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# Low-Stakes Mathematics Placement and Preparation Using EdReady

DAVID THORNTON, PH.D.
*Jacksonville State University*

JAN CASE, ED.D.
*Jacksonville State University*

COURTNEY PEPPERS, M.A.
*Jacksonville State University*

Students at the public four-year institution Jacksonville State University were underprepared for college math and were stalled by a repetitive cycle of failure with remedial math courses and discontinuity from being sent back to the beginning the following semester without regard for academic progress. By replacing the classic high-stakes testing and traditional course structure with a simple, well-mapped placement and study path model, JSU students are moving on to their credit-bearing math courses in less time, at lower cost, and with significantly higher success rates in their subsequent math courses. Over the span of three years, enrollment in developmental courses dropped from over 500 students to less than 140.

Keywords: placement, remediation, low-stakes, college readiness.

## INTRODUCTION

Nationwide, one-third of students entering a four-year institution require mathematical remediation (Attewell, Lavin, Domina, & Levey, 2006); (Bailey, Jeong, & Cho, 2010). This lack of preparation typically leads to poorer student outcomes (Barry & Dannenberg, 2016), where the high failure rate associated with these non-credit, remedial courses delays students and increases their student loan debt. Moreover, at Jacksonville State University, of the roughly 50 percent of students who completed remedial math, only about 50 percent of *them* were successful in their subsequent college-level math class. This is consistent with findings by Hughes/Clayton (2010), who uncovered no evidence of improved student outcomes after placement into remediation. Whether this is more the fault of poor placement or poor remediation, both stand to provide better outcomes for the student and institution.

David Thornton is an Associate Professor of Computer Science at Jacksonville State University, Jacksonville, AL, USA. Email: thornton@jsu.edu
Jan Case is a Professor of Mathematics at Jacksonville State University, Jacksonville, AL, USA. Email: jcase@jsu.edu
Courtney Peppers is the Director of Learning Services at Jacksonville State University, Jacksonville, AL, USA. Email: cpeppers@jsu.edu

This problem is of particular concern at JSU, where the six-year graduation rate of 31 percent lags well behind the national median of 40 percent (Department of Education, 2018). Poor placement and remediation imposed a hardship on students and their families, and it cost JSU millions of dollars in lost tuition revenue when failing students dropped out of school (Beckett, 2015). While student performance is based on many factors besides academic ability (Armstrong, 2002), these were two areas within institutional control.

Like most institutions, JSU historically relied on high-stakes exam scores—from Compass, SAT, and ACT—to place students in appropriate math courses, including developmental math. Such tests are considered high-stakes because they are used to make major decisions about a student's educational path based on a one-time data sample. Students often do not grasp the consequences, financial and otherwise, of such high-stakes exams (Safran & Visher, 2010). Seeking better student outcomes, the JSU administration charged the faculty with developing a better, faster, and more cost-effective way to improve college-math readiness.

Led by the Learning Services and mathematics departments, JSU tested the traditional high-stakes placement model against a low-stakes approach supported by the online adaptive learning mathematics platform, EdReady. With EdReady, students take an initial diagnostic exam, which identifies knowledge gaps and produces a personalized study path, akin to the Hughes/Clayton (2010) concept of "actionable assessment," based on the student's goals. If a higher-level math course is required by a student's major, that study path will be tailored to that goal. Such an approach is "low stakes" in that the exam score is predictive but not conclusive or final in nature.

Low-stakes exams have proven to be a reliable diagnostic tool for college algebra readiness (Hilgoe, Brinkley, Hattingh, & Bernhardt, 2017) with less cost and better reliability than some standard high-stakes exams (Scott-Clayton, 2012). In comparison, classic placement exams like Compass and ACCUPLACER provided less predictive information than high school GPA (Belfield & Crosta, 2012) or the ACT math score (Medhanie et al, 2012), though ACCUPLACER was more predictive in some studies (Mattern & Packman, 2009), especially in regard to math content.

EdReady also made possible an "Emporium Model" approach for students who do not succeed at their first attempt in a developmental course. With Emporium, students benefit from a more personalized learning approach wherein lecture is replaced with personalized assistance and self-pacing. This model has become popular with developmental and even upper-level math courses (Barbara S. Bonham & Hunter R. Boylan, 2011).

## Research Questions

The authors evaluated the effectiveness of this placement/ pathway approach with the following research questions:

1. Have the number of students placed in developmental courses decreased at JSU after the use of the EdReady Placement/Pathway approach?
2. Have the pass rates in a JSU student's first credit-bearing math course improved at JSU after the use of the EdReady Placement/Pathway approach?
3. Is the current EdReady Placement/Pathway approach more accurate in judging if students are prepared for their college-level math class than those placed by the old system of ACT/SAT or Compass?

## The EdReady Placement/Pathway Approach

### Partnership with NROC

The shared purpose of a learning-centered community has been the foundation for a JSU/NROC partnership that changes the way college readiness is approached and supported. The NROC Project is sustained by NROC member institutions, The William and Flora Hewlett Foundation, the James Irvine Foundation, and the Bill & Melinda Gates Foundation (The NROC Project).

In the summer of 2011, after a meeting at the American Association of State Colleges and Universities (AASCU) Conference, JSU and NROC entered into a membership agreement, and initial use of NROC's online resources in JSU courses began immediately. During this period, other personalized learning courseware offerings were considered, including ALEKS (Assessment and LEarning in Knowledge Spaces). Cost was the deciding factor, with EdReady's fee of $1 per full-time enrolled student compared to $25 with ALEKS.

In 2014, NROC launched their new online adaptive learning platform, EdReady; through beta testing, JSU was the first institution to see its potential for solving a stubbornly persistent problem: students who are not ready for college math. JSU's mathematics department curriculum committee meticulously pored over the skills necessary for success in credit-bearing math classes and matched these prerequisite skills to the list of objectives offered through EdReady. NROC then created an EdReady assessment that evaluated the student's status and created a personalized study path to address any deficiencies. By February 2015, a pilot program was in place using EdReady for evaluation and assistance in

mastery of prerequisite topics. The program was initiated campus wide in summer 2015 and is now the method of assessment and placement for every student at JSU.

### The JSU EdReady Model

Table 1 contrasts the core ideas of the JSU EdReady model with traditional placement.

**TABLE 1**
**Comparison of Traditional Placement with the JSU EdReady Model**

| Traditional Placement | JSU EdReady |
|---|---|
| High-stakes placement exams | Low-stakes diagnostic with personalized study path |
| One-time assessment | Unlimited use of improvement and evaluation tools |
| Focus on placement | Emphasis shifted to readiness, improvement, retention, and completion |

Student support begins with admission, where all students receive EdReady information and log-in instructions upon acceptance. Before freshman orientation, each student receives, via email, a reminder to take the EdReady initial diagnostic; also included in the email is contact information should students have questions. The diagnostic is taken online and is unproctored. At orientation, students are advised to follow their EdReady study path so that they can skip developmental math. If students enroll in developmental math, however, they are supported in classes with low student-to-teacher ratios (20:2), a paper-and-pencil workbook aligned with the EdReady content, and free access to tutoring and proctoring. In addition, a Fast Forward Algebra course (labeled "MS 100 Accelerated" in Figure 1) has been created for those students in need of the most extensive remediation and these sections have an even lower student-to-teacher ratio (15:2).

Because attempting to pass a developmental course multiple times is costly to students, JSU instituted a "one attempt only" policy, followed by a free emporium model. Students who do not pass developmental math on their first attempt are registered for LS 106 Algebra Emporium, a zero-credit, zero-cost emporium with the same 15:2 student-to-teacher ratio as Fast Forward Algebra. Not only does this model provide more individualized instruction, but students also begin right where they left off in their previous attempt. A description of the two classes follows:

- **MS 100, Intermediate Algebra for Precalculus**: Operations and properties of real numbers, rates and proportions, units and measurement, elementary plane geometry, linear equations and inequalities, exponents and polynomials, factoring algebraic expressions, graphing in the cartesian plane, systems of equations and inequalities, rational and radical expressions, and functions.
- **LS 106, Algebra Emporium**: This zero-credit emporium is a mandatory laboratory for students who have received an "NC" in MS 100. The learning environment in the laboratory will be individualized and mastery-based to enable students to prepare for their first general education mathematics course.

The JSU EdReady model is depicted in Figure 1.

To communicate the model in a way that is easy to digest for both advisors and students, the flowchart in Figure 2 separates the STEM and non-STEM paths and enumerates the stages of student progress.

## Methods

### Student Population

The initial pilot study took place during the 2014–2015 academic year, when EdReady was optional for placement. That year, 338 students were placed by EdReady, with the other 630 placed by traditional, high-stakes exams. Together, these 968 students represented 82 percent of the 1,185 first-time freshmen.

The following year, EdReady became the mandatory placement exam. Following are some top-line student enrollment data for the 2015–2016 academic year (Simmons, 2015):

- Total Enrolled: 8,314
- White: 5,899
- Black/African American: 1,839
- Male: 3,523
- Female: 4,791
- Undergraduate: 7,383

### The Diagnostic

NROC and JSU worked together to set the raw cutoff scores, which are displayed in Figures 1 and 2. JSU's math curriculum committee determined the course objectives. Next, JSU defined two mathematical paths, as shown in Figure 2: STEM and non-STEM. While there are a variety of STEM definitions and major lists, the authors defined STEM majors as those that required Pre-Calculus Algebra.

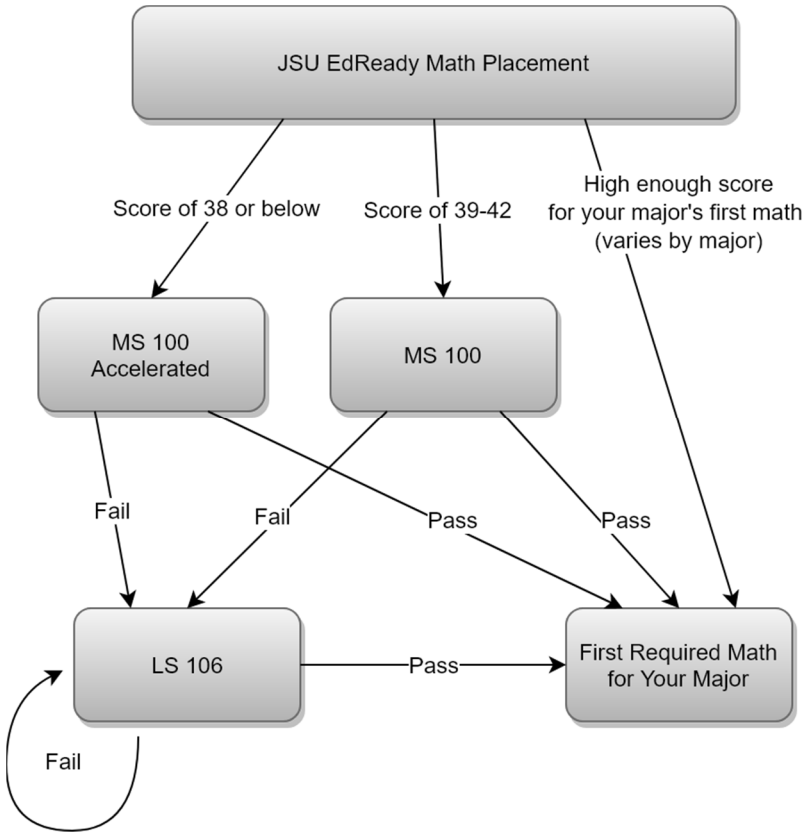


**Figure 1. JSU EdReady Math Model, Fall 2015.**

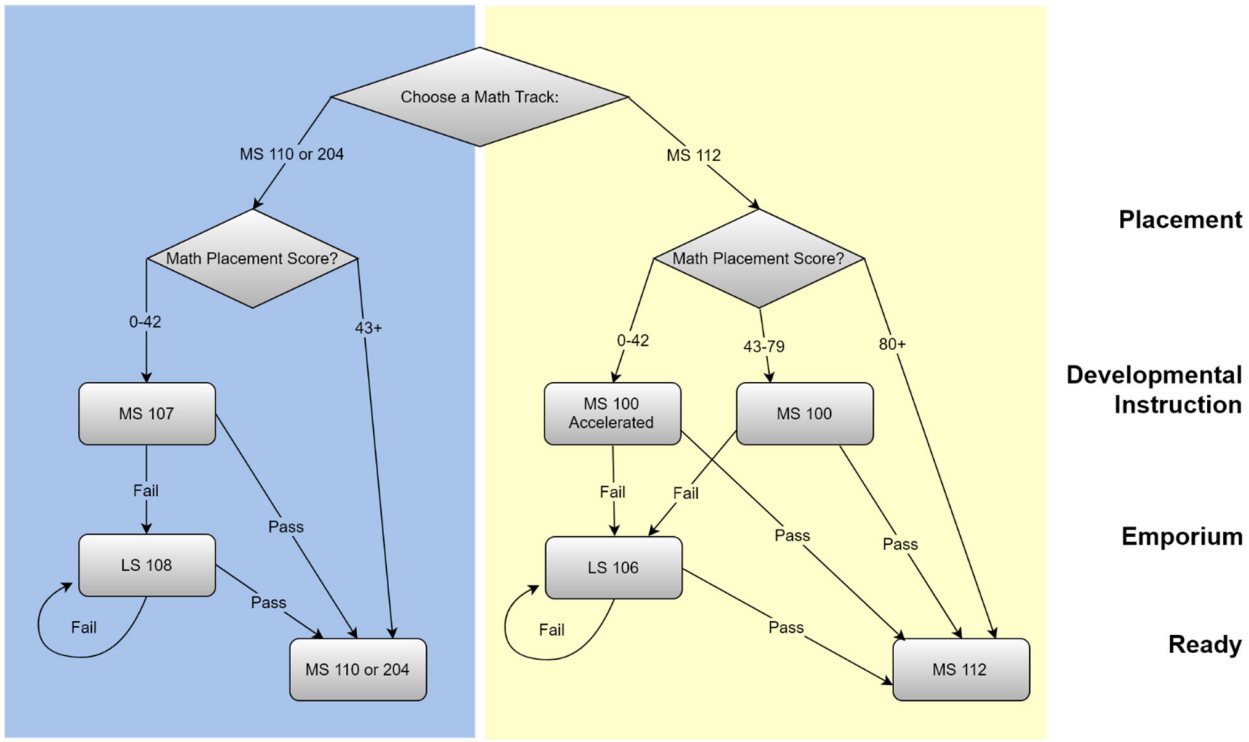


**Figure 2. JSU EdReady Math Model, Fall 2017.**

During the pilot, the target scores shown in the Figure 1 were estimated using logistic regression, as recommended by Sawyer (1996). A cutoff score of 43 was chosen as the target score for lower-level, non-STEM courses. Because placement tools nationwide tend toward underplacement (Rodríguez, Bowden, Belfield, & Scott-Clayton, 2015), JSU initially set the target score for the STEM path at 70. This score gave students an 84 percent chance of earning a grade of "C" or higher. This target score was raised to 80 by the 2017–2018 academic year, as course objectives were tweaked. Reliability and validity statistics have not been published by EdReady.

## Results

*Research Question 1: Have the number of students placed in developmental courses decreased at JSU after the use of the EdReady Placement/Pathway approach?*

As hoped, improved student outcomes have led to a decrease in demand for developmental math courses. Before the conversion to EdReady, JSU offered an average of 20 sections of developmental math in the fall semester and 15 sections in the spring, each with an enrollment limit of 30 students. As shown in Table 2, the number of sections as well as the enrollment limit have steadily decreased.

*Research Question 2: Have the pass rates in a JSU student's first credit-bearing math course improved at JSU after using the EdReady Placement/Pathway approach?*

In fall 2015, STEM majors were significantly more likely than non-STEM to fail their first credit-bearing math course (Pearson Chi-Square = 14.005, DF = 1, P-Value = 0.000; Likelihood Ratio Chi-Square = 14.226, DF = 1, P-Value = 0.000). STEM majors were significantly more likely than non-STEM to receive grades of F, W, or I in their first credit-bearing math course (Pearson Chi-Square = 3.814, DF = 1, P-Value = 0.051; Likelihood Ratio Chi-Square = 3.880, DF = 1, P-Value = 0.049).

For visual comparison, the grade distribution for MS 110 (non-STEM track) and MS 112 (STEM track) for fall 2015 to fall 2017 are shown in Figure 3.

As shown, since using EdReady for placement, students enrolled in MS 112 (college Algebra) have maintained a grade of C or better. A study by SRI Education (Griffiths et al, 2018) found that students placed by EdReady did not differ in pass rate in credit-bearing math courses.

**TABLE 2.**
**Number of Sections and Enrollment Limit for Developmental Math, Fall 2014 to Fall 2017**

| Semester | Number of Sections | Enrollment Limit |
|---|---|---|
| 2014 Fall | 19 | 30 |
| 2015 Spring | 16 | 30 |
| 2015 Fall | 12 | 25 |
| 2016 Spring | 11 | 25 |
| 2016 Fall | 14 | 20 |
| 2017 Spring | 9 | 20 |
| 2017 Fall | 7 | 20 |

*Research Question 3: Is the current EdReady Placement/ Pathway approach more accurate in judging if students were prepared for their college level math class than those placed by the old system of ACT/SAT or Compass?*

Comparisons between traditional placement and EdReady placement were observed during the 2014–2015 academic year, when EdReady was optional for students. Students placed by EdReady were significantly more likely to pass their subsequent college math class with a grade of C or better than students placed by traditional methods (Pearson Chi-Square = 6.449, DF = 1, P-Value = 0.011; Likelihood Ratio Chi-Square = 6.559, DF = 1, P-Value = 0.010). Figure 4 contrasts performance in students' first credit-bearing math courses.

STEM students placed by EdReady were from 2.1 percent to 13.6 percent less likely to receive grades of W, I, or F in their college math class (Z=2.66, p=0.008). Figure 5 shows this contrast between traditional placement and EdReady regarding students' grade distribution in their first credit-bearing math courses.

## Discussion

### Major Findings

By replacing classic high-stakes testing and traditional course structure with a simple, well-mapped placement and study path model, JSU students are moving on to their credit-bearing math courses in less time, at lower cost, and with significantly higher success rates in their subsequent math courses. Over the span of three years, enrollment in developmental courses dropped from over 500 students to fewer than 140. At the same time, undergraduate enrollment increased by 1.5 percent, with little variation in demographics. Lastly, average ACT math scores remained identical for first-time, full-time freshmen, as shown in Table 3 (Simmons, 2015, 2017).

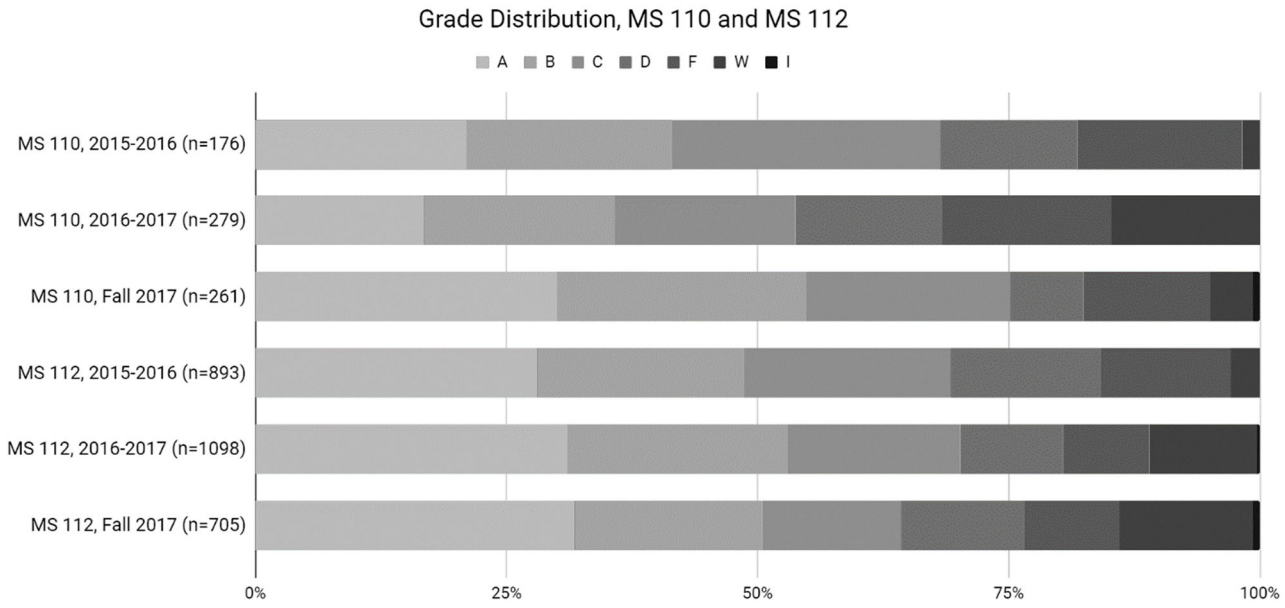


**Figure 3. Grade Distributions for MS 110 and MS 112, Fall 2015 to Fall 2017.**

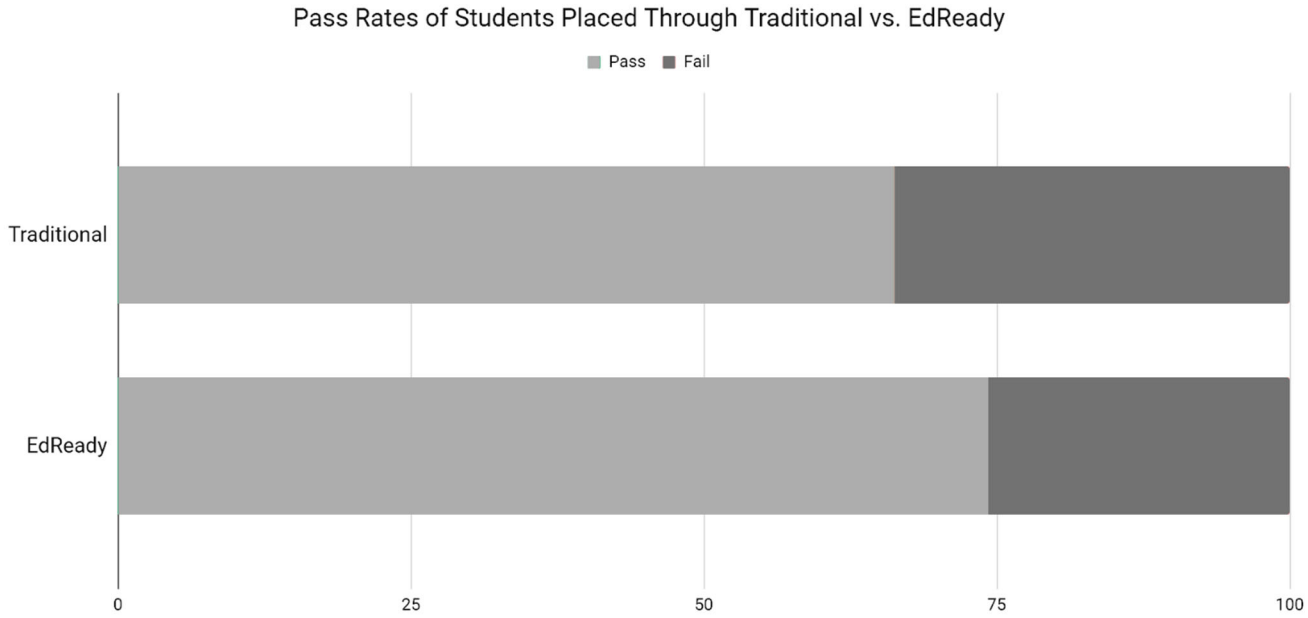


**Figure 4. Student Pass Rates in First Credit-Bearing Math Course, EdReady Placement Vs. Traditional, 2015–2016 Academic Year.**

This decrease in demand for developmental courses suggests that students are benefiting from faster progress while the university wastes less money on extra faculty. Whether this translates to a higher six-year graduation rate is likely, but yet unknown.

**TABLE 3.**
**Enrollment Demographic Comparison of 2015–2016 and 2017–2018 Academic Years.**

| | 2015–2016 | 2017–2018 |
|---|---|---|
| Total Enrolled | 8,314 | 8,567 |
| White | 5,899 | 6,176 |
| Black/African American | 1,839 | 1,609 |
| Male | 3,523 | 3,546 |
| Female | 4,791 | 4,974 |
| Undergraduate | 7,383 | 7,491 |
| Average ACT Math Score, First-time, Full-time Freshman | 21.4 | 21.4 |

There was some challenge with getting reliable numbers regarding student success with college algebra because it was not a stationary target. During the period of this study, the math department experimented with a variety of supplemental materials (textbook, workbooks, etc.) and staffing (faculty vs. adjunct). A future study would control these variables and would likely provide a more reliable result.

## Cost

In terms of affordability, the JSU EdReady low-stakes placement is extremely low cost for all students, and is, in fact, free for motivated students who are not in need of extensive remediation. JSU pays $1 per FTE annual fee ($9,000) to support The NROC Project and has chosen to provide the placement resources to all students at no cost. Those students who show deficiencies in necessary topics as measured by their initial assessment use EdReady to review and master the topics. If they can do so before classes begin, they may register for their credit-bearing math course. Those who are unable to independently master the topics may enroll in a one-time course and a subsequent free emporium if needed. Therefore, the student cost is limited to a maximum of the cost of one course, and every effort is made to assist students in independently completing their review.

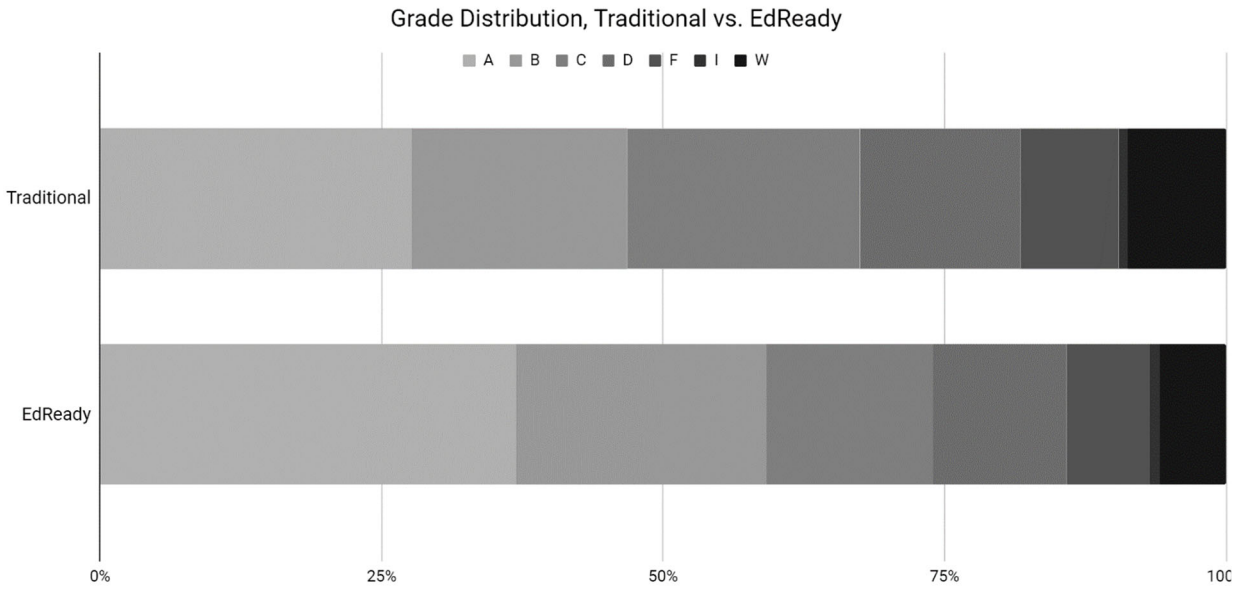


**Figure 5. Grade Distributions in First Credit-Bearing Math Course, EdReady Placement Vs. Traditional, 2015–2016 Academic Year.**

### Need for Campus-Wide Coordination

The inner team for this project consists of the JSU Department of Learning Services and the Department of Mathematical, Computing, and Information Sciences (MCIS) and The NROC Project, but the connections radiate far from the core. The initial support from JSU Dean Earl Wade and Provost Rebecca Turner represents the leadership buy-in that was present while the project was still in the "What if?" stages. But nothing could have been accomplished without the dedicated support teams consisting of orientation leaders, advisors, IT, tutors, instructors, teaching assistants, and clerical staff. This success is a team effort in the truest sense.

### Sustainability

To sustain this new approach, time and effort have been invested in professional development. All project administrators, instructors, teaching assistants, and clerical staff meet at the beginning and end of each semester for a two- to three-hour debriefing and planning session. The meeting area is arranged in a circle to guarantee that every voice is heard and respected equally from undergraduate to department head. These meetings have been crucial to the success of the project, with a distinct evolution in content and focus. Initially, the meetings were consumed by logistics such as how the single sign-on should work and finding the best way to provide student progress information to advisors. The most recent meetings have gravitated toward deep dives into best practices.

Another important contribution to faculty development is the annual NROC Member Meeting. A JSU delegation including as many team members as possible attends to share experience and absorb innovation from other members.

## Continuing and Future Work

The students placed by EdReady will be tracked throughout their college experience using a combination of EdReady reporting features and institutional data. JSU has conducted trainings, webinars, and special information sessions with institutions such as Bitterroot College, Hawaii CC system, Pasadena CC, and Mohave CC that are in various stages of replicating the JSU model at their institution.

EdReady has become part of JSU culture, with a part-time coordinator hired in 2016 to field emails, calls and student/parent questions. Further, a full-time coordinator was hired in 2018 to provide additional student support and progress monitoring. As more students place out of developmental math, classroom size reduction means that students with the greatest need will benefit from even smaller, individualized classes. Formal training manuals for instructors and teaching assistants have been developed and are used for staff training, which maintains institutional memory for best practices and allows for replication and sustainability.

In 2015, JSU was the first university in the country to employ EdReady for low-stakes, unproctored mathematical placement and preparation. In an effort to expand the success of the project nationwide, The NROC Project entered a strategic partnership with American College Testing in 2017, and the EdReady program is now available as an "out of the box" learning tool for users nationwide as "ACT CollegeReady."

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