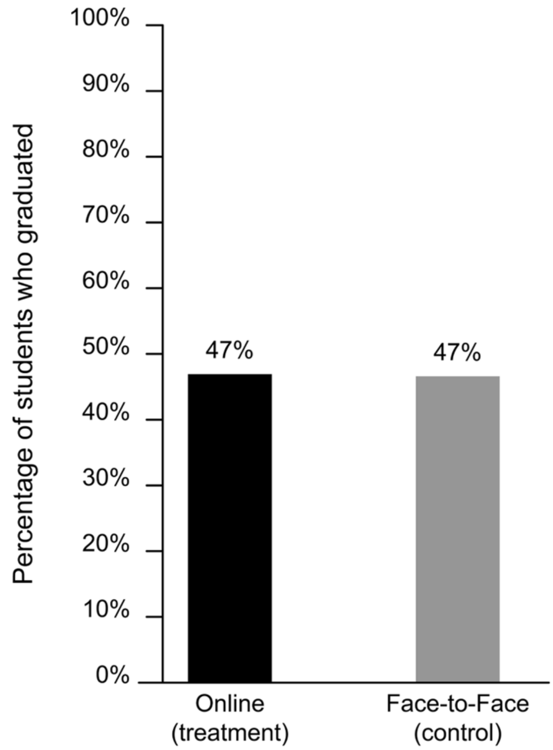

FIGURE 2. *On-time high school graduation rate, by condition.*
Note. The percentage reported for students in the online course is the observed percentage. The percentage reported for students in the face-to-face (f2f) course is the model-adjusted percentage, calculated by subtracting the effect estimate from the observed online group mean. The online versus f2f difference is not statistically significant at the 95% confidence level. The analysis was based on 473 online students and 490 f2f students.

students, the impact findings do not speak to the importance of credit recovery in general. To get a sense of whether credit recovery can help students progress to graduation and provide some context for the main impact findings, we looked at course progression and on-time graduation for all students who took Algebra I as ninth graders in the study schools. For these students, we compared, descriptively, five types of students: (1) students who passed Algebra I in ninth grade with a C or better, (2) students who passed Algebra I in ninth grade with a D, (3) students who failed Algebra I and recovered the credit over the summer, (4) students who failed Algebra I and attempted credit recovery over the summer but did not pass the course, and (5) students who failed Algebra I and did not attempt credit recovery over the summer.

For each group, the cumulative number of math course credits earned through four years is presented in Figure 3. Students who failed Algebra I and recovered the credit over the summer ended up with about 1.0 fewer credits by their fourth year than students who initially passed Algebra I with a D but had 1.6 more math credits than students who attempted to recover the credit but were not successful. Similarly, students who recovered the credit over the summer had 1.7 more math credits than students who failed Algebra I but did not attempt to recover the credit over the summer. On-time graduation rates for each group are presented in Figure 4. These results tell a similar story: Students who recover credit do not catch up to students who initially pass Algebra I but do better, on average, than students who do not recover credit the summer after their first year. We cannot make conclusions about the effects of credit recovery based on these descriptive results, but they suggest that efforts to identify ways to improve credit recovery rates have the potential to produce longer term outcomes.

Discussion

Many high schools are turning to online credit recovery courses to get students back on the path to graduation. While our study tests only one online course model and one content area, the pattern of findings raises questions about the rush to online courses for credit recovery, especially without giving careful consideration to the specifics about how the online course will be implemented, the bundle of instructional features that comprise implementation of an online course, and the academic and social-emotional needs of at-risk students. In the short term, Heppen et al. (2017) found that students may benefit more from a f2f course than an online course because they are more likely to recover credit and learn more in a f2f course. The online course may not provide the same degree of personal support as the f2f class, which may be particularly important for students who have already failed the course in the past. In this study, students in the online course found the course more challenging and instruction less clear than students in the f2f class. Thus, there is no evidence that online courses provide a better opportunity for students to get back on track than traditional f2f courses, despite the optimism that has been expressed about them.

At the same time, we do not find evidence that taking an online course rather than a f2f course is harmful to students in

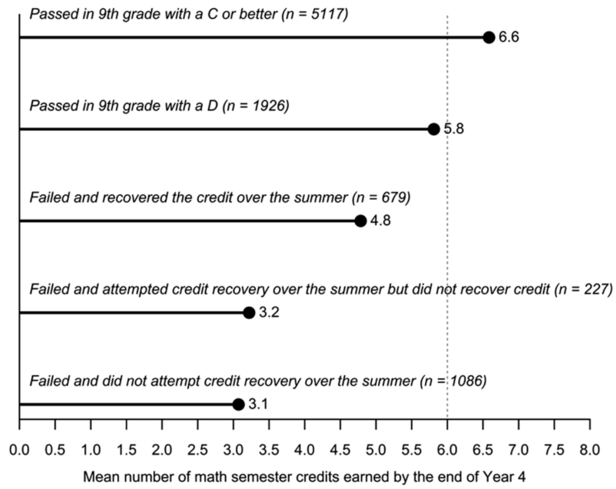

FIGURE 3. *Math course credits earned through four years of high school, by Algebra I passing status.*

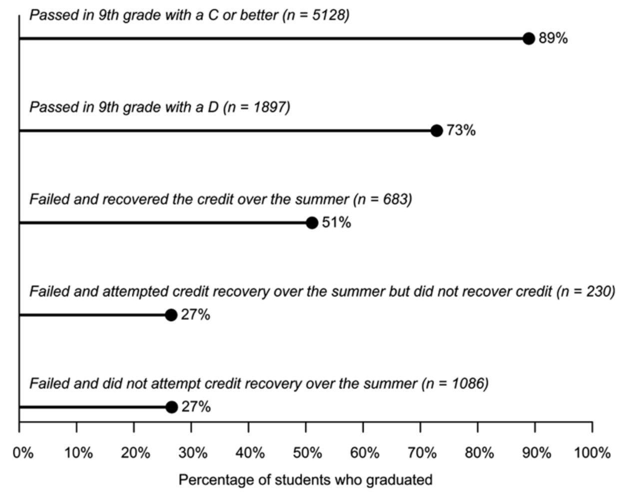

FIGURE 4. *On-time high school graduation rate, by Algebra I passing status.*

the long run. Students were no more or less likely to accumulate math course credits over time or graduate if they took an online Algebra I credit recovery course instead of an f2f version. This suggests that the initial negative effects of online relative to f2f credit recovery in Algebra I may dissipate. For schools that find it impractical to offer f2f classes due to the logistical demands they entail, online courses may be a viable option for expanding access to credit recovery.

With little rigorous evidence favoring one credit recovery option over the other, it is important to consider the factors that might influence the relative benefits and costs of online credit recovery (Bakia, Shear, Toyama, & Lasseter, 2012). We can use a benefit-cost framework to help contextualize the specific online credit recovery course implemented for our study and consider ways future implementations of online credit recovery can be more effective, or at least more cost-effective, than the f2f alternative.

Students may benefit more from an online course than a f2f course if the online learning environment promotes active learning, individualized instruction, and personalized learning. These potential benefits are tied to the content coverage, pacing, and instructional supports of the online course. The online course implemented for our study, for example, allowed students to move at their own pace but focused exclusively on second-semester Algebra I topics and did not include supports to help students struggling with the content. Each online class included an in-class mentor, but the mentors did not have to be a certified mathematics teacher and were not expected to provide instructional support. A supplemental exploratory analysis of the short-term outcomes found that students in classes with instructionally supportive mentors had higher credit recovery rates than students who had less instructional support from their mentors (Taylor et al., 2016). In addition, a review of the content taught in the online and f2f credit recovery classes indicates that about half the content taught in the f2f classes covered pre-algebra and first-semester algebra topics (Walters et al., 2016). It is possible that the online course's rigid focus on second-semester algebra content prohibited students from learning prerequisite content that could help them understand the second-semester content and that the more flexible structure of the f2f classes provided opportunities for the f2f teachers to address these gaps in knowledge.

Another potential benefit of online courses is that they may afford districts and schools more flexibility in terms of student enrollment and staffing, which could provide students with greater access to needed courses. For credit recovery, schools may have a difficult time determining how many students will enroll in particular classes and how many certified teachers are needed in specific subject areas, especially when trying to arrange credit recovery during the summer. With an online credit recovery course, schools may have more flexibility with teacher-student ratios, and students from multiple schools can enroll in the same course.

In our study, implementation of the online credit recovery course followed practices commonly recommended by online providers, including Aventa. Two critical practices pertaining to costs were that students take the online course in a standard school classroom setting and that each class have an in-class mentor in addition to the online teacher. The use of school-based facilities, an in-class mentor, and the cost of Aventa (that included access to the course software and the online teacher) meant the per-pupil costs were higher for the online credit recovery course than the f2f course. Future implementations of online credit recovery could seek to limit these constraints in ways that reduce school-based facility costs, reduce salary costs, or provide greater economies of scale. For example, schools may be able to teach multiple credit recovery courses within a single online classroom and with one in-class mentor. The feasibility of such cost-cutting options will depend on the school context, specifically, the number of students who need to recover credit in any particular course. For example, in large schools with enough students to fill course-specific credit recovery classes, f2f may be the most efficient option. In smaller schools, however, the ability to use an online course as a more general credit recovery class, where the online platform provides the course-specific content, may make the online option more efficient. If online credit recovery courses are cheaper to implement than f2f courses and provide students with equivalent educational outcomes in certain contexts, then efforts to promote online credit recovery may allow for greater access to credit recovery overall.

Even if improved implementation of online credit recovery increases its relative benefits and costs, it may be unrealistic to expect a single credit recovery course, whether online or f2f, to put failing students back on the path to on-time graduation. As the baseline characteristics and the average cumulative math course credits and high school graduation rates indicate, students in our study were extremely at risk. Compared to other ninth graders in Chicago, students who failed Algebra I were more likely to enter high school with low mathematics and reading scores, have higher absenteeism, and fail multiple courses during their ninth-grade year (Rickles et al., 2016). For these students, navigating course and graduation requirements is an uphill battle that likely requires targeting multiple aspects of school engagement beyond specific math credits or subject knowledge. A credit recovery course may provide an opportunity to acquire specific content knowledge and course credit the student struggled to obtain the first time around, but if that struggle occurred alongside performance issues in other courses and broader school disengagement (e.g., suspensions and chronic absenteeism), retaking a single course in any format may be too little too late. Given these challenges, efforts to improve the utility of online credit recovery should focus on ways to better target online credit recovery to the students most likely to benefit from such a course and ways to incorporate online credit recovery into a comprehensive intervention strategy for school engagement and dropout prevention.

NOTES

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[1]Students are not required to retake Algebra I during the summer between their first and second year, though students are required to eventually recover the course credit in order to graduate from high school. As part of the study, the study team worked with the participating schools to encourage students to retake Algebra I during the summer after their first year. Students who chose to retake Algebra I over the summer (and participated in the study) were, on average, less at risk academically than their peers who also failed Algebra I but did not try to recover the credit in the summer. While both groups of students faced serious academic struggles in their first year of high school, those who attended summer credit recovery failed about one fewer semester courses (4 courses vs. 5 courses), had about 18 fewer absences, and were less likely to have been suspended (40% vs. 52%) than students who failed Algebra I and did not attend summer credit recovery.

[2]More specifically, randomization occurred within blocks defined by school, year, summer session (first or second session), student gender, and whether the student failed the first semester of Algebra I in addition to the second semester.

[3]Neighborhood poverty is a composite of the male unemployment rate and percentage of households below the poverty line of the students' census block group, standardized across all Chicago census block groups. Neighborhood social status is a composite of the mean level of education of adults and the percentage of employed individuals who work as managers or professionals in the census block group.

[4]Students could retake the second semester of Algebra I even if they failed the first semester and had not yet recovered credit from the first semester.

[5]One should not necessarily interpret these rates as official dropout rates. Since a student's status as a dropout can be fluid and schools can be inconsistent in their use of the dropout exit codes in district administrative data, we did not focus on dropout as an outcome of interest. Rather, we used dropout, along with other exit codes and data on student enrollment over time, to determine inclusion/exclusion rules for our analysis.

[6]The analysis of on-time graduation includes more students than the analysis of cumulative math course credits because the analysis of course credits excludes students with any transfer out of Chicago Public Schools (CPS) during their first four years of high school and excludes students who transferred to a charter school. The analysis of graduation includes students in CPS-affiliated charter schools and excludes students only if they transferred out of CPS during their first four years of high school and remained out of the district.

[7]Because the course credit outcome is a count of the number of credits earned over a specific time period, we also used a Poisson regression model for the course credit outcome. The Poisson and linear regression models produced similar point estimates and identical conclusions regarding statistical significance. For ease of interpretation, we present results based on the linear regression model.

[8]We also examined whether online credit recovery had an effect on students' ACT scores (which CPS students were expected to take in Grade 11). Among the 59% of online and face-to-face (f2f) students who took the ACT, there was no statistically significant difference between each group's average ACT composite score or math score.

[9]The mean math course credits and graduation rates presented in the findings section are the observed values for the online group and the covariate-adjusted, or regression predicted, values for the f2f group. We report the covariate-adjusted values for the f2f group so that the estimated treatment effects are accurately depicted in the figures.

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AUTHORS

JORDAN RICKLES, PhD, is a principal researcher at the American Institutes for Research, 1000 Thomas Jefferson St., NW, Washington, DC 20007; *jrickles@air.org*. He specializes in research design and quantitative methodology for estimating the effects of educational practices, policies, and programs.

JESSICA B. HEPPEN, PhD, is a vice president at American Institutes for Research, 1000 Thomas Jefferson St. NW, Washington DC 20007; *jheppen@air.org*. Her research examines the impact of educational interventions and policies on outcomes for diverse learners.

ELAINE ALLENSWORTH, PhD, is the Lewis-Sebring Director at the University of Chicago Consortium on School Research, 1313 East 60th Street, Chicago, IL 60637; *elainea@uchicago.edu*. Her research examines factors influencing educational attainment and school improvement.

NICHOLAS SORENSEN, PhD, is a principal researcher at the American Institutes for Research, 10 S. Riverside Plaza, Suite 600, Chicago, IL 60606; *nsorensen@air.org*. His research focuses on dropout prevention and helping struggling students succeed across the transition to high school.

KIRK WALTERS, PhD, is a managing researcher at the American Institutes for Research, 1050 Thomas Jefferson St., NW, Washington DC 20007; *kwalters@air.org*. His research focuses on mathematics teaching and learning, with a special emphasis on improving algebra achievement for underperforming students.

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Appendix

Table A1
Student Characteristics for the Math Course Credits Analytic Sample, by Condition

	Online			Face-to-Face				
Covariate	*N*	*M*	*SD*	*N*	*M*	*SD*	SMD	*p*
Percent female	425	0.39	0.49	430	0.37	0.48	0.06	.402
Percent passed Algebra 1A	425	0.43	0.50	430	0.43	0.50	0.00	.991
Percent unknown Algebra 1A	425	0.17	0.37	430	0.19	0.39	–0.05	.467
Percent 2012 cohort	425	0.58	0.49	430	0.60	0.49	–0.04	.576
Percent summer session 2	425	0.66	0.47	430	0.67	0.47	–0.02	.735
Mean EXPLORE math score	378	13.76	2.81	382	13.60	3.03	0.06	.437
Mean concentrated poverty[a]	425	0.03	0.83	430	0.07	0.72	–0.05	.455
Mean social status[b]	425	–0.38	0.87	430	–0.48	0.86	0.11	.103
Percent special education	425	0.12	0.32	430	0.11	0.31	0.02	.781
Percent Black/African American	425	0.36	0.48	430	0.32	0.47	0.09	.177
Percent Latino	425	0.55	0.50	430	0.58	0.49	–0.05	.441
Percent other race	425	0.09	0.29	430	0.11	0.31	–0.06	.389
Percent native Spanish speaker	425	0.44	0.50	430	0.47	0.50	–0.05	.422
Percent suspended	424	0.35	0.48	428	0.38	0.48	–0.05	.497
Percent moved schools	424	0.04	0.21	428	0.04	0.21	0.00	.976
Percent absent 0–4 days	424	0.09	0.29	428	0.09	0.28	0.02	.777
Percent absent 5–9 days	424	0.15	0.36	428	0.14	0.35	0.03	.656
Percent absent 10–14 days	424	0.12	0.32	428	0.09	0.28	0.11	.131
Percent absent 15–19 days	424	0.12	0.32	428	0.13	0.34	–0.03	.639
Percent absent 20–29 days	424	0.15	0.36	428	0.19	0.40	–0.11	.118
Percent absent 30+ days	424	0.37	0.48	428	0.36	0.48	0.01	.917

Note. Sample includes 17 schools and a total student sample of 855 first-time freshmen. The *p* values are based on an unconditional ordinary least squares regression for continuous covariates and an unconditional logistic regression for dichotomous covariates. SMD = standardized mean difference.

[a] Concentrated poverty is a standardized measure of poverty for the census block group in which the student lives. A large positive number indicates a high level of poverty concentration; a large negative number indicates a low level of poverty concentration. This measure is calculated from census data (the percentage of adult males employed and the percentage of families with incomes above the poverty line), and is standardized such that a 0 value is the mean value for census block groups in Chicago.

[b] Social status is a standardized measure of educational attainment/employment status for the census block group in which the student lives. A large positive number indicates a high social status; a large negative number indicates a low social status. This measure is calculated from census data (mean level of education of adults and the percentage of employed persons who work as managers or professionals), and is standardized such that a 0 value is the mean value for census block groups in Chicago.