The Analysis of Mathematical Test Questions in Relation to Reading Difficulty

A PROPOSAL for a THESIS in MATHEMATICS

by

Jennifer Leary

COMMITTEE MEMBERS

Dr. Elaine Young
Committee Chair

Dr. Jose Guardiola
Committee Member

Dr. Sherrye Garrett
Committee Member

Elaine Young

Sherrye Garrett

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Abstract

The main component of this thesis is an analysis of the 2004 and 2006 Texas Assessment of Knowledge and Skills (TAKS) mathematics questions for seventh grade. Test questions will be analyzed and split into three categories of error: mathematics, reading, and other. This analysis will be used to determine the greatest probability of why students got them wrong. After analysis, the data will be looked at in terms of the distribution of student's answers among the possible answer choices for each question.
Introduction

Since the establishment of standardized testing, schools and education have been rated by the results of the testing. Irregularities on the Texas Assessment of Knowledge and Skills (TAKS) test have caused 14 out of 100 schools scheduled to receive between $90,000 to $100,000 in teacher incentives to have those incentives stalled until investigations are completed (Minaya, 2006).

Most of the ratings have shown that mathematics is the area that needs the most improvement across the nation. A related issue that has not been seriously considered and explored is that part of the reason the mathematics scores are so low is because the reading skills of the students affect their ability to decipher and solve the word problems on the assessment. In order for students to excel on the mathematics test, consideration needs to be taken of their reading ability and the reading level of the test. Therefore, the purpose of this study is to dissect the 2004 and 2006 mathematics (TAKS) test for 7th grade to determine the non-mathematics related reasons students get questions wrong and the frequency of the occurrences of these reasons.

Research Questions

- What non-mathematical factors affect the mathematics TAKS test scores for 7th grade students?
- How influential are the non-mathematical factors on the mathematical TAKS test scores?
- How prominent are reading difficulty factors on the mathematics TAKS test?
Related Work and Justification

A study done by Clements in 1980 found that 8% of errors on written mathematical tasks were reading related (Helwig et al., 1999). If this error percentage were applied to the 48 questions mathematical TAKS tests, this would be the difference of 3.84 questions for each student. In 2004, if each student would have gotten three more questions correct, there would have been 29,097 more students listed as passing the test. In 2006, three questions would have brought the number of students who passed up by 24,611 students. These numbers are almost ten percent of the students who took the test (TEA, 2006). Research on word problem based mathematical standardized tests in terms of reading related difficulties could not be found.

Most articles discussing the need for reading strategies to be taught in the mathematics classroom are based on teacher produced activities or the textbook. William Schurter (2002) wrote an article on comprehension monitoring with the basis that “If mathematics students are not aware of what is wrong with their attempts to solve a problem, they can never take any kind of corrective action that might lead them to success” (22). The strategy was not tested in a standardized testing situation though. Fay Jackson (2002) wrote an article discussing the reading strategy RIDD: Read, Imagine, Decide, and Do and Delinda van Garderen (2004) applied reciprocal teaching as a strategy to help with reading comprehension of mathematical questions. While all of these strategies will help students on the mathematical TAKS test, the articles do not discuss the fact that mathematical testing should be based on mathematic skills and not reading skills. These strategies were also not tested in a standardized testing environment where the pressure on the students to perform is dramatically increased.
My proposed thesis qualifies as a significant component leading to the receipt of a Master's Degree in Mathematics because of the significance the topic and the effects on mathematics testing and curriculum at the local, state, and even national level. If the analysis of the 7th grade TAKS mathematics test shows that most of the student difficulties come from reasons other than mathematics, it will revolutionize the teaching of mathematics. Emphasis will have to be put on reading skills in the mathematics classroom. The reading emphasis will not only be on basic reading, but also on how to read word problems and filter out excess information, especially in high pressure situations present with standardized testing. In order to do this, teachers are going to have to be taught how to teach these reading skills while teaching the concepts as well. This opens the possibility for an acceptable new elective within the Master’s Program at TAMUCC. Another effect on curriculum and testing is that the test writers will understand the difficulties resulting from writing mathematics tests at a higher reading level and with more difficult reading structure than the reading test at the same grade level and a movement will happen to change the test again. Students should be tested on mathematical skill instead of reading ability on the mathematics standardized test. Either way, the correlation will have a profound impact on the teaching of teachers of mathematics.

Planned Actions

The first part of the research will be an analysis of the scores from the 2006 TAKS test for 7th grade in mathematics and reading. This will be done by creating a scatter plot and determining the correlation between the mathematics and reading
scores. Once the scatter plot is created, possible justification for the results can be examined, taking into account the confounding factor of IQ.

The second part of the research will involve the questions on the mathematics 2004 and 2006 TAKS test for 7th grade. Analysis of the mathematics questions will be based on an emergent viewpoint. Each question on the mathematics TAKS test will be analyzed to determine the question type and the most probable reason that the students got the question wrong. Each question will be placed in one of three categories: mathematics-based, reading-based, and other. The question will be placed in the mathematics category if the most probable reason the student got it wrong is because of mathematical concepts or vocabulary. The questions placed in the reading based category will be due to sentence structure or reading difficulty. The other category will include questions that the students had difficulties with because of the things other than just mathematics or reading. For example, a student looking at the question and determining they are just going to guess because of the length of the problem, or because they don’t know how to pronounce the name at the beginning of the question would go in the other category. These two examples show difficulties that are somewhat related to reading, but are not things that the language arts teacher could fix with more instruction.

Once the questions are put into the difficulty categories, they will be looked at in terms of what mathematical strand they are under and in terms of the distribution of student’s answers among the possible answer choices for each question. There will be three distribution categories based on the percentage for each answer choice within a question. Questions will go into a “know” category if only the right answer has a higher
percentage than 15. Questions will go into a “distractor” category if the right answer and one other answer are the only ones with a higher percentage than 15. Questions will go into the “guess” category if two or more answers beyond the correct answer have higher percentages than 15. Analysis of the data will be done to compare the percentages of each distribution category within each difficulty category.

Proposed Timeline

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<th>July</th>
<th>1. Finish proposal</th>
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<td>2. Analyze the correlation between reading scores and mathematics scores on the 2006 TAKS test</td>
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<td>3. On July 28, when the tests are released, begin analyzing the 2006 mathematics test questions for seventh grade</td>
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<td>August</td>
<td>1. Get proposal signed</td>
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<td>2. Continue analysis of test questions</td>
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<td>3. Obtain approval from Hamlin Principal, Debbie McAden, for use of TAKS data in thesis</td>
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<td>September</td>
<td>1. Continue analysis and work on conclusion write-up</td>
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<td>October</td>
<td>1. Finish write-up and get recommendation from committee members about changes</td>
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<td>November</td>
<td>1. Get write-up recommendations</td>
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<td>2. Complete final write-up</td>
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<td>3. Present to committee members</td>
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<td>December</td>
<td>1. Defend thesis</td>
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<td>2. Get signatures on final thesis</td>
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<td>3. GRADUATION</td>
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End Results Intended

Proof that most difficulties on TAKS testing come from reading, rather than mathematical difficulties, will increase the attitude that focus in the mathematics classroom needs to not only be on mathematics concepts, but also on reading skills. The vocabulary that needs to be focused on is not only mathematical, but also basic common language. For example, what is called a “kiddy pool” in one area of the US is called a “wading pool” in another area. Even names can throw a student’s focus off the
solving of the problem and on the pronunciation of the name. The proof of reading difficulties will show that a need for reevaluation of standardized testing is present. There are two potential effects that could happen on the TAKS tests because of this study. The first one is that a student's mathematics score will be changed and be based on the ability they show on the mathematics test as well as the ability they show on the reading test. A second possibility is that the TAKS test will be redesigned to reduce the amount of influence reading strategies have on the mathematics portion of the TAKS test. Mathematical abilities are not tested on the reading portion, so why should reading abilities be a component of the mathematics portion.
References


