Developing a K-12 Mathematics Placement Assessment for Private Schools

A PROPOSAL for a PROJECT in MATHEMATICS

by

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ABSTRACT

A local K-12 private school is in need of a competent method of placing new students into appropriate mathematics courses. Currently, the school administers a commercial, curriculum-specific placement test that yields incomplete and unreliable results which must be adjusted by the assessor in arbitrary and often unsuccessful ways. When students are placed in mathematics courses that are not appropriate for their level of ability, it is detrimental to them, their teachers, and their classmates. Overall, this problem hinders the smooth progression of the mathematics program at the school.

This project will remedy this problem by providing a reliable, research-based placement test especially suited to the curriculum of the school. Not only will assessors be able to accurately place mathematics students, but they will also be able to identify gaps in students' skills and abilities, and recommend strategies for remediation before students begin school. Students will be able to make a smoother transition to a new school; mathematics teachers will be better equipped to instruct all of their students.

Because this placement test will be used for all incoming transfer students, both elementary and secondary, it will have to be versatile, comprehensive, and accurate, yet be easily administered and interpreted, as well as time and cost efficient. This will require a thorough understanding of the proper scope and sequence of mathematics and knowledge of effective test design.
INTRODUCTION

The target school for this project is a private K-12 school with a challenging curriculum and rigorous standards. Transfer students' mathematics skills are often one to two years behind those of their new classmates. During the application process, students take a placement test to help administrators determine the best mathematics course for initial enrollment. This test has not accurately measured the skill level for many students during the six years the author has been head mathematics teacher. As a result, some students have spent up to a semester struggling with failure and frustration before they are placed in the course in which they can be successful learners of mathematics. Usually, the graders try to compensate for the test's inadequacies by using more subjective criteria, which is somewhat haphazard, yet has been more successful than going strictly by the test results. From a preliminary sampling of the current school records, only 25% of the students placed into the course indicated by the placement test thrived in that course. Graders successfully placed over 50% of the students at a higher or lower level than the test indicated. The rest were placed higher or lower than the tests indicated, but did poorly.

Other public and private schools in the area use a variety of methods to place new students, including using transcripts, standardized test scores and various placement tests. The current method employed by the target school consists of a commercial curriculum-specific test that only includes ten questions per grade level. The instructions prescribe placement by the number correct at each level. The testing procedure varies widely. Some students show their work
and others only give a final answer, and calculator use is inconsistent for the upper grades. The identity and method of the grader varies, as well. The transfer students that take the placement test come from a variety of academic backgrounds, such as other private schools, public schools, and home schools. Most of them are unfamiliar with the question format of the placement test, and are confused when the questions do not resemble the mathematics questions to which they are accustomed.

The target school has a problem in accurately and efficiently placing new students into appropriate mathematics courses. To remedy this problem, information must be sought concerning level-appropriate mathematics objectives, and the proper assessment of these objectives. Also needed is information about content design and test format when constructing placement tests.

The purpose of this project is to develop an effective mathematics placement test for potential transfer students at the private K-12 school. This test will also be used to determine the need and level of possible remediation. In developing the mathematics assessment, the following guiding principles will be considered:

- Test Content: An effective placement test will indicate a student’s level of mathematical ability, and inform the teacher of gaps in student knowledge and skills that need to be remediated.

- Test Format: An effective placement test will adequately assess all desired objectives, be general enough for students from a variety of academic backgrounds, and be time and cost efficient.
RELATED WORKS AND JUSTIFICATION

Four topics will be investigated to establish the foundation for an effective, research-based mathematics placement test. "Building a valid test begins with accurate definitions of the constructs (i.e., the knowledge domains and skills) to be assessed" (Let's Go Learn, Inc., 2008, 1). Therefore, reputable sources that list mathematics objectives will help organize and narrow the field of K-12 mathematics. Next, examples of existing placement tests will be examined, compared, and contrasted to determine current trends. Then, research on student learning and assessment will be explored to aid in choosing appropriate test content. Finally, the actual format of the instrument will be determined by investigating the validity and applicability of various test designs and item types.

Mathematics Objectives

"A diagnostic assessment is a short, targeted, fine-grained examination of the students' knowledge of a particular aspect of mathematics" (Berkas & Pattison, 2008, 1). Before developing any assessment instrument, it is important to determine what objectives will be assessed. Many sources exist for grade-level appropriate mathematics objectives. For example, the National Assessment of Educational Progress (NAEP) developed a framework for mathematical achievement levels (National Assessment Governing Board, 2006), and the National Council of Mathematics Teachers (NCTM, 2000) has outlined a complete set of mathematics standards for each level of elementary and secondary school. At the state level, the Texas Essential Knowledge and Skills for Mathematics (TEA, 2007) contain the official objectives for Texas; the Charles
A. Dana Center (2007) also recommends objectives for mathematics teaching and learning. Public school districts use their state guidelines to formulate their local curriculum guides, and textbook publishers either use their own or the state objectives. Most private schools, like the target school, have a board-approved set of objectives in their curriculum guides. Each of these sources will be examined and compared to ensure that the placement test will correspond to the appropriate objectives.

**Placement Tests**

It is not difficult to find placement tests to assess the level of a student’s mastery of these various sets of objectives. For example, the Texas Assessment of Knowledge and Skills test (TEA, 2008) is used in Texas to retain or promote students. Many states use similar tests, including the MMLA Mathematics Assessment (MMLA, 2005), the California Achievement Test (CTB/McGraw-Hill, 2008a), and the Iowa Test of Basic Skills (The Riverside Publishing Company, 2007). The National Assessment of Educational Progress (NCES, 2007) conducts and reports on assessments periodically in the US. Textbook publishers, such as Saxon, Key Curriculum Press, and Glencoe, also have placement tests.

Other tests include the Stanford Achievement Test (Pearson Education, Inc., 2008b), the Metropolitan Achievement Test (Pearson Education, Inc., 2008a), Singapore Math Test (SingaporeMath.com Inc., 2008), and the Catholic High School Placement Test (Scholastic Testing Service, Inc., 2007). Commercial organizations, such as the ALEKS Corporation, Sylvan Learning,
and Let's Go Learn, also market assessments. Although no single one of these tests would be suitable for the specific needs of the unique target school, having these tests available for reference will be extremely valuable when developing a suitable placement test.

Test Content

Placement test content should reflect and assess curriculum content. The NCTM outlines the general content that mathematics students should learn in K-12. "The Content Standards—Number and Operations, Algebra, Geometry, Measurement, and Data Analysis and Probability—explicitly describe the content that students should learn. The Process Standards—Problem Solving, Reasoning and Proof, Communication, Connections, and Representation—highlight ways of acquiring and using content knowledge" (NCTM, 2000). These "content standards" are similar to the "content areas" recommended for the NAEP Mathematics Assessment. The NAEP content areas are number properties and operations, measurement, geometry, data analysis and probability, and algebra (National Assessment Governing Board, 2006). Likewise, the Balanced Assessment in Mathematics Project (BA) lists the "objects" of mathematics as number and quantity, shape and space, pattern and function, chance and data, and arrangement. They go on to discuss the "actions" of mathematics as modeling/formulating, transforming/manipulating, inferring/drawing conclusions, and communicating (The Concord Consortium, 1995).

These sources clearly provide a general framework on which to build a
valid assessment. But developing a specific, targeted placement test will require answering the following questions:

- Does the test identify students' specific strengths and weaknesses with respect to both conceptual understanding and procedures?
- Does the test investigate students' knowledge of key mathematics concepts that are grade appropriate?
- Does the content that is assessed align with the school's prescribed curriculum?
- Do the assessments communicate students' strengths and weaknesses in ways that teachers and parents can understand? (adapted from Berkas & Pattison, 2008)

James H. McMillan has listed several fundamental assessment principles, one of which states that "good assessment enhances instruction....Test scores, when used appropriately, help teachers understand student strengths and weaknesses to target further instruction" (McMillan, 2000, para. 9). Therefore, in addition to placing students, the desired test can also be used for identifying the need and level for remediation.

**Test Format**

The test format must be designed to balance the competing needs of accuracy, feasibility and efficiency (McMillan, 2000). Factors to consider include test designs and item types that are most effective in showing student mastery, the use of pencil-and-paper tests as opposed to computer-based tests, student use of calculators, thoroughness and placement accuracy versus test length and testing costs, and the fact that test design has an impact on student motivation and performance. Constraints specific to the target school, such as the available testing environment and level of assessor training must also be considered.
Justification

This project is worthy of a master's degree because of the benefits it will provide to the target school, its community of private schools, its administrators, mathematics teachers, and students. Most small, young private schools such as the target school do not have ready access to the expertise necessary to develop a valid mathematics assessment and placement system. Yet it is important to have such a system if the school is to be time and cost efficient. By offering superb service and education to the families that are considering enrolling students, they are more likely to attract and retain these families. Another benefit to the target school is more indirect, but also important. The school is continually seeking to improve its curriculum guides, streamlining and expanding them as necessary to support the vision statement set forth by the school board. As this placement test is developed and implemented, the curriculum committee, of which the author is a member, will have a clearer and more knowledgeable perspective with which to make these important modifications.

The community of private schools to which the target school belongs is close-knit and connected on many levels. They continually share useful programs and information with one another. Other schools that are developing their curriculum standards and meaningful mathematics assessment programs will have access to the results of this project, both through the internet and by way of school conferences.

Administrators at the school will benefit from this project because they will have confidence in a straightforward and consistent placement scenario that will
produce accurate and significant results. Mathematics teachers at the school will also benefit because their classes will begin the school year with a more homogeneous grouping of student skill levels. This project will permit them to focus on moving their classes forward mathematically because it will have already allowed administrators and parents to identify and help students in need of remediation.

Most importantly, the students will benefit from this project because they will be more comfortable taking a well-designed and relevant test. Once placed correctly, they will be more likely to enjoy a successful, positive learning experience in mathematics as they adjust to a new school.

A final, but significant advantage of this project is that it validates the Teacher Quality grant programs that have made the master's degree possible. These grant programs are having a positive influence in the private school arena as well as in the larger educational community.
PLANNED ACTIONS

This project will begin with an investigation to discover exactly what criteria are currently being used to place transfer students at the target school and other local private schools. Next, the author will examine data collected by the target school which compares students’ initial mathematics placement with their enrollment status and progress after one semester. Then, the author will analyze inadequacies in the current placement test and assessment procedures. The next step will be to investigate mathematics objectives, existing diagnostic tests, research on student learning and assessment, and validity and applicability of various test designs and item types. Finally, the author will construct the new placement test.

TIMETABLE

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<thead>
<tr>
<th>Date</th>
<th>Activity</th>
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<tbody>
<tr>
<td>January – April 2008</td>
<td>Prepare project proposal</td>
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<tr>
<td>February – March</td>
<td>Gather data to analyze current placement procedure and research related works</td>
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<tr>
<td>April</td>
<td>Analyze current test and assessment procedure</td>
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<td>April 23, 2008</td>
<td>Distribute project proposal to committee members</td>
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<td>May 5, 2008</td>
<td>Project proposal defense</td>
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<tr>
<td>May – June</td>
<td>Construct new placement test</td>
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<tr>
<td>Late June 2008</td>
<td>Distribute project to committee members</td>
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<tr>
<td>Late June 2008</td>
<td>Project defense</td>
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<tr>
<td>August 2008</td>
<td>Graduation</td>
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END RESULTS INTENDED

The result of this project is to develop an effective and efficient placement test for incoming transfer students for a K-12 private school. Using this test, the school will be able to reliably predict the highest math course in which a student will have an opportunity to be successful. The school will also be able to use the test to recommend possible remediation strategies to help students close existing gaps in knowledge or skills. Other schools in the private school community will also have access to the results of this project. Once the placement test is implemented, new students will have a smoother transition after enrolling and be more likely to succeed mathematically. Mathematics teachers will be better equipped to help students succeed, and administrators and parents will have the opportunity to enjoy a simple, effective method of determining the mathematical ability of their students.
BIBLIOGRAPHY


Texas Educational Agency (TEA). (2007). Texas Essential Knowledge and Skills


