An analysis of the Predictive Power of Easily-Calculated Early Warning Measures in Gateway Mathematics Courses

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ABSTRACT

Existing institutional and departmental data for all 163 students enrolled in Intermediate Algebra (SIU's remedial mathematics class) in the Spring of 2013 were analyzed, including the following: ACT math sub score, a non-proctored SIU mathematics placement exam scores, a proctored SIU mathematics placement (MP) exam score, the quiz/homework grade at the 3-week mark (HQ), and the grade from the first classroom test (T1), also given in week 3. These scores were used to create a weighted metric that would be able to identify which students would successfully pass Intermediate Algebra. Two factors–the ACT mathematics sub score and the non-proctored SIU mathematics placement exam score–were determined to offer insignificant added predictive value and, as a result, were excluded from the metric. The results of the students' individual weighted metrics in the third week of class correctly identify 74.4 percent of students who did not successfully complete the course in Spring 2013.

INTRODUCTION

A large number of students graduate every year from United States' high schools unprepared for college level mathematics work (Wirt et al., 2004). While what constitutes "unprepared" for college mathematics may vary considerably from one institution to the next, the result is that these students are placed into remedial courses designed to improve their mathematical ability. Approximately 22 percent of students nationwide require remediation in mathematics, (Parsad, Lewis, & Greene, 2003) and while remedial classes are intended to help students succeed, the data on their effectiveness is mixed. Some researchers have found support for remediation (Bahr, 2008; Kreysa, 2007; Lesik, 2007), while others have found evidence that even though remediation improves mathematical skills, it does not necessarily result in college retention and degree attainment (Bahr, 2012; Attwell, Levin, Domina, & Levey, 2006; Johnson & Kuennen, 2004). In fact, some researchers have found evidence that remedial education can have negative effects on degree attainment (Johnson & Kuennen, 2004; Bahr, 2012). Thus, while remediation is prevalent at the college level, there is little consistent evidence that taking remedial classes in their current format results in students being retained and graduating.

Completing remedial mathematics courses can improve students' mathematical skills and likelihood of attaining a degree, but few students actually complete the remediation courses successfully. Furthermore, successful results are not seen in students who require excessive amounts of remediation. Bahr (2010) found that completing a remedial mathematics class successfully increased students' likelihood of earning a passing grade, a *D* or higher, in a college-level mathematics class. Crisp and Nora (2010) found that students who were identified as needing remedial college courses and chose to take them were more likely to earn a degree at a 2-year institution than students who were identified as needing remediation but chose not to take it.

While remediation courses seem to increase mathematic abilities, studies have shown that the more remediation that is required in order to graduate, the less likely a student is to continue toward any degree. This is especially true for longer-term degree attainment goals such as Bachelor's degrees. Bahr (2008) found that students who successfully completed mathematics remediation were just as likely to obtain a degree as students who placed out of remedial mathematics classes. Unfortunately, only approximately 75 percent of students placed in remedial mathematics classes completed the courses successfully, with the cutoff for passing being a *D* or higher (Bahr, 2008). Even fewer of these students passed with a *C* or higher, which is often the cutoff grade for passing at other institutions. In addition, Kolajo (2004) found that the more developmental classes a student is required to take in order to attain a degree, the less likely they are to graduate. Persisting longer may ultimately result in degree attainment for remedial students, but the longer a student is required to persist in order to attain a degree, the less likely they are to actually do so (Bahr, 2012).

HYPOTHESIS

We expected that the students that are identified as high-risk students (Red/Orange) at the end of the 3rd week of their Intermediate Algebra class would be less likely than students identified as not at risk (Green) to pass the class with a C or better.

METHODS

Participants:
- 163 SIUC college students enrolled in Intermediate Algebra in the Spring of 2013

Procedures:
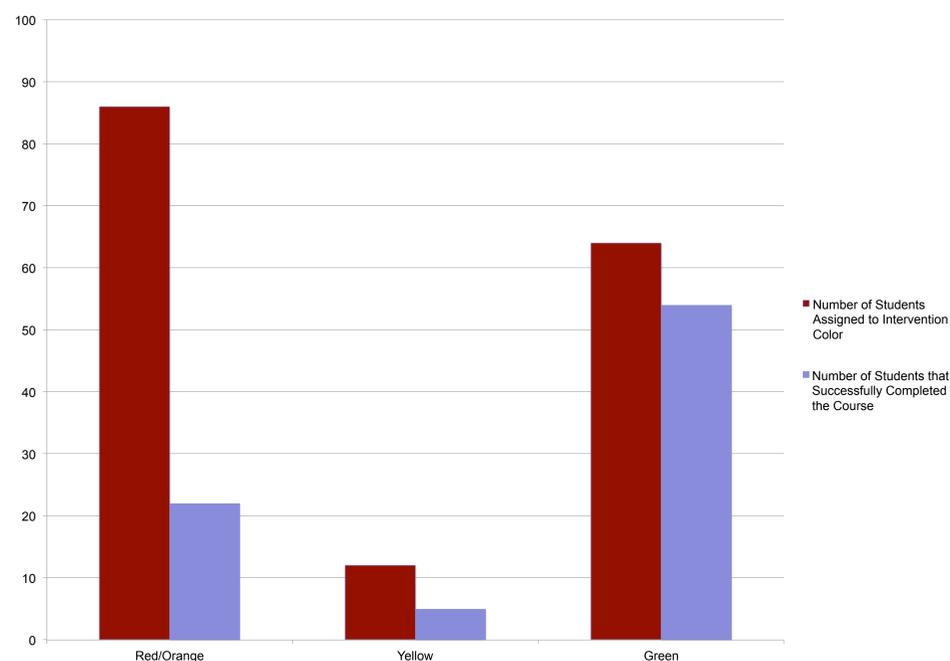Students' existing Intermediate Algebra data was examined.

Measures:
- ACT Mathematics sub-score- The mathematics' portion of the ACT's score
- Non-proctored mathematics placement exam score-A non-proctored mathematics-placement exam administered before the semester begins in order to place students in the appropriate level of mathematics at SIU
- .Proctored mathematics placement exam score- A proctored mathematics-placement exam administered before the semester begins in order to place students in the appropriate level of mathematics at SIU
- Quiz and homework grades-All homework and quiz grades from the first three weeks of class
- First test score- The first Intermediate Algebra test was administered during the third-week of classes
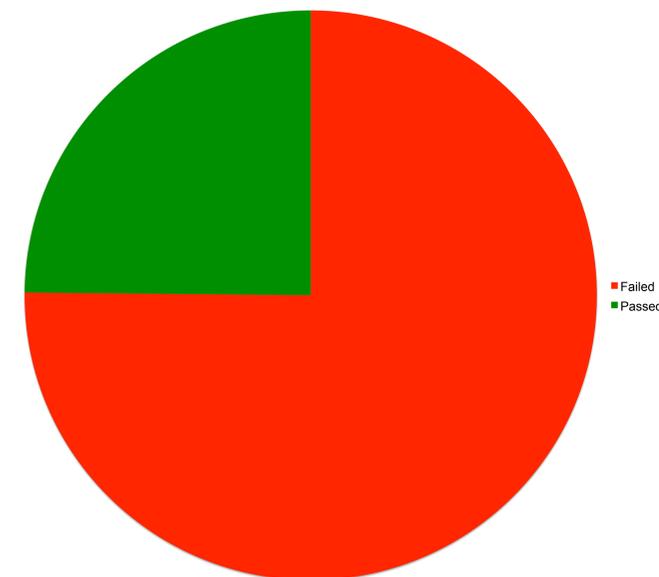
RESULTS:

Two factors–the ACT mathematics sub score and the non-proctored SIU mathematics placement exam score–were determined to offer insignificant added predictive value and, as a result, were excluded from the metric. The resulting weighted metric M_1 was the following:

$M_1 = .25*MP + .25*HQ + .5*T1$. Since certain students missed the proctored math placement exam, an alternative metric M_2 was designed that ignored MP and weighted T1 more highly.

$M_2 = .25*HQ + .75*T1$. The metric M for each student was the greater of M_1 and M_2.

In Spring 2013, the researchers found that of the 86 of the 163 students enrolled in Intermediate Algebra were identified by M as being at risk. Of these at-risk students, 64 did not successfully complete the course with a C or better (the threshold required for entrance into the credit-bearing College Algebra course). Thus, the metric correctly identified 74.4% of those students who did not successfully complete the course in Spring 2013.

Intermediate Algebra Success Rate of Red/Orange Students

Legend: Failed, Passed

Number of Students Assigned to Each Intervention Color and Their Pass Rates

Legend: Number of Students Assigned to Intervention Color; Number of Students that Successfully Completed the Course

DISCUSSION AND IMPLICATIONS:

The results of this study indicate that it is possible to use an easily calculated metric to predict student success in a remedial mathematics course as early as during the first 3 weeks of class. This early identification provides students with the opportunity to change their behaviors in the course or to drop the course without receiving a failing grade. In addition, allocation of resources can be optimized with targeted support systems and ILPs.

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