

# ACHIEVING STUDENT SUCCESS

Using indicators of college  
readiness to measure the  
efficacy of Achieve



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**Ethics and peer review.** This research complied with APA ethical standards for research. It was approved by a third-party Institutional Review Board (IRB) prior to recruitment, and then approved by individual institutional IRBs at each participating institution where required. This paper and the results herein, have been peer reviewed, revised, and approved for publication as a Macmillan Technical Report by the Impact Research Advisory Council, a panel of experts in applied research, measurement, educational technology, and the learning sciences.



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# Foreword

Success in postsecondary education is critical to a student's future. And yet, students continue to complete degree or certificate programs at alarmingly low rates. Researchers have found that a student's high school grade point average and their performance on college entrance exams significantly predict their future success in two- and four-year institutions (College Board, 2019; Allen, 2013; Attewell et al., 2010; Belfield & Crosta, 2012). Entrance exam performance data and remedial course enrollment rates are evidence that students continue to lack the academic preparedness needed to succeed (NCES, 2019). As instructors work to support students with skills gaps, the evolution of digital learning tools can complement their efforts. Educational technology that is built on sound learning science principles - such as self-regulation and metacognition, formative assessment and reflection, and personalized and adaptive learning has the potential to support student mindset, develop regulatory skills, contribute to academic success, and ultimately bridge the achievement gap between students less academically prepared and their more academically prepared peers. Differential efficacy, or evidence of how a learning tool supports different cohorts of students, could be of significant value to instructors evaluating digital learning tools. Insights into whether a tool supports students less and more academically prepared to succeed in college is a critical piece of that evidence.

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# Introduction

The personal and societal benefits of earning a postsecondary certificate or degree are well documented. Researchers have developed evidence of the relationship between completion and a healthier lifestyle, increased family engagement, job satisfaction, and higher earning potential (Baum, Ma, & Payea, 2013; Danzinger & Ratner, 2010; Forbes, 2013; Grossman & Kaestner, 1997; National Center on Education Statistics (NCES), 2019). For example, in 2018, 4.1% of men and women in the United States with a high school diploma were unemployed, as compared to the 2.8% with an Associate's degree, and the 2.2% with a Bachelor's degree (Bureau of Labor Statistics, 2019). Even throughout the Great Recession of 2008, when compared with their less-credentialed counterparts, college graduates maintained employment at higher rates, and graduates displaced from their positions were able to find employment more quickly than their less educated peers (Pew Economic Mobility Project, 2013; Carnevale, Jayasundera, & Cheah, 2012). Perhaps the most well-documented disparity between adults with at least a college education and those with a high school diploma is earning potential (Bureau of Labor Statistics, 2019). The median weekly earnings of high school graduates with no postsecondary education working full time in 2018 was \$730 as compared to median earnings of \$862 among individuals with an Associates degree and \$1,198 among individuals with a bachelor's degree.

Even with the consensus on the personal and societal benefits of earning a postsecondary certificate or degree, the United States continues to realize alarmingly low completion rates. The National Center on Education Statistics recently reported that the average six-year graduation rate among first-time, full-time students that matriculated to a four-year institution in 2011 was only 60%. More alarming, at two-year institu-



tions, among first-time, full-time students who began seeking a certificate or degree in 2014 only 32% had successfully completed the program by 2017 - and 41% were no longer enrolled in that institution nor had they transferred to another institution (NCES, 2019).

Research has suggested that various social and structural factors play a role in college success including family engagement in a student's education, stable peer groups, student access to an equitable education in primary and secondary schools, and racial and gender disparities (Black et al., 2015). Additionally, once a student reaches college, there are many postsecondary factors that play a role in academic achievement, such as strong orientation programs, engagement with college faculty, academic advising, course placement, and peer groups (NCES, 2006).

Given the disparate factors associated with postsecondary success, researchers have long attempted to isolate the causes for low graduation rates. Much research has suggested that a student's experience leading up to college is an important, if not the most significant factor related to postsecondary success. Attewell et al. (2011) concluded that at four-year institutions secondary academic preparation was the most significant factor related to degree attainment.

The researchers found different results at two-year institutions, however, suggesting that placement tests and high school performance did not predict college completion at two-year institutions and rather demographics, hours worked, and financial support were the most significant predictors in the two-year institution model. Belfield & Crosta (2012) reported that although they agree that placement tests are not good predictors of community college success, prior academic performance as measured by high school grade point average (HSGPA) is an "extremely good and consistent" predictor of community college success.

Recognizing the demonstrated relationship between academic preparedness and college success, the proportion of students entering college lacking the skills they need to succeed weighs heavily on administrators, instructors, and researchers. The ACT reported that among 2019 high school graduates who participated in the ACT, 37% met three out of the four college readiness benchmarks - valid indicators that they had a 50% chance of earning a B or higher in that discipline and 75% chance of earning a C or higher in that discipline in the first year of college (ACT, 2019). This proportion dropped from 38% in 2018. Similarly, The College Board



reported that among all students who participated in the SAT in 2019, 45% met both college readiness benchmarks - valid indicators that students have at least a 75% chance of earning a C in related courses (College Board, 2019). The proportion of “college ready” in 2019 was down from 47% in 2018. Lack of college preparedness is also evidenced by the rate at which students are enrolling in remedial coursework. In 2011–12, about one-third of all first- and second-year bachelor’s degree students—29 percent of those at public 4-year institutions and 41 percent of those at public 2-year institutions—reported having ever taken remedial courses (U.S. Department of Education, 2014).

With such strong evidence that students are entering college less prepared to succeed and many never complete, instructors are working to identify skills gaps early in the course and close them in an effort to bridge the gap in success between less and more academically prepared students. The advances in learning sciences and the evolution of digital learning tools can support these efforts. Educational technology that is built on sound learning science principles such as self-regulation and metacognition, formative assessment and reflection, and personalized and adaptive learning has the potential to support student mindset, develop regulatory skills, and ultimately bridge the achievement gap between students less academically prepared and their more academically prepared peers. Investigating whether a learning solution supports the success of less and more academically prepared students should be a core piece of the evidence of the efficacy of the solution.

“ This study investigated the differential efficacy of a new digital learning tool, Achieve, among students less and more academically prepared to succeed.”

Consequently, this study investigated the differential efficacy of a new digital learning tool, Achieve, among students less and more academically prepared to succeed. Because the previous research mentioned here found that in some educational contexts HSGPA might be a better indicator of postsecondary success than college readiness as established on an entrance exam, we explored both measures. Students were asked to self-report their HSGPA and section scores on the ACT or SAT if they had taken one or both. Then they were categorized as less or more academically prepared based on each.

We therefore undertook to measure the effectiveness and efficacy of Achieve for students both more and less academically prepared while the product was early in development (in beta). Our goal was to use actual course results and in-course feedback from instructors and students to guide the evolution and optimization of the product, and to provide a transparent body of research that instructors could refer to when Achieve was launched and when deciding if and how to implement it in their courses



# Achieve

Achieve is a digital learning solution developed for higher education courses. It provides a connected suite of course tools designed to give instructors choice, with flexible recommendations for optimal learning paths based on the learning sciences. The key principles that Achieve is built on include: everyone has the potential to learn, each learner starts at a different place and learns at their own pace, cognition can be enhanced through technology, an instructor's pedagogy matters, learning is a social activity, and students should be empowered to manage their learning. Achieve is built on learning science foundations developed based on research from experts on how students learn and how instructors and students can achieve desired outcomes. Based on these foundations a learning model was constructed to act as a blueprint for the design of Achieve.



# Procedures

The study presented in the following sections complied with American Psychological Association ethical standards for research. It was approved by a third-party Institutional Review Board (IRB) prior to participant recruitment, and then approved by instructor participant's individual institutional IRBs where required.

In the Spring 2019 semester, 40 instructors teaching one of five disciplines (Biology, Calculus, Chemistry, Composition, and Economics) agreed to participate in an evaluation of a beta version of Achieve, while it was still being evolved and optimized. In this study instructors and students received Achieve free of charge to use. All students were required to use Achieve in their course because it was the curricular material their instructor selected, but they were not required to participate in this study. Interested students were required to actively consent to participate in the study if they chose to. Of all of the students enrolled in the participating courses, 74% (2,251 students) elected to participate in the study. The research presented in this report is a secondary analysis of the data that were collected as part of the overall beta study.

## RESEARCH QUESTIONS

This study addressed three research questions designed to help educators better understand whether use of Achieve in their course may help less academically prepared students to succeed in their course and keep more academically prepared students challenged and continuing to succeed.

- *Research question 1.* Previous research has demonstrated that there is a relationship between a student's perception of a learning tool and the extent to which they engage with it. Put simply, the more they value a tool the more they will use it. Therefore,



we wanted to evaluate whether students who are less academically prepared had significantly different perceptions of Achieve than their more academically prepared peers by exploring do perceptions of Achieve statistically significantly differ based on college readiness status or HSGPA? We hypothesized that perceptions would not significantly differ because Achieve was developed based on learning science principles that are proven to support all students. And, because Achieve provides students with as much or as little personalized support as they may need.

- *Research question 2.* Previous research has demonstrated that there is a relationship between engagement, persistence, and completion and future academic performance. Therefore, we wanted to evaluate whether students who are less academically prepared engaged, persisted, and completed at a significantly different rate than their more academically prepared peers by asking do perceptions of Achieve statistically significantly differ based on college readiness status or HSGPA? We hypothesized that rates would not significantly differ because all students would find value in Achieve activities and because the features built into assessments promote motivation.

- *Research question 3.* In order to validate that Achieve supports both less and more academically prepared students, we wanted to measure the relationship between engagement in Achieve and academic performance in the course while holding academic preparedness constant by investigating, is there a relationship between engagement in Achieve and final exam score and does academic preparedness moderate that relationship? We also wanted to explore whether engagement in Achieve could help close the achievement gap by examining descriptively whether the gap in average final exam score performance closed as students engaged in more Achieve activities. We hypothesized that use of Achieve would be related to higher final exam scores and that prior academic performance would not moderate that relationship.

## DATA COLLECTION

Data were collected for a mixed-methods analysis. Student and instructor surveys were administered at the beginning and end of the semester, instructors completed weekly implementation logs, and instructor interviews were conducted mid-semester. Product usage data were extracted from the Achieve platform on a weekly basis and at the end of study, and student records were shared by instructors at the



end of the semester. Data were matched across sources, and descriptive and empirical analyses were conducted. A complete description of the collected data can be found in the complete Achieve efficacy report: Achieving more: the learning engineering of Achieve and insights into instructor implementations and instructor and student outcomes.

### SAMPLE

The complete study sample of 2,251 students was reduced to two analytic samples. Sample 1. Students who reported that they had taken the ACT and/or SAT and reported valid section scores and had valid final exam score data (n=1,637). Sample 2. Students who reported a valid high school grade point averages and had valid final exam score data (n=1,222).

The general distributions of the samples were similar, the statistics from sample one are presented here but all distributions can be found in the appendix. The largest proportion of students using Achieve were taking Economics or Chemistry courses (35% and 35%, respectively), while a smaller proportion were taking courses in Calculus, Composition, and Biology (11%, 10%, and 10%, respectively). Most students were in their first year of college (58%) and were female (54%). The average high school grade point average of the sample was 3.64 and the average final exam score of the sample was 75.09%.

## DESCRIPTION OF ACTIVITIES INSTRUCTORS ASSIGNED TO THEIR STUDENTS IN ACHIEVE

**Reading.** Any assigned section of reading.

**Diagnostic.** Any activity that was assigned prior to that preceded the content being taught and that provided a pre-test, study plan, and post-test with associated diagnostic information (i.e. Pathfinder diagnostic activities).

**Pre-class formative assessment.** Any assessment where students were given more than one opportunity to answer a question correctly or where the goal was persistence to completion and when the assignment was due prior to the class in which the content would be introduced. These activities tended to be video tutorials and adaptive reading quizzes.

**In-class activity.** Any activity that was assigned to be completed during in-class time. These activities tended to be case studies, current event assignments, and iClicker student response system questions.

**Post-class formative assessment.** Any assignment where students were given more than one opportunity to answer a question correctly or where the goals was persistence to completion and when the assignment was due after the class in which the content was introduced. These activities tended to be end of chapter problems, data analysis activities, etc.

**Post-class summative assessment.** Any assignment where students were assigned a discrete number of items and they were given one attempt to answer each, or the activity was weighted more heavily in a student's grade. These activities tended to be quizzes, tests, and homework.



## DESCRIPTION OF VARIABLES

**Average rate of engagement in Achieve.** All instructors assigned activities for credit. If a student had launched an activity, he or she was recorded as having “engaged”. An average engagement rate was calculated by summing all of the activities engaged and dividing that number by the sum of all of the activities assigned.

**Average rate of persistence in Achieve.** Formative assessments in Achieve are developed to enable practice, provide feedback, and help students grow in their learning. Student success on a formative assessments is measured by persisting to complete the goal of the activity. Students earn a zero if they do not persist and a 100 if they do persist. Average rate of persistence was calculated by coding persistence on each activity as “1”, otherwise the activity was coded as zero. Persistence was summed across assigned formative assessment and divided by the total number of formative assessments assigned.

**Average rate of completion in Achieve.** If a student had launched an activity, he or she was recorded as having “engaged”, if the student met the completion status as defined by the activity they were re-coded as having “completed” the activity. An average completion rate was calculated by summing all of the activities completed and dividing that number by all of the activities assigned.

**High school grade point average.** Students self-reported their high school grade point average on the pre- and post-survey, where the two reported averages were not the same, the average was taken. A mean high school grade point average was calculated for sample 1 and students below

the mean were coded as “less academically prepared” and students who met or exceeded the average high school grade point average were coded as “more academically prepared”

**College readiness status.** Students self-reported whether they had taken the ACT and/or SAT. If they indicated that they had they self-reported their scores by section. ACT and SAT scores are then placed on the same scale based on concordance work conducted by The ACT and the College Board, and new fields are created for each student indicating whether they met the Math benchmark (“Math ready”), whether they met the Reading benchmark (“Reading ready”), and whether they met both benchmarks (“College ready”). In total, 1,052 students (69.6%) met both college readiness benchmarks and were coded as “college ready” and 459 students (30.4%) in sample two did not meet both college readiness benchmarks and were coded as “not college ready”.

**Final exam score.** Instructors shared final exam scores for all students who consented to be in the study.

**Final course grade.** Instructors shared final course grades for all students who consented to be in the study.



## RESEARCH QUESTION 1.

*Are there differences in perception of Achieve based on a student's college readiness status?*

### General perceptions

To measure student perception of Achieve, students were asked sets of questions on the post-survey. To investigate whether there were differences in perception of Achieve by students' academic preparedness, we examined the statistical differences in the mean scores using HSGPA and college readiness as predictors.

We first calculated differences in general perception. Students were asked a modified net promoter score in that they were asked to rate, on a scale of 0-10, how likely they were to recommend a course to a friend if they knew that Achieve was going to be used. An independent-samples t-test was conducted to compare net promoter score among students who fell below the mean HSGPA and those who met or exceeded the mean HSGPA. There was not a significant difference in the ratings for students who fell below the mean ( $M=6.94, SD=2.24$ ) and average ratings of students who met or exceeded the mean HSGPA ( $M=6.78, SD=2.22$ );  $t(1,302)=1.02, p = 0.8134$ . There was not a significant difference in the ratings for students who were not college ready ( $M=6.60, SD=2.36$ ) and average ratings of students who were college

ready ( $M=6.60, SD=2.36$ );  $t(965)=-1.97, p = 0.0587$ . These findings suggest that both groups of students would recommend a course to a friend if they knew Achieve was being used.

Students were also asked to rate, on a scale of 1 = "strongly disagree", 2 = "disagree", 3 = "agree", and 4 = "strongly agree" the extent to which they agreed that Achieve is easy to use. Again, there were no meaningful differences between the ratings of students more or less academically prepared as measured by either HSGPA or college readiness status. These findings suggest that both groups of students perceived Achieve to be easy to use.

Students were also asked to rate, on the same scale the extent to which they agreed that Achieve supported their mastery of the content in their course. While in both cases of HSGPA and college readiness, students less prepared tended to agree more strongly, on average, the differences were not statistically significant suggesting that both students less and more academically prepared perceive Achieve to have helped them gain mastery.

**Table 1. Student perceptions of Achieve by academic preparedness as measured by HSGPA and college readiness**

	HSGPA			College readiness		
	< mean	> mean	Diff	Not ready	Ready	Diff
How likely are you to recommend a course to a friend if you knew Achieve was being used? (Scale 0-10)	6.94 (2.24)	6.78 (2.22)	0.16 ( $p=0.81$ )	6.60 (2.36)	6.91 (2.14)	-0.31 ( $p=0.06$ )
Achieve is easy to use (Scale 1-4)	3.07 (0.74)	3.04 (0.71)	0.03 ( $p=0.53$ )	3.08 (0.69)	3.07 (0.71)	0.00 ( $p=0.45$ )
Achieve supported your mastery of the content in this course (Scale 1-4)	2.91 (0.68)	2.85 (0.72)	0.06 ( $p=0.20$ )	2.88 (0.70)	2.85 (0.71)	0.03 ( $p=0.87$ )



**Table 2. Student perceptions of course challenges by academic preparedness as measured by HSGPA and college readiness**

	HSGPA			College readiness		
	< mean	> mean	Diff	Not ready	Ready	Diff
Actively engage in class	2.86 (0.86)	2.80 (0.80)	0.06 (p=0.08)	2.86 (0.86)	2.80 (0.80)	0.06 (p=0.08)
Collaborate with other students	3.07 (0.80)	3.03 (0.74)	0.04 (p=0.04)*	3.07 (0.81)	3.03 (0.74)	0.04 (p=0.33)
Come to class having completed assignments that were due	2.94 (0.77)	3.05 (0.75)	-0.11 (p=0.56)	2.94 (0.77)	3.06 (0.75)	-0.12 (p=0.56)
Comprehend material	2.72 (0.83)	2.68 (0.77)	0.05 (p=0.13)	2.73 (0.83)	2.67 (0.78)	0.05 (p=0.13)
Come to class prepared to participate	3.01 (0.77)	3.03 (0.73)	-0.03 (p=0.15)	3.01 (0.77)	3.03 (0.73)	-0.03 (p=0.15)

**Note:** Green shading represents a statistically significant difference.

### Supporting classroom behaviors

Students were asked to rate, on a scale of 1 = “strongly disagree”, 2 = “disagree”, 3 = “agree”, and 4 = “strongly agree” the extent to which they agreed that they demonstrated a set of classroom behaviors during the semester that they were using Achieve as their primary curricular material. The data were disaggregated by academic preparedness (measured by both HSGPA and college readiness) and differences calculated. In all but one case there was no meaningful differences in the average ratings between students less and more academically prepared. The difference between the average rating of agreement that students collaborate

with other students below the HSGPA mean and those above it was significant. Students less prepared tending to more strongly agree that they collaborated.

The results presented here provide early evidence that both more and less academically prepared students (whether measured by HSGPA at high school graduation or by a validated measure of college readiness). These insights are encouraging, especially because of what we know about perception being a leading indicator of engagement and persistence.



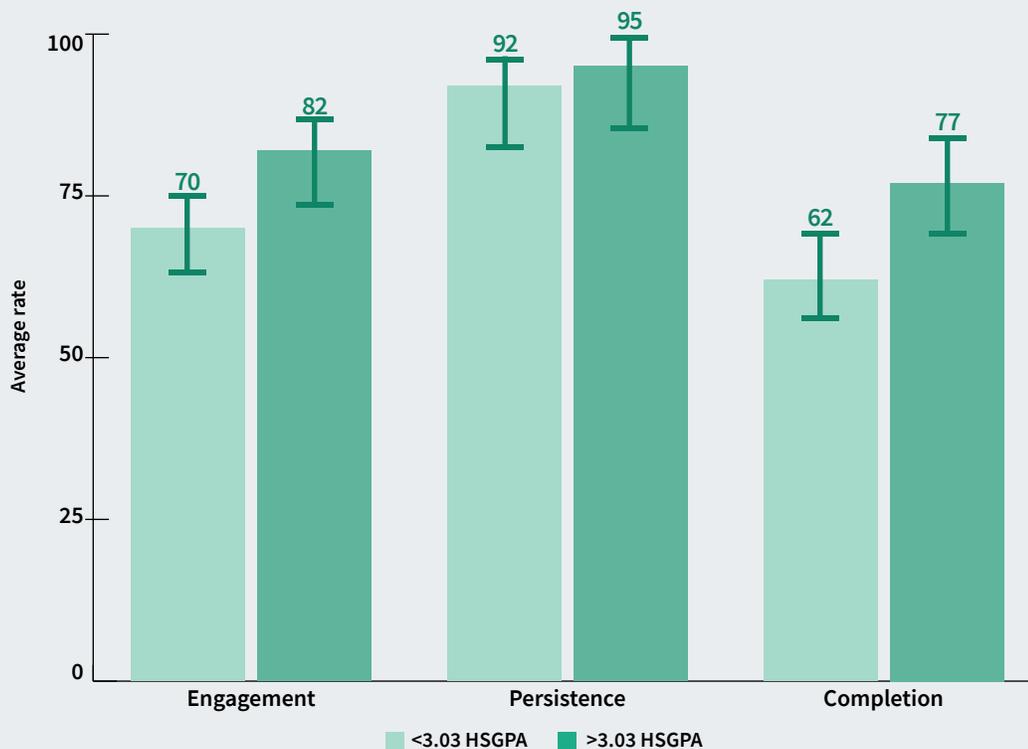
## RESEARCH QUESTION 2.

*Are there differences in engagement, persistence, or completion rates in Achieve among students less and more academically prepared to succeed?*

To examine whether there were differences in usage by academic preparedness as measured by high school grade point average, an independent-samples t-test was conducted to compare engagement rates among students who fell below the mean HSGPA and those who met or exceeded the mean HSGPA. There was a significant difference in the overall engagement ratings for students who fell below the mean (M=0.70, SD=0.26) and average ratings of students who met or exceeded the mean HSGPA (M=0.82, SD=0.20);  $t(1,873)=12.45$ ,  $p < 0.0001$ . These

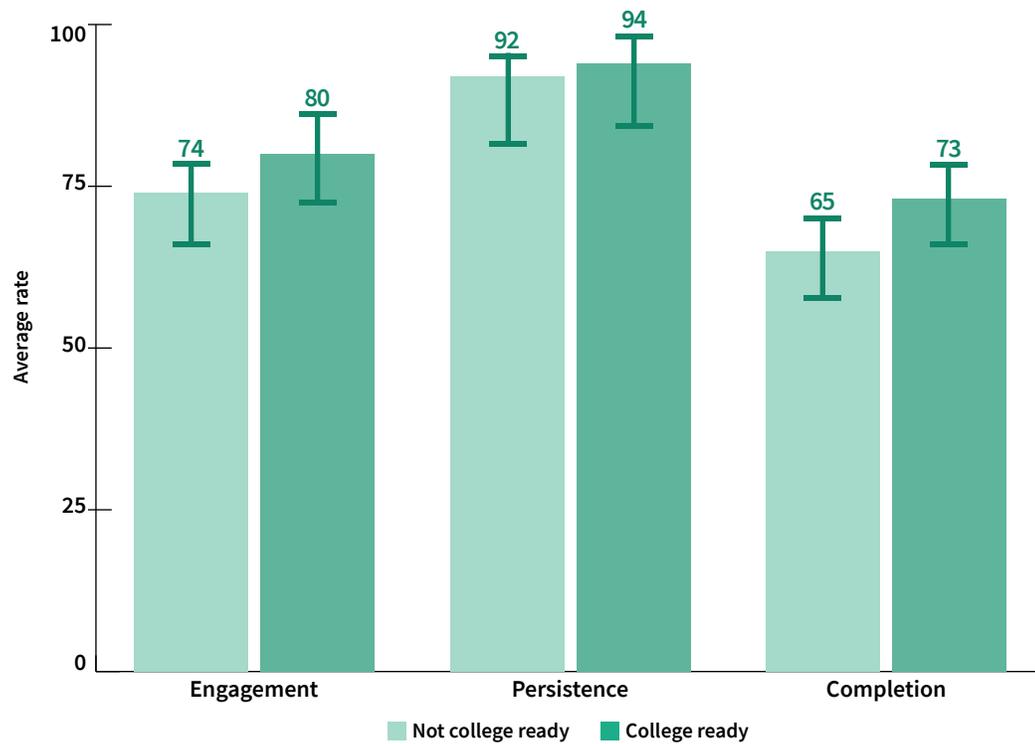
findings suggest that students who fell below the HSGPA average in the sample engaged in assigned activities in Achieve at a lower rate than their more academically prepared peers. Similarly there was a significant or meaningful difference in average persistence rate among less (M=0.92, SD=0.19) or more academically prepared students (M=0.95, SD=0.14);  $t(1,332)=-3.67$ ,  $p = < 0.001$  and in completion ratings, with students falling above the average HSGPA completing assignments at a rate of 15 percentage points higher  $t(1,873)=-12.45$ ,  $p < 0.0001$ .

**Graph 1. Engagement, persistence and completion rates by high school grade point average**





Graph 2. Engagement, persistence, and completion rates by college readiness status



To examine whether there were differences in usage by academic preparedness as measured by college readiness status, an independent-samples t-test was conducted to compare engagement rates among students who were classified as not college ready and those who were classified as college ready. There was a significant difference in the overall engagement ratings among students not college ready ( $M=0.74$ ,  $SD=0.24$ ) and average ratings of students who were college ready

( $M=0.80$ ,  $SD=0.22$ );  $t(1,366)=-4.80$ ,  $p < 0.0001$ . Similarly there was a significant or meaningful difference in average persistence rate among less ( $M=0.92$ ,  $SD=0.19$ ) or more academically prepared students ( $M=0.95$ ,  $SD=0.14$ );  $t(1,018)=-2.19$ ,  $p = < 0.001$  and in completion ratings, with students falling above the average HSGPA completing assignments at a rate of 8 percentage points higher  $t(1,364)=-5.89$ ,  $p < 0.0001$ .



### RESEARCH QUESTION 3.

*Is there a relationship between the engagement in Achieve and final exam scores and does the magnitude of the relationship vary based on student's prior academic performance?*

Research presented in Achieve Success suggested a relationship between engagement in Achieve and final exam scores when holding prior academic performance and baseline level of motivation constant. This study builds on that research by examining the differential efficacy of Achieve based on prior academic performance. Results of the Pearson correlation indicated that there was a significant positive association between engagement in Achieve and final exam scores,  $r(1,835) = .54, p < .0001$ .

Because research suggests that both HSGPA and college readiness are predictive of post-secondary success, we wanted to use both indicators to measure the differential efficacy of Achieve by level of academic preparedness.

#### HSGPA

Data were disaggregated by whether a student fell above or below the mean and correlations between engagement and final exam scores were

calculated within subgroups. When examined among students who fell below the mean (or less academically prepared) results of the Pearson correlation indicated that there was a significant positive association between engagement in Achieve and final exam scores,  $r(658) = .58, p < .0001$  and the same was true of students at the mean or above (or more academically prepared), a significant relationship emerged,  $r(961) = .42, p < .0001$ . Interestingly, when the relationships between the two subgroups are compared, use of Achieve is a stronger predictor of academic success among students less academically prepared as measured by HSGPA.

The data were further disaggregated by discipline to understand whether there were differences in the magnitude of the relationships by discipline. In each discipline the magnitude of the relationship was stronger among students less academically prepared — with a notable similar magnitude in Chemistry.

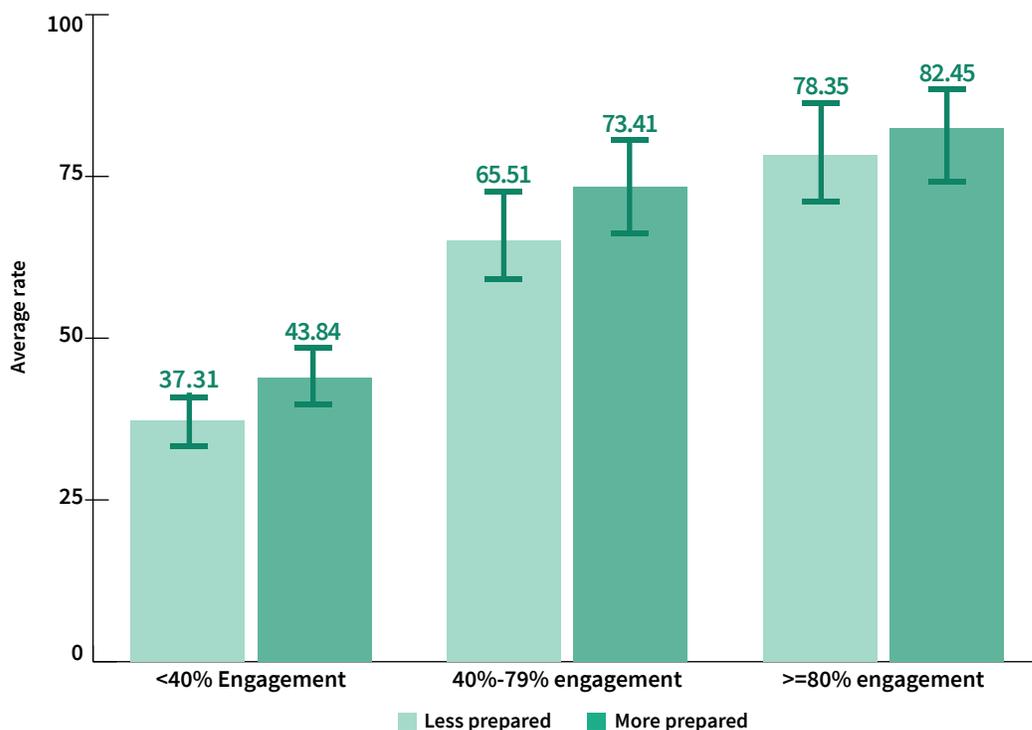
**Table 3. Differential efficacy of Achieve by high school grade point average and discipline**

	<u>Less prepared (&lt;HSGPA mean)</u>	<u>More prepared (&gt;=HSGPA mean)</u>
<b>All students</b>	$r(1,835) = .54, p < .0001$	
By academic preparedness	$r(657) = .58, p < .0001$	$r(961) = .42, p < .0001$
Biology	$r(74) = .42, p = .0002$	$r(103) = .34, p = .0004$
Calculus	$r(81) = .51, p < .0001$	$r(113) = .40, p < .0001$
Chemistry	$r(66) = .51, p < .0001$	$r(322) = .51, p < .0001$
Economics	$r(207) = .61, p < .0001$	$r(413) = .47, p < .0001$
Female STEM	$r(205) = .57, p < .0001$	$r(416) = .33, p < .0001$
Male STEM	$r(237) = .41, p < .0001$	$r(281) = .39, p < .0001$

**Note:** Green shading represents a statistically significant difference.



**Graph 3. Relationship between the rate of engagement in assigned Achieve activities and average exam scores by HSGPA**



We were also interested in understanding whether there were any differences in the magnitude of the relationships among students in STEM courses by gender. Results suggest that the strongest magnitude emerges among students who identify as female and come into college less academically prepared to succeed. These results suggest that use of Achieve can support the academic performance of female students in STEM courses to an even greater extent than their male or more academically prepared peers.

We wanted to further visualize the difference in the magnitude of the relationship between engagement in Achieve and final exam score by academic preparedness (and for ease of interpretation). To do so, we graphed average exam score by rate of engagement with Achieve among students who fell below the HSGPA average and those who met or exceeded it. Graph 3 illustrates

the positive relationship between engagement in assigned Achieve activities and final exam grades for both students who met or exceeded the mean HSGPA and those who fell below it. More interestingly, however, is that it shows that among students who engaged in between 40% and 79% of activities, there was nearly an eight percentage point difference between students who fell below the HSGPA mean and those who met or exceeded it. When considered among students who engaged in at least 80% of activities that gap decreased to four percentage points. These results suggest that less academically prepared students (as measured by HSGPA) who engage in at least 80% of assigned activities in Achieve could not only move their final exam grade from a D to a C+, but they could close the gap in their average performance and the performance of their peers who met or exceeded the average HSGPA by about half.



**Table 4. Differential efficacy of Achieve by college readiness status and discipline**

	Not college ready	College ready
<b>All students</b>	$r(1,835) = .54, p < .0001$	
College readiness	$r(335) = .51, p < .0001$	$r(1,602) = .50, p < .0001$
Biology	$r(56) = .38, p = .0031$	$r(85) = .22, p = .0402$
Calculus	$r(35) = .47, p = .0040$	$r(117) = .41, p < .0001$
Chemistry	$r(178) = .65, p < .0001$	$r(241) = .67, p < .0001$
Economics	$r(66) = .53, p < .001$	$r(420) = .54, p < .0001$
Female STEM	$r(157) = .42, p < .0001$	$r(306) = .39, p < .0001$
Male STEM	$r(89) = .46, p < .0001$	$r(317) = .33, p < .0001$

**Note:** Green shading represents a statistically significant difference.

### COLLEGE READINESS

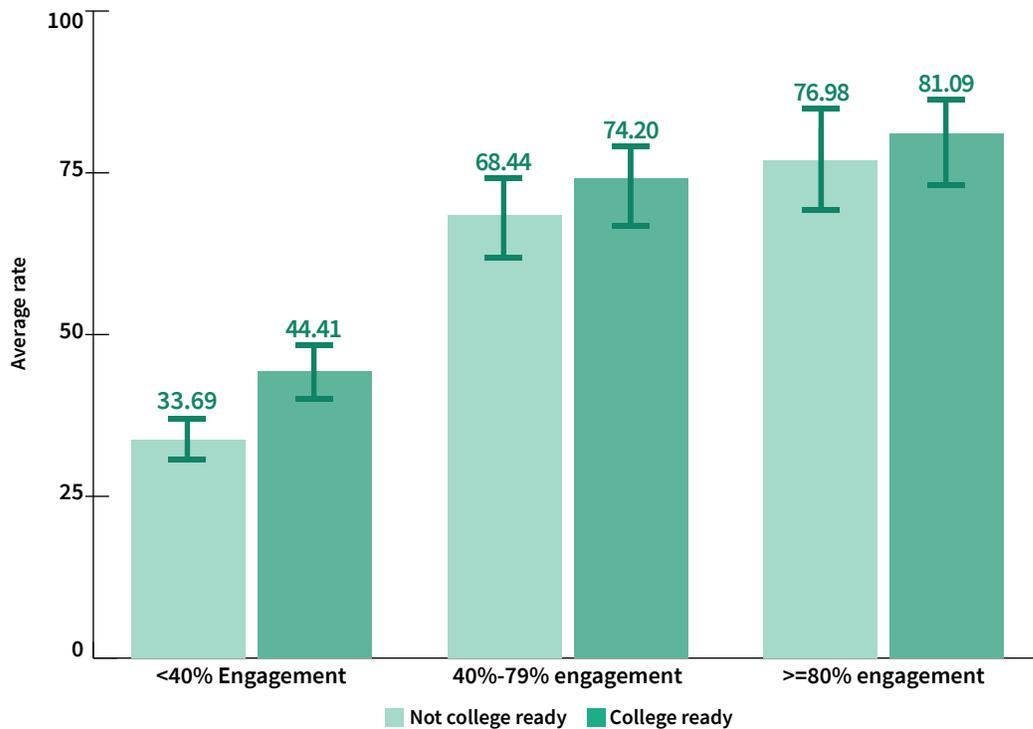
Data were disaggregated by whether a student was classified as college ready or not college ready based on their performance on the ACT or SAT and correlations between engagement and final exam scores were calculated within subgroups. When examined among students who were not college ready (less academically prepared) results of the Pearson correlation indicated that there was a significant positive association between engagement in Achieve and final exam scores,  $r(335) = .51, p < .0001$  and the same was true of students classified as college ready (more academically prepared), a significant relationship emerged,  $r(1,602) = .50, p < .0001$ . Interestingly, when the relationships between the two subgroups are compared, the magnitude of the relationship between use of Achieve and final exam scores was slightly stronger among less academically prepared students, similar to the finding when preparedness was measured by HSGPA.

The data were further disaggregated by discipline to understand whether there were differences in the magnitude of the relationships by discipline. Unlike when preparedness was measured by HSGPA, the magnitude of the difference was higher among college ready students in Chemistry and Economics, but the difference was minimal.

We were also interested in understanding whether there were any differences in the magnitude of the relationships among students in STEM courses by gender. Results suggest that, like HSGPA, the strongest magnitude emerges among students who identify as female and do not meet the college readiness benchmarks. These results suggest that use of Achieve can support the academic performance of female students in STEM courses to an even greater extent than their male or more academically prepared peers.



**Graph 5. Relationship between the rate of engagement in assigned Achieve activities and average exam scores by college readiness**



To further visualize this relationship and for ease of interpretation, we graphed average exam score by rate of engagement with Achieve by college readiness status. Graph 4 illustrates the positive relationship between engagement in assigned Achieve activities and final exam grades for both students who were college ready and those who were not college ready. More interestingly, however, is that it shows that among students who engaged in between 40% and 79% of activities, there was nearly a six percentage point difference between students

who fell below the HSGPA mean and those who met or exceeded it. When considered among students who engaged in at least 80% of activities that gap decreased to about four percentage points. These results suggest that less academically prepared students (as measured by college readiness status) who engage in at least 80% of assigned activities in Achieve could not only move their final exam grade from a D+ to a C, but they could close the gap in their average performance and the performance of their peers who were college ready by about half.



# Discussion

With the benefits of college success well documented, and the rates of degree and/or certificate completion so staggering, more can be done to help instructors support academic success among all of their students. We know that students entering college less academically prepared to succeed are more likely to take longer to complete their program or never complete the program at all. We also know that more academically prepared students can disengage if the coursework isn't engaging and challenging, putting them at risk of not completing. To that end, to complement their pedagogical approach, instructors should implement learning tools that support the academic success of less and more academically prepared students. Evidence of differential effectiveness should be available to instructors when they are making adoption decisions.

An investigation into the differential effectiveness of Achieve, a new digital learning solution, began while the tool was in beta. We undertook this so that real in-course data and feedback from instructors and students could be used to evolve the product, and so that we could provide instructors with a transparent body of evidence when the product was launched to allow them to assess whether Achieve was the right solution for their students and how to implement it.

Three research questions were investigated in this study to examine whether there were differences in perception, engagement, and/or relation to academic performance between less and more motivated students. Both students more and less academically prepared had positive perceptions of Achieve. There was no statistically significant difference in average Net Promoter Score ratings, ease of use ratings, or perception of Achieve supporting student mastery. When classroom behaviors were considered

there was only a significant difference in the average rating of collaboration with other students, and in this case there was a higher average rating among less academically prepared students. Evidence that there is no meaningful difference in ratings of perception is encouraging given that student perception is a leading indicator of engagement. If students less prepared had significantly lower average ratings they may be less likely to find value in Achieve or if students more prepared had significantly lower average ratings they may perceive Achieve not to be engaging or challenging enough, making them less likely to use it.

It was also important to investigate any meaningful differences in engagement, persistence, and completion. Students less academically prepared tended to engage in at a lower rate, on average, than students more academically prepared. Although this is not surprising given previous research we should work to understand this difference and support higher engagement rates among less academically prepared students. Interestingly, when considered by activity type, less academically prepared students have the highest engagement and completion rates within pre-class formative assessments. Given that pre-class formative assessments are adaptive and gamified, students less academically prepared may enjoy these activities more or find

“ One of the best parts of Achieve is being able to see on the instructor reports which students have skills gaps coming into the course— this way I can intervene to help get those students on track”

more value in them. In fact, when providing feedback on specific components all students rated these activities the highest. The development team might explore including more activity types like this as other features.

The third research question explored whether there was a relationship between use of Achieve and academic performance and whether academic preparedness moderated that relationship. That is, we wanted to measure whether both less and more academically prepared students benefited from Achieve. When academic preparedness of



measured both by HSGPA and college readiness the same pattern in the relationship between engagement and performance emerged. That is for students of both levels of preparedness there was a significantly positive relationship between the predictor and the outcome. And, the results suggest that These results suggest that less academically prepared students who engage in at least 80% of assigned activities in Achieve could not only move their final exam grade from a D to a C+, but they could close the gap in their average performance and the performance of their more academically prepared peers by about half. Because this research suggests that less academically prepared students benefit from engagement it is even more important that both educators and the developers of Achieve work to encourage more engagement among that subgroup of students.

The research presented in this report contributes to an important body of literature investigating ways to support student success in college. It also provides instructors with early evidence to suggest that use of Achieve will benefit their less academically prepared students in the same way that it will benefit their more academically prepared students. This work extends the research by classifying student academic preparedness both by HSGPA and by college readiness, given that preparedness is often categorized by performance on an initial exam in that course - however that is not a true indicator of academic preparedness for college, rather it is a baseline level of knowledge. And, the study was conducted using data from students at both two- and four-year institutions. Given that much of the research on post-secondary success is conducted among students at four-year institutions, the addition of other educational contexts is important.



# Limitations and future research

These findings are strong, valuable in guiding us refining Achieve, and we hope are valuable to interested educators. However, like most applied research there are limitations that are important to note. First, this study was conducted in the first of three semesters of beta testing so Achieve was still in development. Perception and engagement would likely be stronger when Achieve is more fully developed, but as noted it was important to conduct this research early so that instructors could use the findings when making adoption decisions. Second, these analyses are correlational and therefore causal statements cannot be made based on the results. The Fall 2019 replication study will provide us with the data that we need to have the power to conduct a propensity score match between less and more academically prepared students and look at differences. In the Fall 2019 semester a replication study is being conducted and it will give us the data that we need to enable a propensity score match between less and more academically prepared students enabling causal statements. Finally, this research focused only on less and more academically prepared students. In an effort to more robustly investigate the differential efficacy and help us understand whether Achieve is contributing to promoting equity in education, future research will look at the differences between other important subgroups, like first generation students and their peers who are not the first in their family to attend college.

In an effort to offer timely, peer reviewed insights to instructors, we are grateful to the Impact Research Advisory Council for their peer review of this report. Their guidance and critique since we began developing our approach to efficacy, ongoing insight throughout each study, and honest reviews of findings have been invaluable. Chris Dede, Michael Feldstien, Sara Finney, Suzanne Lane, Thanos Patelis, and Elana Zieda we are indebted to you.



# Note on data privacy

Prior to data collection, this study and the associated consent forms and instruments were reviewed and approved (found exempt) by the Human Resources Research Organization (HumRRO). HumRRO is a third-party Institutional Review Board organization with no affiliation with Macmillan Learning (federal wide assurance number 00009492 and IRB number 00000257). Macmillan Learning seeks independent and unfunded third-party review to eliminate any bias in decision of exemption. Macmillan Learning then seeks local Institutional Review Board approval at each participating institution, where required. The data collected in this study, which are provided by the instructor and consenting students, are initially identifiable. However, once a random identifier is generated identifiable data are destroyed. Data are provided in secure storage locations, and access is permitted only to the primary investigator in the study. For full details of our data handling and storage privacy procedures, contact Kara McWilliams, Vice President Impact Research at Macmillan Learning at [kara.mcwilliams@macmillan.com](mailto:kara.mcwilliams@macmillan.com).



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## APPENDIX

Table A1. Student demographic information by proportion and sample

	% Sample 1	% Sample 2
<b>Dicipline</b>		
Biology	9.85	10.85
Calculus	10.56	11.45
Chemistry	34.65	31.57
Economics	35.03	38.32
Composition	9.90	7.81
<b>Year in college</b>		
Dual enrolled	4.33	4.97
First	58.09	66.38
Second	20.51	17.27
Third	10.18	6.42
Fourth	3.78	3.11
Fifthe	0.85	0.66
Other	2.12	1.19
<b>Eligible for federal financial aid</b>		
Eligible	64.11	63.69
Ineligible	35.89	36.31
<b>First generation</b>		
Yes	22.77	19.77
No	77.23	80.23
<b>Gender</b>		
Male	44.49	45.95
Female	54.90	53.54
Prefer not to say	0.61	0.51
<b>Taking the course as a disiple requirement</b>		
Yes	71.74	71.56
No	28.76	28.44
Traditionally underrepresented (yes)	27.94	26.20
Average HSGPA	3.65	3.74
Average summative assessment score	75.17	76.47
Average final exam score	75.09	76.08



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Kara is passionate about researching the impact of digital technologies in higher education, and how insights can inform teaching and learning. She has ten years of experience conducting qualitative and quantitative investigations of how course and classroom interventions can improve learner outcomes and influence learning gains. She holds a doctorate in Educational Research, Measurement and Evaluation and a master's degree in Curriculum & Instruction from Boston College.

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## **About Macmillan Learning**

Macmillan Learning improves lives through learning. Our legacy of excellence in education continues to inform our approach to developing world-class content with pioneering, interactive tools. Through deep partnership with the world's best researchers, educators, administrators, and developers, we facilitate teaching and learning opportunities that spark student engagement and improve outcomes. We provide educators with tailored solutions designed to inspire curiosity and measure progress. Our commitment to teaching and discovery upholds our mission to improve lives through learning. To learn more, please visit <http://www.macmillanlearning.com> or see us on Facebook, Twitter, LinkedIn or join our Macmillan Community.

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## **About the Learning Science and Insights Team**

As the Learning Insights company, we are passionate and scientific about helping students, instructors, and institutions to achieve their full potential. We use a unique combination of user-centered design, research from the learning sciences, and empirical insights from extensive data mining and Impact Research. To learn more about this approach, please visit <http://www.macmillanlearning.com/catalog/page/learningscience>