Exploring the Transition from High School to College: The Mathematics Placement Exam

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Introduction

One of a student's first responsibilities as a college student is determining which courses to take to accomplish the goals of the post-secondary education. In particular, determining which mathematics course to take can be a difficult and important task. If the student chooses a course at too low of a level, no learning takes place and the student wastes a semester of mathematics and the money and time for the course. Choosing too difficult of a course can cause the student to fail the course hurting the grade point average and sometimes making it difficult to enroll in the appropriate course.

High school mathematics courses vary considerably in terms of material covered and depth of understanding communicated by various grades. Therefore, some consistent system of determining a student's academic level independent of previous coursework is necessary. While many post-secondary institutions are using ACT and SAT scores to assist in the placement of students in mathematics courses, the placement exam is the most prevalent method.

A placement exam is a test usually given to a student entering an educational institution to determine specific knowledge or proficiency in various subjects for the purpose of assignment to appropriate courses or classes. "Mandatory placement will provide underprepared students with better odds for success. Colleges will still be giving them the choice of how successful they ultimately will be regardless of where they start" (Hadden, 2000, p. 835).

The goal of this article is to communicate the exact contents of the placement exam and its relationship to the high school mathematics curriculum to assist mathematics faculty at the secondary and post-secondary levels to make appropriate decisions regarding student advising, programs to assist during the secondary to post-secondary transition, curriculum decisions, and other related issues.

Literature Review

A large portion of students who take the placement tests are required to take at least one remedial math course. "There is much hand wringing and blame shifting about the causes of this expense remediation. Universities blame high schools for low standards, secondary schools blame elementary schools, and elementary schools blame parental neglect" (Kirst, 1998b, p. 1) . There appears to be an issue of who is responsible for students struggling in mathematics once they reach the college level.

Many teachers blame universities for the students' problems in mathematics at the college level "Education reformers stress that some placement exams are rapid-paced, multiple-choice exams that are not aligned with high school curricula. This assessment-alignment gap is a particular problem for students who attend high schools that stress performance assessments, portfolios, and math problem-solving" (Kirst, 1998a, p. 76). Many secondary teachers emphasize that while they teach the state curriculum requirements they also feel that it is important to address applicative problem solving. Because of this, teachers often feel college math placement exams focus too much on computation rather than real life skills and problem solving. In contrast, colleges and universities tend to shift the blame towards the secondary level. "Critics of public education frequently interpret these high failure rates and the subsequent proliferation of post-secondary 'developmental education' courses as further evidence that secondary school curricula and standards have become diluted" (Roth et al., 2001, p. 72). Many people are confident that the problem lies merely at the secondary level and that they are not making the curriculum challenging and rigorous enough for the students. "Many [state legislators and university officials] blame high schools for a lack of academic rigor, but high schools contend that they are unaware of the content or stakes concerning university placement" (Kirst, 1998a, p. 77). There is an obvious disagreement here. If teachers are following the state standards and teaching the students what they are required to know, then their curriculum should be rigorous and meet standards. However, the university and state officials argue that teachers do the opposite of this and students fail at the post-secondary level.

Although these tests may be beneficial in helping place students, there is still some doubt that the placement exams are accurately designed. "Controversial for some time, most of these tests are multiple choice and focus largely, if not exclusively, on algebraic symbol manipulation skills" Schoen et al. (2001). Usually when doing math, students face open-ended questions, however during placement tests questions

are usually multiple choice. Some argue that this format encourages poor prepared students to guess and devalue their own reasoning. Advantages of taking tests "on-line" include shorter testing times, fewer security problems, and more immediate results. However, there are the disadvantages such as needed special equipment, software, and space. Another debatable topic is the use of calculators. If a student is prepared to use a calculator he or she could be very discouraged if they found out otherwise before the test. NCTM has issued supportive statements about the usage of calculators Akst and Hirsch (1991).

Methods

To compare mathematics placement exams to the secondary mathematics curriculum, the most appropriate measure is to study this relationship using a placement exam at a large state university and that state's mathematics course of study. The University of Alabama was selected since it is the largest university in the state of Alabama with over 20,000 undergraduates with approximately two-thirds of the incoming freshman from high schools in the state of Alabama University of Alabama (2007).

At The University of Alabama, all incoming freshmen and transfer students lacking college level mathematics credit or a sufficient score on the mathematics portion of the ACT or SAT are required to take a placement exam. This exam is in multiple-choice format and administered on a computer. To analyze the relationship between the University of Alabama's math placement test and the Alabama Course of Study (ACOS), we looked individually at each math course's practice placement exam. For each question on the practice placement exams, we identified the state standard that corresponded to the question using the Alabama Course of Study text. We then examined the results and determined to which high school courses the college courses were equivalent. We decided this by looking at the number of questions on each test that matched to a secondary grade level or course. The majority of each test had a grouping of similar questions from the same high school course standards.

Results

Math 005 (Remedial Mathematics)

The math 005 test assesses students' abilities ranging from skills introduced in 6th grade mathematics curriculum to skills covered in the Algebra 2 curriculum. The problems are arranged in random order, not necessarily from least to most difficult. The majority of the problems assess students' algebra skills only. Seven out of fifteen questions on the practice exam for this course's placement test assess students on skills covered in sixth, seventh, or eighth grade according to the Alabama Course of Study.

Applying the order of operations to various problems seems to be a major theme on this practice test. A portion of the ACOS focuses on students applying the skills learned to solve every day real life problems, while the practice test

for math 005 simply asks students to solve procedural problems that only require memorizing a formula or a previously learned algorithm.

There are several topics mentioned in the ACOS which are not tested on the math 005 practice placement test. These topics include mathematical skills such as probability, measurement, and using the Pythagorean Theorem. We have found that there are very few, if any, geometry topics addressed in this test.

According to the University of Alabama's testing services website, math 005 is an appropriate course for students with limited experience in studying mathematical concepts. UA's testing services also claims that math 005 is an introductory level algebra course while their Mathematics Technology Learning Center claims that with a slower pace, this course helps students to master the concepts of elementary algebra.

Math 100 (Intermediate Algebra)

The math 100 test assesses students' abilities ranging from skills introduced in 8th grade pre- algebra to skills covered in Algebra 2. The test is formatted similar to the math 005 test, with questions appearing in random order. Once again, this test is focused mainly on algebra skills. Ten of the fifteen questions on the practice exam for this course's placement test assess students on skills covered in Algebra 1 according to the Alabama Course of Study.

A part of the ACOS focuses on students using equations and inequalities to solve and model real life problems. There is one question on the math 100 practice test that forces students to use this skill. There are several topics included in the ACOS Algebra 1 standards that are not assessed on this exam. These include data analysis and probability, such as using scatter plots, measurement, such as using and finding the perimeter of polygons and cylinders, and geometry such as calculating length and midpoint.

According to the University of Alabama's testing services website, math 100 is an intermediate level algebra course which is an appropriate course for students with limited experience in studying mathematical concepts while their Mathematics Technology Learning Center states that math 100 builds on the topics of math 005 at a faster pace and while leading students to more algebra and algebraic applications.

Math 112 (Precalculus Algebra)

The math 112 test assesses students' abilities on skills mostly covered in an Algebra II class in high school. The test format, again, is similar to math 005 and math 110 where all questions are in random order. This test covers only algebra skills. Part of the Algebra II ACOS focuses on complex numbers and functions including variations of functions, quadratic functions, performing operations on functions, and two variable equations. This test covers each of these in several questions, especially performing operations on functions which is covered in five of the fifteen questions.

However, there are several Algebra II concepts not covered by the math 112 practice test. This includes relationships between subsets of complex numbers and solving coordinate geometry problems using algebraic techniques. It covers none of the data analysis and probability sections of the Algebra II ACOS. This includes using different forms of representation to compare characteristics of data gathered from two populations, determining an equation of linear regression from a set of data, and using the laws of probability to calculate probabilities of events.

According to the University of Alabama's testing services website, math 112 is a precalculus mathematics class appropriate for students with strong algebra skills and for students who need calculus for their major.

Math 113 (Precalculus Trigonometry)

The math 113 test assesses students' abilities ranging from skills introduced in Algebra II with trigonometry to skills covered in precalculus. Once again, the questions are in random order. The test covers mostly algebra skills, but also slightly covers geometry skills.

Part of the Algebra II with trigonometry ACOS focuses on solving equations involving absolute values, radicals, quadratics over complex numbers, simple trigonometric functions, exponential functions, and logarithmic functions. This is covered in five of fifteen questions on the test. Also covered is defining the six trigonometric functions, solving coordinate geometry using algebraic techniques, and identifying characteristics of quadratic functions, all of which are also covered on the test.

The precalculus ACOS covers solving applied problems involving sequences, converting from Cartesian form to polar form and vice versa, performing vector operations, and solving trigonometric equations using trigonometric identities, all of which are covered on the test. However, there are several skills included in the precalculus ACOS that are not covered on the test. This includes, but is not limited to, applying the laws of logarithms, finding limits of functions, and analyzing graphs.

According to the University of Alabama's testing services website, math 113 is a continuation of math 112 and is for students need analytical calculus for their majors. This class is not recommended for students whose majors do not require calculus, and after taking this class, students should be prepared to enter a college calculus class.

Conclusions

The placement test is a vital part of a university student's success at the college level. The placement test is a good method that places people in a class that best suits their ability. After examining the Alabama Course of study and placement test questions, it is fair to say that almost every question from the placement test can be found in the course of study. Students, regardless of the level of math they completed in high school, should have seen some of these topics before.

All students who complete the high school mathematics curriculum should place higher than math 100, since completion of Algebra 1 and Geometry are required for high school graduation, and therefore all high school graduates should understand the topics included in the questions on the placement exam related to the Math 100 material. Unfortunately, during fall 2007, nearly 500 students enrolled in Math 005 and almost 1,500 students enrolled in Math 100.

This clearly shows there is a problem somewhere in the system. Either the high school teachers are not following the state standards, or the students are just memorizing the information and never really learning it. It is important that when high school students come to a university, they are prepared and ready to learn. It can put a student far behind if they have to take one or two remedial classes before starting the classes that count for their major. This issue must be addressed and the problem must be fixed so that students can be more successful at universities.

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