Technical Manual for the DT-PAM

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Chapter 1. Introduction

The mathematics achievement of individual students has always been very important, but recently it has become the subject of renewed focus. Many states have recently introduced statewide testing requirements for high school graduation. Not only are students being judged and held accountable, but also schools and school administrators are being judged by the test performance of their students. There has long been a need for an efficient, wide ranging diagnostic math test to assess students in a way which would help pinpoint their weaknesses. This need is due to the math curriculum's cumulative nature, which builds on basic competencies, such as adding numbers or using fractions. Often success in new courses or topics is impossible without mastery of material covered earlier. The Diagnostic Te for Pre-Algebra Mathematics (DT-PAM) is designed to provide diagnostic information on the competencies of individual students in various areas of basic math. This information may be used to direct instruction, which should help students do better on mandated statewide assessments.

Statewide Testing Programs

Massachusetts is one of many states that have instituted new statewide testing programs in the public schools. A fundamental goal of education reform in Massachusetts is to raise expectations and promot high standards for all the students of the Commonwealth. A central aspect of this reform is the establishment of the Mathematics Massachusetts Comprehensive Assessment System (MCAS), a statewide testing program now conducted at the 4^{th}, 8^{th}, and 10^{th} grade levels. Successful performance will be required for graduation from high school beginning in the year 2003. The Massachusetts Department of Education has released the test questions for several past tests. Much of the development of the Diagnostic Test for Pre-Algebra Mathematics (DT-PAM) was guided by analysis of these released test questions.

One important feature of the MCAS is that the questions generally require students to use several competencies. This feature reflects the way mathematics is used in the real world. However, this type of test question is not ideal for diagnosing specific limitations in a student's mathematical skills. If a student answers a particular question incorrectly, it could be because of lack of knowledge in any of several content areas. The MCAS only provides an indication of overall level of performance.

Need for a Detailed Diagnostic Math Test

There is clearly a need for a detailed diagnostic math test to assist students, teachers, and curriculum developers in monitoring progress and identifying weaknesses. Also, parents often ask, "What should my child do to improve in math?" Frequently schools lack the diagnostic information which would allow a specific response. The range of possible knowledge gaps is great. One student may have failed to learn how to add and subtract signed numbers. Another may have failed to master addition of common fractions. Another students may not have learned even the most basic aspects of percentages. Statewide tests such as the MCAS provide an overall measure of competence, not diagnostic information. There is clearly a need for a detailed diagnostic math test to assist students in remediation. The DT-PAM was developed to provide diagnostic information on individual students as well as on groups of students to help solve this problem.

Need for an Overall Math Assessment

School administrators make placement decisions at the end of the 7^{th} or 8^{th} grade concerning placement of individual students in various pre-algebra or algebra courses in the following year. A test which provides an overall evaluation of the level of mastery of pre-algebra math would be useful in this placement process.

DT-PAM Diagnostic Areas: Content Analysis of the MCAS

A detailed content analysis was conducted of past 8^{th} grade mathematics MCAS tests. Specifically, for each test question the mathematical competencies required to correctly answer the question were identified. Twenty-one competencies were found to be sufficient to answer the MCAS questions. The 21 competency areas of the MCAS are described in Table 1. Most questions in the MCAS require more than one competency. This part of the development of the DT-PAM is covered in more detail in Chapter 3.

Table 1. Competencies Needed to Answer the MCAS 8th Grade Math Questions			
1	Whole Numbers	11	Geometry
2	Common Fractions	12	Comparisons
3	Decimal Fractions	13	Graphs
4	Percentages	14	Tables
5	Units of Measurement	15	Estimation
6	Signed Numbers	16	Probability
7	Simple Powers	17	Statistics
8	Substitution	18	Order of Operations
9	Setting up Equations	19	Ratios
10	Solving Equations	20	Math Vocabulary
		21	Word Problems

DT-PAM Scores

The DT-PAM provides a score in each of the 21 competency areas and a total score.

Value of Using the DT-PAM as a Diagnostic Tool

The diagnostic information obtained from the DT-PAM will allow a teacher, parent, or student to target remedial efforts.

The DT-PAM can be given at the start of a school year when the teacher does not know the students, and thereby quickly provide the teacher with detailed information about the strengths and weaknesses of individual students.

Since the DT-PAM is group administered, it is much less expensive than an individually administered assessment.

Value of Using the DT-PAM as a Placement Tool

The DT-PAM can be given at the end of the school year to help make placement decisions for the following year. Despite its usefulness, the DT-PAM is not meant to be a complete substitute for an

individualized student evaluation by a competent guidance counselor or teacher.

This manual provides information about the DT-PAM materials, administration, scoring, development, norms, and use.

Chapter 2. Use, Administration, and Scoring of the DT-PAM

The DT-PAM materials include this manual, a disposable question booklet, and a machine-scorable answer sheet. Completed answer sheets are returned to the publisher for computer scoring. The grade reports provided by the publisher include: (1) student reports - a listing of scores, one page per student meant for use by individual students, (2) class reports - a summary listing of the student scores by class and (3) a school-wide report - a set of summary statistics for the scores for all students. The DT-PAM is easy to administer and is suitable for administration to groups. This chapter provides instruction for administering the DT-PAM and for understanding and using the grade reports.

Qualifications to use the DT-PAM

The DT-PAM was designed for use by middle-school teachers. No specific professional qualifications in testing are required to use and administer the DT-PAM. However, teachers and administrators should follow the test administration instructions. Interpretation of the DT-PAM report may reasonably be made by the personnel for whom they are intended. Teachers and administrators using the DT-PAM score reports should first carefully review the material in this manual.

Maintaining Test Security

The DT-PAM is a secure test. The questions should not be shared with students or parents. The test areas may be shared (for example as presented in Table 1 in Chapter 1 or in the tables in Chapter 3). Care should be taken to store and discard the test in a secure manner. The tests should be kept under lock and key at all times when not in use.

Intended Uses

There are three intended uses for the DT-PAM: (1) to identify possible areas of weakness of individual students currently taking pre-algebra math or beginning an algebra course, (2) to assess overall readiness of a student or group of students to undertake a first algebra course, and (3) to evaluate progress of grades/classes over time, such as from year to year.

Test Administration

The amount of introduction that a teacher will give a class concerning this test may depend on the amount and type of contact the students have had with such tests. The teacher should encourage students to do their best, but not create undue anxiety about the test. All students who may be compared on their DT-PAM scores should take the test under the same test conditions. The school should check the ID numbers on the student answer sheets to be sure the students completed them correctly. If this is not done, it may be impossible to identify each student.

The DT-PAM may be administered in one 45 minute class period (as a timed test) or in two such class periods (basically as an untimed test). There is some indication that administration in two periods yields more accurate scores.

Motivation of the Students

A student's performance on a test such as the DT-PAM is a reflection of the student's ability and other factors such as his or her level of attention, motivation, or effort in taking the test. A student's te results will be more accurate if the student pays attention and does careful work while taking the examination. The teacher should prepare the students with this in mind.

Introducing the DT-PAM to Students

Efforts should be made to minimize test anxiety. Any test may be threatening. When possible, reassure the students that the test results will not be used against them, that they will not be reassigned to a lower class as a result of their test score, and that they will have an opportunity to address any weaknesses with extra curriculum material. (Of course, if any of these statements are not true, that reassurance should not be given.) This introduction might best be done a day or two before the actual test to allow for maximum testing time on the day of the test administration.

Answering Students' Questions

Prior to the day of test administration, students should be given an opportunity to ask questions about the DT-PAM. Students may be told what the test will cover and may even be given a copy of the competencies list.

During the test itself, teachers or proctors should not help students answer any questions. We want to measure the competency of the student alone. If a student asks, “Am I on the right path?” the proctor should explain that the testing time is not a lesson, and that the student needs to answer the questions without help. It is rare to get questions from students while the test is in progress.

Use of Calculators

The DT-PAM has been normed on groups who took the test without the aid of calculators. However, the diagnostic value of the test should remain strong even if used with calculators.

Answer Sheet Competencies

If students are not familiar with use of computer scored answer sheets, they may need instruction in the use of the answer sheets. This might best take place a day or so before the test administration, and might include the students filling out the ID sections of the answer sheet. Students may not get credit f what they know if they fill out the answer sheets incorrectly.

Some of the things students need to know concerning answer sheets are listed below, together with related problems.

1. Complete ID numbers correctly
   Sometimes students fill in ID numbers incorrectly or in the wrong place or leave the ID blank. If thi happens, it may be impossible to identify the students. This may also cause students to be included in the wrong class report.

2. Need to right justify numbers
   Some students fail to right justify numbers. For example, if a student has an ID number of 6, it should be entered with leading zeros. Sometimes students enter the digit 6 in the leftmost column, and the computer may read that as a 6 followed by many zeros. A similar problem occurs when a student incorrectly enters the date March 2nd and it is read as March 20th.

3. Fill in bubble spaces completely
   The correct way to fill in the bubbles is by shading the entire circle dark enough so that the letters cannot be seen through the shading. The pencil marks must be within the lines. Common errors in marking answers include: circling answers, not filling in the entire circle, leaving a blank spot at the center of the circle, or shading too lightly.

4. Erase all stray marks fully
   Students must use new erasers to achieve a clean erasure. Any residue from the eraser or any dark smudge left after the erasure may cause the answer to be scored as incorrect because the scanner reads this as two choices being picked.

5. Fill in the rectangular boxes above the bubbles
   The ID information bubbles have rectangular boxes above the bubbles for writing in the information by hand. Sometimes students leave these boxes blank. This information is needed because sometimes the bubbles do not scan correctly and some errors are sent to a (human) test scorer to be corrected manually.

Scoring the DT-PAM

The DT-PAM is returned to the publisher for scoring. Instructions for returning the DT-PAM answer sheets are included with each test order. After scoring, the DT-PAM answer sheets are returned to the school, together with the student, class, and school grade reports.

Interpreting the DT-PAM Diagnostic Scores

The DT-PAM diagnostic scores are reported in terms of raw scores. This is done so as not to create an impression of precision which the scores do not support, since each scale score is based on responses to 2 or 3 questions. So, for example, a student report might indicate that the student correctly answered 0 of the 3 questions on whole numbers. This would indicate an area of weakness. Anything less than a perfect score indicates an area of possible weakness. Norms are provided for these scores (see Chapter 5).

Number of Questions Not Attempted

The reports indicate the number of questions left blank. This may provide information about the speed with which a student can answer these types of questions or the confidence of the student to fill i answers. Norms are provided for this score (see Chapter 5).

Percent Correct of Questions Attempted

The reports indicate the percent correct for only the questions attempted. This may provide information about the student's test taking strategy, such as the willingness of a student to guess. Norm are provided for this score (see Chapter 5).

Interpreting the DT-PAM Total Score

The reports give the total score for all competency areas, again in terms of a raw score. The highest possible score is 50. Norms are provided for this score (see Chapter 5).

Setting Passing Points on the DT-PAM

Sometimes it is necessary for schools to set an operational passing point for practical reasons, as when selecting students for an advanced first algebra course. This can pose a dilemma. There is no magic number above which students will be able to do the course work and below which students will not. Rather, as the passing point is set higher, a higher proportion of the students selected will be successful. Unfortunately, with higher passing points, more students will be rejected who would have been able to handle the course work successfully. Setting passing scores is a sensitive matter and expert advice may be needed if this is to be done. In some instances it may be reasonable to make class assignment decisions based solely on scale scores. In other circumstances class assignment decisions may more reasonably be made based on scale scores together with other information the school may have about the students.

Reporting DT-PAM Results to Students and Parents

When used for diagnostic purposes, we recommend that students be given a copy of their student report and counseled that additional curriculum material is available to help them in areas of weakness. The student reports explain that the diagnostic scores are only an indication of their strengths and weaknesses, since they are based on only 2 or 3 questions for each competency area. One way to structure the reporting of DT-PAM scores is to hold a meeting for both students and parents in which topics are covered such as: the goals of the diagnostic testing, the nature of the diagnostic scores, the limits of this type of testing in general, and the steps which may be taken to address the skill deficits revealed by the test.

When used for placement purposes, we recommend that students not be told that they have "failed" the test. Rather, we suggest that students be told that they will be placed in the level/class that will be best for them.

Ordering Information and Prices for the DT-PAM

The DT-PAM is distributed and scored by:

APR Testing Services
27 Judith Road
Newton, MA 02459
(617) 244-7405
E-mail: Support@APRTestingServices.com

The prices on the Price List and Order Form include disposable test booklets, answer sheets, and machine scoring. The turnaround time for grading is typically two weeks. Prices may be found on the Price List and Order Form which are provided in Appendix A.

Chapter 3. Development of the DT-PAM

During the development of the DT-PAM, two fundamental issues were addressed: (1) determining the competencies covered in the 8th grade Massachusetts statewide math test, and (2) developing a relatively short test which would measure these competencies.

The purpose of the test is twofold: (a) to provide a measure of knowledge in various areas of pre-algebra math, and (b) to provide an overall score predictive of future performance on the MCAS and in math courses. For diagnostic purposes, this test is intended to be used on an absolute basis: either the student has or has not mastered certain material. For placement purposes, the test may be used on a normative basis, to identify those students in a group with stronger math preparation and competence.

The method used to identify the test areas and test format is described, followed by the description of the test question development.

Identifying Test Content

This test was intended, in part, to help teachers and administrators prepare students in all the areas needed to be successful on statewide math examinations, and specifically the Massachusetts examination (the MCAS). Several sources were reviewed to identify the competency areas for the DT-PAM. First, several textbooks were reviewed. The content of the MCAS was then systematically analyzed (as described below) and competency areas identified. The competencies required by some additional statewide testing programs were reviewed also. (For a systematic evaluation of the relationship between the content of the DT-PAM and that of various statewide tests, see Chapter 4.) Finally, discussions were held with a number of math teachers and math tutors concerning the tentative test areas, and refinement of the material was undertaken as needed.

Competencies Required by the MCAS

The MCAS is a Massachusetts statewide testing program of the type in use by most states. A fundamental goal of the Massachusetts Education Reform Act is to raise expectations and promote high standards for all the students of the Commonwealth. Although the MCAS publications list test areas, called "learning standards," some are rather broadly described. For example, one learning standard is to "use patterns and functions to represent and solve problems" and another is to "create and apply number theory concepts, including prime numbers, factors, and multiples" (Massachusetts Department of Education, 1999, pages 144-145). To identify the competencies required by the MCAS, we examined each question which appeared on the 8th grade mathematics section of the MCAS tests (released questions for May 1998 and Spring 1999) and reviewed the list of learning standards.

The test questions for the first two sets of MCAS 8th Grade Math released questions (1998 and 1999) were classified into 21 competency areas as listed in Table 1 (see Chapter 1). Each question on these two released MCAS tests was classified as requiring one or more of the 21 competencies. One MCAS question might require several competencies. The number of MCAS questions requiring each competency is summarized in Table 2. Descriptions of the 21 competency areas are given in Table 3.

Table 2. Number of MCAS Questions Using Each Competency: Grade 8 Math

Subject/Competency Area	Number of Questions	Subject/Competency Area	Number of Questions
1. Whole Numbers	36	11. Geometry	19
2. Common Fractions	21	12. Comparisons	11
3. Decimal Fractions	10	13. Graphs	13
4. Percentages	8	14. Tables	10
5. Units of Measurement	11	15. Estimation	13
6. Signed Numbers	4	16. Probability	7
7. Simple Powers	3	17. Statistics	7
8. Substitution	5	18. Order of Operations	3
9. Setting up Equations	7	19. Ratios	8
10. Solving Equations	4	20. Math Vocabulary	19
		21. Word Problems	47

Note: This table reflects analysis of the May 1998 and Spring 1999 released questions. The total of these entries is greater than the number of released questions because many questions were linked to more than one competency.

Table 3. Competencies Needed for MCAS Grade 8 Math Questions	
Subject Area	**Description**
1. Whole Numbers	Add, subtract, multiply, and divide whole numbers; including carrying, borrowing, and saving a place with a zero.
2. Common Fractions	Add, subtract, multiply, divide, and reduce common fractions and mixed numbers; including finding common denominators.
3. Decimal Fractions	Add, subtract, multiply, and divide decimal fractions.
4. Percentages	Add, subtract, multiply, and divide percentages. Determine X percent of a given number. Determine what percent X is of a given number. Relate percentages to a whole (e.g., 110% is more than 1 unit).
5. Units of Measurement	Recognize and use units of measure. Convert from one unit to another. Understand measurements and common units (i.e. hours, feet, etc.) Know the difference between measurements of mass, length, time, and volume.
6. Signed Numbers	Add, subtract, multiply, and divide signed numbers.
7. Simple Powers	Work with and solve simple equations containing powers and roots.
8. Substitution	Substitute values for unknowns in an expression or equation.
9. Setting up Equations	Set up a simple equation when given information in the form of a word problem or a data chart.
10. Solving Equations	Understand that variables may assume various numeric values. Simplify and isolate variables to find the solution (without using the "guess and check" method).

Table 3. Competencies Needed for MCAS Grade 8 Math Questions (continued)	
Subject Area	**Description**
11. Geometry	Have knowledge of and be able to work with one and two dimensional figures such as points, angles, parallel lines, surfaces, vertices, basic shapes (rectangles, circles), different types of triangles (e.g., isosceles), and right angles. Find the area and perimeter of triangles and rectangles, as well as the area and circumference of circles. Know that angles of a triangle sum to 180E, a circle has 360E, and a square has 90E in each of its angles. Apply this information to new situations. Understand and work with figures within figures (e.g., a circle within a square).
12. Comparisons	Compare size of numbers/shapes.
13. Graphs	Understand common types of graphs (i.e., bar, pie, and Cartesian). Find and chart points using X and Y coordinates (on a reasonable scale) and construct a graph from given data. Read and apply the information in a key. Interpret a graph and explain it.
14. Tables	Understand how row and column titles correspond to data inside a table. Find pertinent information in a table and transfer the information to a graph.
15. Estimation	Know when and how to use estimation. Round and estimate to check answers.
16. Probability	Find the probability of an event based on a narrative description and make reasonable predictions using probability.
17. Statistics	Know how to find the average (mean), median, and mode of a data set. Work backwards using the equation of an average (i.e., if Average = Sum/Number, know that Sum = Average * Number).
18. Order of Operations	Understand precedence. Know and apply PEMDAS (Parentheses, Exponents, Multiplication, Division, Addition, Subtraction).
19. Ratios	Represent data in ratio form and set up ratio problems, including attention to units. Add, subtract, multiply, divide, and reduce ratios.
20. Math Vocabulary	Know words like numerator, denominator, product, sum, and prime number.

Table 3. Competencies Needed for MCAS Grade 8 Math Questions (continued)	
Subject Area	**Description**
21. Word Problems	Understand scenarios and work with "real life" math situations. Translate word problems into equations and discern what information is necessary to solve the problem and what information is not.

Rationale for the Choice of a Multiple-Choice Format

The multiple-choice format was chosen based on several considerations, primarily for testing time economy and grading ease. Since there are 21 competency areas identified, testing time was a major concern. Typically, a test is constructed with 10 or more questions to measure a competency. However, that would result in a test with over 200 questions, and it was thought such a test would be too long to be practical for most users. The decision was made to use multiple choice questions with 15 choices for three reasons. First, it would increase the reliability of the scale scores, since score reliability tends to be proportional to the number of answer choices. Second, it would reduce the score that would be expected if a student was merely guessing. Third, it would reduce the feasibility of "working questions backward" (i.e., trying each answer to see if it satisfies the conditions of the question).

Writing Test Questions

Several goals guided the writing of the test questions. First, each question is a substantive test of the competency area being tested. Second, each question is a rather pure test of the competency, minimizing reliance on knowledge of other areas. Third, the two or three questions for a competency cover important parts of the competency. Fourth, the subject matter of the word problems is familiar t most or all students and avoids areas which may be culturally biased. (This is consistent with the spirit of the Civil Rights Act of 1964.) Fifth, the grammar, syntax, and vocabulary used is simple and straightforward, thereby avoiding having the level of English competence unnecessarily affect the scor ("confounding").

In writing distracters, we were guided, in part, by wrong answers provided by students who took the test for this purpose.

Difficulty Level of Questions

For each competency area, we wrote some questions to be very basic and others to be more advanced, while avoiding writing unrealistically difficult questions. This was done so that the test woul identify students who lacked even basic knowledge of a competency area. Each competency area was

tested with at least two questions and some with three.

Question Sequence

The questions were arranged so that even if a student only finishes half the test, at least some information will still be available for all competencies. The first 21 questions cover each of the 21 competencies. The next 21 questions ask a second question in each competency area. The last 8 questions cover those 8 competency areas which required 3 questions. So the first question measures use of whole numbers, the 21st question measures word problems, the 22nd question begins the second set with a question on whole numbers, and so forth.

Randomized Answer Key

After the questions were written, the correct answer was assigned to one of the 15 answer choices using a table of random numbers, subject to the constraint that every choice be used 3 or 4 times.

Review, Piloting, and Revision of Questions and Competencies

At several points during its development, the DT-PAM was reviewed by diverse subject matter experts (teachers, counselors, mathematicians, psychometricians) from diverse backgrounds (including both public and private schools). The competency areas were reviewed for clarity and accuracy. Student feedback on the test questions was collected on early versions of the test by simply asking students to comment while taking the test. Based on these reviews, some questions were edited and others added to improve clarity and exhaustiveness. The questions were pilot tested prior to field use.

An Evaluation of the 15 Choice Test Question Format

It is quite unusual to offer students 15 choices, so an evaluation of the efficacy of this approach was done. There were several anticipated potential problems with this approach: (1) some of the 15 nominal choices might be very poor distracters (rarely chosen) which would have the effect of reducing the number of real choices, and (2) the students might find the number of choices to be confusing. Both these possibilities are considered below and rejected.

The number of distracters the students chose gives an indication of how well the distracters are working. (In this discussion, all 15 choices are referred to as distracters.) Choice of distracters was evaluated using a group of 424 8th graders from an urban/suburban school. These students will be referred to as Norm Group 1 for the remainder of the technical manual. (See Appendix B, Table B1 for a list of the norm groups and validity groups.) For all but 6 questions, students chose all 15 distracters. The number of distracters chosen averaged 14.8 per question. From this analysis it appears that the 15 distracter approach worked as intended.

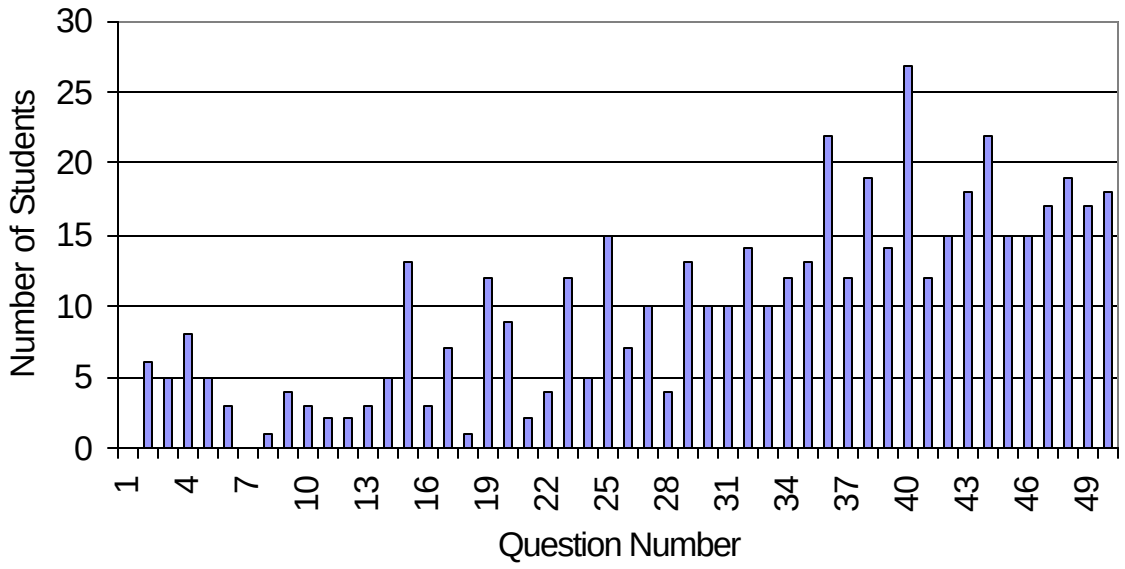
The question intercorrelations within each competency area give another indication of how well the questions are functioning. In Norm Group 1, these question intercorrelations ranged from .066 to .42 with a median of .258 and a mean of .257. See Appendix C for the question intercorrelations within each competency area. These question intercorrelations were reasonably high for individual questions, which indicates that the test questions were not confusing and were functioning as intended.

An Evaluation of the One Class Period Time Limit

Five approaches were used to evaluate whether one class period is sufficient time to take the DT-PAM: (1) the proportion of students who leave the last questions blank, (2) the difficulty levels of the last questions (with high difficulties a possible indication of guessing), (3) the proportion of students w leave many questions blank throughout the test, (4) the proportion of students who skip hard questions (which is sometimes taught as test taking tactic), and (5) the correlation of the DT-PAM and the MCAS.

Few students left blanks anywhere in the test. Norm Group 1 students took the test in one 45 minute class period. They tended to leave more questions blank on the last half of the examination (see Figure 1). However, no more than 6.4% of the students left any one question blank and each of the last 5 questions was left blank by less than 5% of the students. This is an indication that most students finished the test.

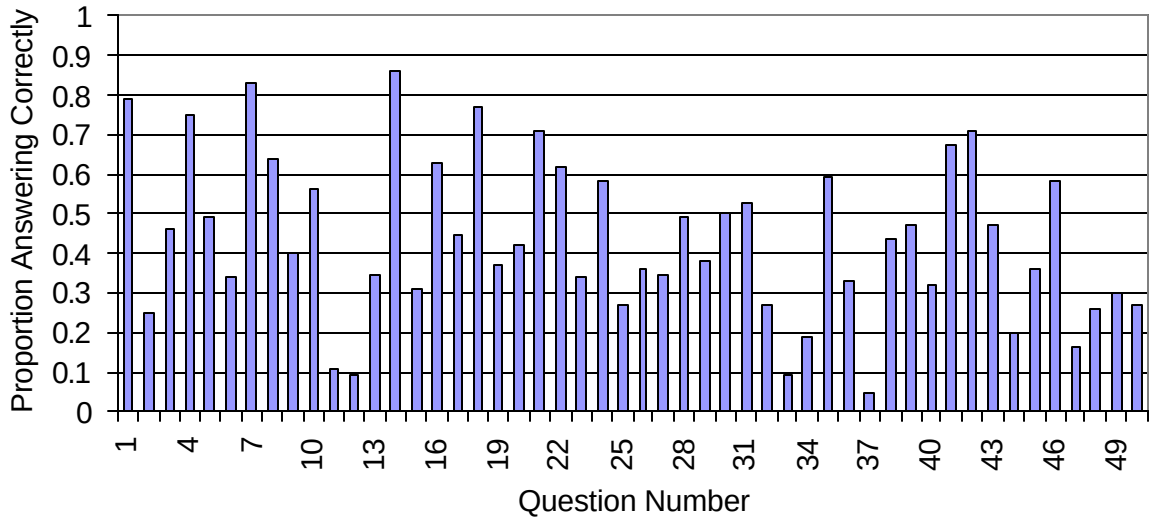
Figure 1. Number of Students Leaving Each Question Blank



Note: There is one bar for each question. This figure is based on Norm Group 1 students (n=424) who took the DT-PAM in one 45 minute class period. The bars for each of the last 5 questions represent less than 5% of the students.

The proportion of students who correctly answered the last questions can give an indication of whether students were rushed or could not finish the test. The questions numbered 40 to 50 include some of the easiest questions of the test. Question difficulties are presented in Figure 2. This figure indicates that the students who answered the questions on the second half of the examination were not merely guessing.

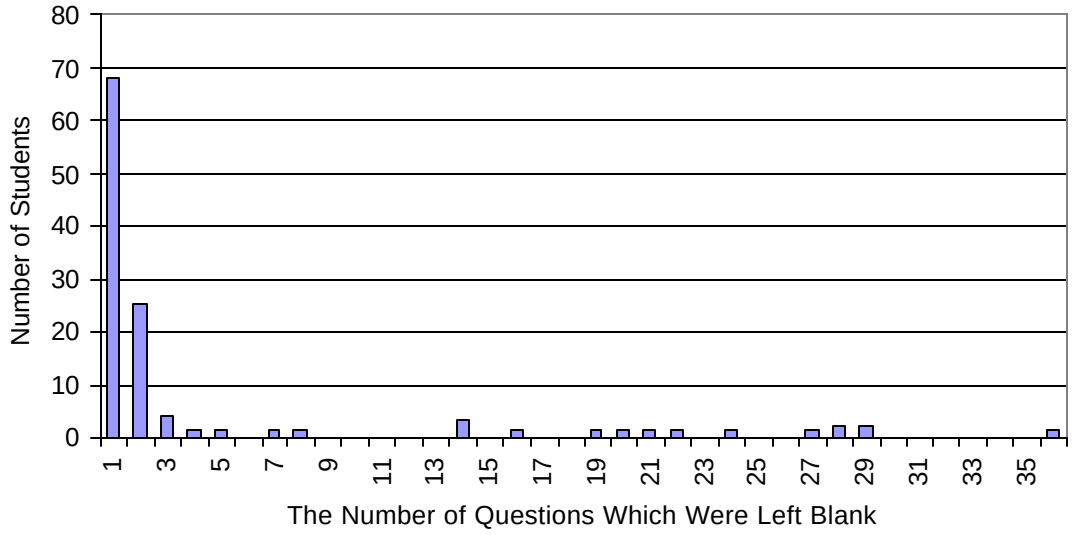
Figure 2. Difficulty Levels of the DT-PAM Questions



Notes: There is one bar for each question. This figure is based on Norm Group 1 students (n=424) who took the DT-PAM in one 45 minute class period.

The number of questions which any one student left blank is one indicator of whether there was enough time to take the test. Of the 424 8th graders in Norm Group 1, 72.6% (308) answered all the questions, and only 3.5% (15) left more than 10 questions blank. Figure 3 shows the distribution of blanks. Most of the non-zero entries in Figure 3 represent one student.

Figure 3. Frequency of Students Leaving Questions Blank



Note: This is based on the 424 students in Norm Group 1. Of these, 72.6% (308) answered all the questions.

Students did not leave the most difficult questions blank. The most difficult questions were numbers 11, 12, 33, and 37 (see Figure 2). The students did not leave these questions blank more than the other questions (see Figure 1).

Finally, the DT-PAM scores correlated highly with the operational 8th Grade Math MCAS. (The validity research is discussed in more detail in Chapter 4.) This would only be possible if the DT-PAM scores were meaningful.

Taken together, these five analyses indicate that students can complete the DT-PAM in one class period without compromising their scores.

A Comparison of the One and Two Class Period Time Limit

A comparison was made between the students who took the DT-PAM in one and two class periods. Data from four school districts were used, two of which administered the DT-PAM in one class period and two in two periods.

The mean total score for the two school districts which administered the test in one class period

were compared with the mean total score for the two other school districts which administered the test in two class periods. The difference between the mean total scores was statistically significant (p<.00 F=143.7, df = 1, 971). The difference in mean total scores was 8.17 (see Table 4 for the means).

Table 4. Summary Statistics for Scores for One and Two Period Administrations				
Number of Class Periods	**Mean Score**	**N**	**Standard Deviation**	**Maximum Score**
One	21.88	580	10.41	50
Two	30.05	392	10.41	47

Notes: N indicates number of 8th grade math students. The standard deviations were the same to the hundredths place.

Although there was a large and statistically significant difference between the mean scores for students who took the test in one period versus two, there was no statistically significant difference see between the schools which took the test within either time period. The comparison of the mean total scores for the two school districts which administered the test in one class period was not statistically significant (p=.64, F=.221, df=1, 578). The means were 21.8 and 22.2. Similarly, the comparison of the mean total scores for the two school districts which administered the test in two class periods was not statistically significant (p=.48, F=.507, df = 1, 390). The means were 29.6 and 30.4.

In one administration of the test to 79 8th grade students, the students were given two periods and the number of questions completed at the end of one period was recorded. The mean number of questions completed at the end of the first of the two periods was 34.1 (median = 34), with a range from 20 to 50 questions completed.

These analyses have implications for selecting a time limit for the test and are discussed in the next section.

Selecting the Time Limit to Use for Your School District

The DT-PAM may be administered in either one or two class periods, but the time limit should be consistent within a school district. Scores for students who took the test with different time limits are directly comparable. Comparing one period and two period test results is not advisable. Separate norms for students who took the test in one or two class periods are provided for this purpose in Chapter 5.

When the DT-PAM is given in one period, it is somewhat speeded. When given in two periods, it is not speeded. It is often best to administer the test in two class periods, which is ample time for almost all students to complete the test, making it a power rather than a speed test.

Scoring Methodology

The scores all represent the number of questions answered correctly unless a percentage is reported (as in the total score).

Professional Test Development Standards

In the development of this test, we have tried to conform to the high standards and ideals embodied in the *Standards for Educational and Psychological Testing* (AERA, APA & NCME, 1999).

Chapter 4. Reliability and Validity of the DT-PAM

The reliability of the DT-PAM may be considered overall and for each diagnostic area. Both approaches are reported here. The validity of the DT-PAM is addressed in two ways: by content validation, and by criterion-related validation using the MCAS as the criterion.

Reliability of the Total Score

To date, a total of 972 8th grade students from four school districts in Massachusetts have taken the DT-PAM: norm groups 1, 2, 3, and 4. (See Appendix B, Table B1 for a listing of norm groups.) The reliability of the total score is .934 (Cronbach's alpha). (See Table 5.) The question-total correlations ranged from .23 to .66, with 35 of the question-total correlations being over .4. The reliability of the total score for the single largest school district (Norm Group 1, n=424) is .928. This is a very respectable reliability for a test, and is especially high given the diverse content of this test. This level reliability is certainly high enough for the intended purpose of the total score: to assess the total level preparation of individual students or groups of students.

Table 5. Reliability of the DT-PAM Total Score

Score Description	Reliability*	Sample Size
Total Score	.934	972

* Cronbach's alpha

Interpretation of the Competency Area Scores Not Limited By Guessing

Interpretation of non-zero test scores is simplified because the probability of getting a non-zero score by chance is low and the probability of getting a perfect score is negligible. (See Table 6.) The probability of getting a perfect score by chance is .004 for the competency areas measured by two questions, and .00002 for the competency areas measured by three questions.

The low expected scores which would be expected due to chance are due to the large number of choices. Each DT-PAM question has 15 answer choices, rather than the typical 4 or 5 choices. If questions with four answer choices were used, the probability of getting a non-zero score by chance would be more than three times as high as seen with the DT-PAM.

In contrast to the low scores due to guessing, students who have mastered a competency area

should be able to achieve a perfect score in that area because the DT-PAM questions are basic in nature. The DT-PAM questions for any competence area are basic in nature, so students should be able to achieve perfect scores in a competency area if they have mastered that area.

Table 6. Probability of Getting Various Competency Area Scores by Chance

	Probability of Getting a Score of Zero by Chance	Probability of Getting a Score of 1 by Chance	Probability of Getting a (Non-Perfect) Score of 2 by Chance	Probability of Getting a Perfect Score by Chance
Competency Area Measured With Two Questions	.871	.129	NA*	.004
Competency Area Measured With Three Questions	.813	.174	.012	.00002

*Not Applicable

In addition to this analysis of the practical utility of the competency area scores, we can consider the classical reliability of these scores.

Reliability of the Competency Area Scores

The median reliability for the competency area scores is .47, as estimated using Cronbach's alpha. Most (16 of 21 areas) were between .4 and .6, and the full range was from .12 to .61, with a median of .47 and a mean of .46 based on data from the 972 8th grade students in norm groups 1, 2, 3, and 4 (see Table 7). This level of reliability is high considering the small number of questions in each area (either 2 or 3), and is high enough for the intended uses of the competency area scores, which are: (1) to serve as an initial quick screen for individual students to suggest areas for more study and more extensive testing, and (2) to assess the strengths and weaknesses of groups of students. The reliability of the total score is high enough for more important individual decisions, such as class placement.

The correlations between the competency area scores and the score on the remainder of the test are

generally higher than the reliabilities (see Table 7). This may indicate that the actual competency area reliabilities are higher than the reliabilities estimated by Cronbach's alpha, or may indicate that the various competency area scores reflect both their specific area knowledge and also a general math knowledge. I think it is due to the former.

Finally the intercorrelations of the area scores ranged from .138 to .671 (based on data from the same group of 972 students in norm groups 1, 2, 3, and 4). The area score intercorrelation matrix is given in Appendix D.

Table 7. Reliability and Validity of the Competency Area Scores				
Area	**Reliability**	**Area-total Correlation**		
		Fall 2000 Administration(n=972)	**Validity Group 1 (n=184)**	**Validity Group 2A (n=97)**
1. Whole Numbers (3)	0.45	.61*	.61*	.60*
2. Common Fractions (2)	0.50	.55*	.40*	.45*
3. Decimal Fractions (3)	0.48	.59*	.49*	.53*
4. Percentages (3)	0.47	.72*	.64*	.70*
5. Units of Measurement (2)	0.53	.62*	.54*	.58*
6. Signed Numbers (2)	0.42	.39*	.04	.54*
7. Simple Powers (3)	0.61	.69*	.61*	.71*
8. Substitution (2)	0.61	.69*	.66*	.70*
9. Setting up Equations (3)	0.43	.65*	.59*	.59*
10. Solving Equations (2)	0.60	.72*	.68*	.72*

Table 7. Reliability and Validity of the Competency Area Scores (continued)				
11. Geometry (3)	0.58	.62*	.62*	.66*
12. Comparisons (2)	0.46	.47*	.38*	.44*
13. Graphs (2)	0.25	.44*	.32*	.48*
14. Tables (2)	0.38	.54*	.40*	.49*
15. Estimation (2)	0.51	.64*	.54*	.65*
16. Probability (2)	0.12	.41*	.43*	.39*
17. Statistics (2)	0.40	.57*	.50*	.58*
18. Order of Operations (2)	0.41	.57*	.56*	.40*
19. Ratios (2)	0.49	.63*	.50*	.51*
20. Math Vocabulary (3)	0.45	.59*	.50*	.62*
21. Word Problems (3)	0.49	.64*	.54*	.57*

Note: Number in parentheses after the area name indicates the number of questions for that area.
* $p < .001$

Content Validity of the DT-PAM for Statewide Tests

Content validity refers to the extent to which the content of the test overlaps or reflects the content the area(s) to be measured. A content validation strategy was used to develop the DT-PAM. Content validation is a widely used approach for test development. Typically this approach involves several key steps: (a) determine the content areas of the test, (b) develop the test to measure these content areas, (c) develop the test so that the questions are a good sample of each content area tested, and (d) minimize measurement of areas not needed (such as unnecessarily hard vocabulary). The content validity of the DT-PAM may be evaluated with respect to the content of various statewide tests through an examination of the content of the DT-PAM and the content of each state's test.

Content Validity of the DT-PAM for the Massachusetts Test

With respect to the Massachusetts statewide examination (MCAS), the content validity of the DT-

PAM is strongly supported by the steps taken in its development (described in Chapter 3). Specifically, the content of the DT-PAM reflects the competencies required for success on the 8th grade MCAS examination.

Content Validity of the DT-PAM for the Florida Test

With respect to the statewide testing program known as the Florida Comprehensive Assessment Test (FCAT), the content validity of the DT-PAM was determined by systematically evaluating each question in the most recent official examination (Florida Department of Education, 2001b). Each question of the 2001 8th grade math test of the FCAT was analyzed to determine which competencies it required using the 21 competency areas of the DT-PAM (see Table 1). Often one FCAT question required several competencies. The number of FCAT questions requiring each competency is summarized in Table 8. There were no questions on this test which required the competency area, signed numbers. However, signed numbers is one of the competencies identified by Florida as a "benchmark." Florida has identified 36 benchmarks which broadly describe the skills necessary for effective math problem solving (Florida Department of Education, 2001a). FCAT literature shows that not every test has questions on every benchmark (Florida Department of Education, 2001b). Our analysis of the competencies required by the FCAT shows that the typical FCAT question requires the application of several competencies. So, like other statewide tests, the FCAT provides an overall measure of competence, not diagnostic information.

Table 8. Number of FCAT Questions Using Each Competency: Grade 8 Math			
Subject/Competency Area	**Number of Questions**	**Subject/Competency Area**	**Number of Questions**
1. Whole Numbers	19	11. Geometry	7
2. Common Fractions	2	12. Comparisons	1
3. Decimal Fractions	2	13. Graphs	2
4. Percentages	3	14. Tables	5
5. Units of Measurement	1	15. Estimation	4
6. Signed Numbers	0	16. Probability	1
7. Simple Powers	4	17. Statistics	4
8. Substitution	2	18. Order of Operations	3
9. Setting up Equations	7	19. Ratios	1
10. Solving Equations	1	20. Math Vocabulary	4
		21. Word Problems	8

Note: This table reflects analysis of the Spring 2001 released questions. The total of these entries is greater than the number of released questions because many questions were linked to more than one competency.

Content Validity of the DT-PAM for the Texas Test

With respect to the statewide testing program known as the Texas Assessment of Academic Skills (TAAS), the content validity of the DT-PAM was determined by systematically evaluating each question in the most recent official examination (Texas Education Agency 2001). Each question of th 2001 8th grade math test of the TAAS was analyzed to determine which competencies it required using the 21 competency areas of the DT-PAM (see Table 1). Often one TAAS question required several competencies. The number of TAAS questions requiring each competency is summarized in Table 9. Two TAAS questions, numbers 4 and 16, test the ability to visualize solids from different perspectives. This ability is not included in the DT-PAM competency list and is not considered further. Texas categorizes math subject matter in several ways, most specifically using 13 knowledge and skill areas (Texas Education Agency, 2000). These areas are broader than the DT-PAM competencies, but

cover the same types of material. Our analysis of the competencies required by the TAAS shows that the typical TAAS question requires the application of several competencies. So, like other statewide tests, the TAAS provides an overall measure of competence, not diagnostic information.

Table 9. Number of TAAS Questions Using Each Competency: Grade 8 Math

Subject/Competency Area	Number of Questions	Subject/Competency Area	Number of Questions
1. Whole Numbers	41	11. Geometry	5
2. Common Fractions	8	12. Comparisons	4
3. Decimal Fractions	21	13. Graphs	12
4. Percentages	7	14. Tables	8
5. Units of Measurement	4	15. Estimation	4
6. Signed Numbers	4	16. Probability	5
7. Simple Powers	4	17. Statistics	3
8. Substitution	1	18. Order of Operations	3
9. Setting up Equations	17	19. Ratios	5
10. Solving Equations	7	20. Math Vocabulary	4
		21. Word Problems	27

Note: This table reflects analysis of the 2001 released questions. The total of these entries is greater than the number of released questions because many questions were linked to more than one competency.

Content Validity of the DT-PAM for Other Statewide Tests

The content validity for the statewide math tests used by other states should be determined on a state by state basis.

Criterion Validity of the DT-PAM Based On Operational MCAS Scores

Two criterion-related validity studies of the DT-PAM based on the operational MCAS scores have been completed to date. In both of these validation studies the DT-PAM was given in the Fall of 2000,

and the criterion was the score on the Grade 8 Math MCAS given in Spring 2001.

The first validity study involved 184 of the students from Norm Group 1 for whom validation data was available. These 184 students are referred to here as Validity Group 1. Validity Group 1 students all were from the classes taught by one teacher. (The other teachers lost the key to the student ID numbers used for this research project, making it impossible to match the students' DT-PAM data with their MCAS data.) The Pearson product-moment correlation between the DT-PAM and the operational 8th Grade Math MCAS is .808 (n=184, p< .001).

The second validity study involved 97 students from Norm Group 2 for whom validation data was available. These 97 students are referred to here as Validity Group 2A. Validity Group 2A students all were from the classes taught by one teacher. (The other teacher lost the key to the student ID numbers used for this research project, making it impossible to match the students' DT-PAM data with their MCAS data.) The Pearson product-moment correlation between between the DT-PAM and the operational 8th Grade Math MCAS is .881 (n=97, p< .001).

It may be noted that the higher validity coefficient was seen for Validity Group 2A which took the test in 90 minutes.

If the correlations found in these two validity studies were adjusted for the unreliability of the two tests, the correlations would be even higher. The high observed correlations mean the DT-PAM and MCAS are measuring very similar things despite the differences in test outline and orientation.

Criterion Validity of the DT-PAM Based on Released MCAS Tests

Two criterion-related validity studies of the DT-PAM have been completed based on administration of released MCAS tests. In both cases, the criterion was the score on the multiple choice questions of the Spring 2000 Grade 8 Math MCAS. This was the most recent set of released MCAS questions at the time the studies were conducted. The full MCAS was not administered due to time constraints. The relationship between this criterion (the score on the multiple choice questions of the MCAS) and the total MCAS math score was shown to be high. First this evaluation of the criterion will be described, and then the criterion-related studies will be reported.

Correlation Between the Multiple Choice and Full MCAS Scores

To determine the correlation between the multiple choice and full MCAS scores, we used the offici "Test Question Analysis Report" of the official administration of the Spring 2000 MCAS to all 171 8th grade students in one suburban school district. This report gives, for each student, the total score and the score for each test question. Two of the 171 students left their MCAS answer sheets blank and their data were excluded from the determination of the correlation. In order to calculate the correlatio

we needed to create a new score for each student based solely on the multiple choice questions.

The Spring 2000 MCAS 8th grade math test consisted of three types of questions: multiple-choice, short answer, and "open response." The Test Question Analysis Report provided by the state to the schools gives, for each student tested, the response to each question, the total score (a raw score of the number correct or number of points earned), the numeric scaled score, and the performance level. For each multiple choice and short answer question which was correctly answered, the student got 1 point. The open response questions were worth either 3 or 4 points. The highest possible score on the test was 53 points: 29 on the 29 multiple choice questions, 5 on the 5 short answer questions, and 19 on the 5 open response questions.

The detailed score report for the MCAS 8th grade math test for the 169 8th grade students was reanalyzed as follows. The score for each student on the MCAS multiple choice questions was determined. Then this score was used to predict the MCAS total math score, which was available from the Test Question Analysis Report. The Pearson product-moment correlation between these two scores was found to be .946. That the correlation is extremely high is not surprising, since the total score is made up in large part by the score on the multiple choice questions. Parenthetically, the correlation of the multiple choice score and the sum of the scores on the short answer and open response questions was .776. The correlation between the score on the MCAS multiple choice questions and the MCAS scaled score was .935. (See Table 10.)

Table 10. Correlation Between Multiple Choice and MCAS Total and Scaled Scores

	MCAS Total Score*	MCAS Scaled Score
MCAS Multiple Choice Score	.946**	.935**

* n=169 (2 students did not answer any questions and their data are omitted)
** p< .001

This reanalysis of MCAS data shows that the score on the MCAS multiple choice questions is a very good predictor of both the total and the scaled scores on the 8th grade math MCAS. Therefore, the score on the multiple choice portion of the MCAS is a reasonable criterion to use in validating the DT-PAM.

Correlation Between the DT-PAM and the Multiple Choice MCAS Scores

All but nine Norm Group 2 students took both the DT-PAM and the (released) multiple choice

questions from the Spring 2000 MCAS 8th grade math test. (They had not previously been given the Spring 2000 MCAS because they were 7th graders when it was administered in Spring 2000.) These 207 students will be referred to as Validity Group 2B. The two tests were administered about 1 month apart, with the DT-PAM given first. The MCAS was given in two periods, which was long enough for all students to finish. The Pearson product-moment correlation between the scores on these two tests was .790 ($n=207$, $p< .001$). If the correlation were adjusted for unreliability of the two tests, the correlation would be even higher. The high observed correlation means the DT-PAM and MCAS are measuring very similar things.

Another group of 159 8th grade math students in a suburban school took both the DT-PAM and the (released) multiple choice questions from the Spring 2000 MCAS 8th grade math test.
These 159 students will be referred to as Validity Group 3. The two tests were administered within about 2 weeks, with the DT-PAM given first. The MCAS questions were given in one period, and it appeared that the students were rushed because the answer sheets were filled out in a relatively sloppy fashion. The Pearson product-moment correlation between the scores on these two tests was .593 ($n=159$, $p< .001$). This correlation is lower than that seen with Validity Group 2B. This may be due to the shorter time this school district allowed for completing the MCAS questions.

Predicting State (MCAS) Scaled Score and Levels Using the DT-PAM

Based on the results of the studies above, it is possible to use the DT-PAM to predict the scores on statewide tests. An example of how this was done for the Massachusetts statewide examination is given in Appendix E.

Construct Validity of the DT-PAM

A test is said to have construct validity to the extent that it measures a characteristic which it is intended to measure. Typically, construct validity is evaluated in terms of the correlation of one test with other measures of the same construct (or similar constructs). The relationship of the DT-PAM to two other measures of mathematical knowledge/ability was investigated with a group of 64 10th grade students from a suburban school. We will refer to these 64 students as Validity Group 5. Three math tests were administered to Validity Group 5 in the same school semester: DT-PAM, COMPASS, and PLAN (ACT, 2001). The results are examined in terms of construct validity of the DT-PAM. The PLAN Test is a "pre-ACT" test and consists of four sections: English, Math, Reading, and Science Reasoning. All four sections were administered and are considered in the following statistical analysis. The COMPASS test consists of three sections: Mathematics Placement, Reading Placement, and Writing Skills Placement. The Mathematics Placement section contains five subsections, of which thre were administered. We present here data from two math sections of the COMPASS: Pre-Algebra, and Algebra (only one student took the College Algebra section). The COMPASS and the PLAN were administered by the school as part of their regular testing program.

The Intercorrelation between the DT-PAM scores and scores on various sections of the COMPASS are presented in Table 11. There is a significant correlation between the DT-PAM score and the COMPASS Pre-Algebra score that demonstrates the validity of the DT-PAM as a test of pre-algebra math. The correlation between the COMPASS Algebra and DT-PAM is low because the topics covered by the algebra test are more advanced, testing knowledge of algebra, while the DT-PAM tests pre-algebra knowledge. The intercorrelations between the DT-PAM and the COMPASS Reading Placement and COMPASS Writing Skills Placement are lower, (although still significant), tha the intercorrelation between the DT-PAM and COMPASS Pre-Algebra. This was expected as the DT-PAM is not a test of English skills.

Table 11. Intercorrelation of DT-PAM with COMPASS

	DT-PAM Score	N
COMPASS Pre-Algebra	.719*	35
COMPASS Algebra	.280	48
COMPASS Reading	.460*	64
COMPASS Writing	.383*	64

Note: N is the number of students. Some students took more than one math section of the COMPASS.
* Correlation is significant at the 0.01 level (2-tailed).

The intercorrelation between the DT-PAM math score and the PLAN math scores are presented in Table 12. The results for the PLAN are presented for the math section only and the combined results from all four sections. (Intercorrelations for each of the 4 sections of the PLAN are not presented because the school did not provide us with those data.) The strong correlations between the DT-PAM and the math scores on the PLAN support the construct validity of the DT-PAM. The high correlation with the PLAN overall score may be due to the math score being a component of the overall score, and the science reasoning having a math component.

Table 12. Intercorrelation of DT-PAM with PLAN	
	DT-PAM Score
PLAN Math Score	.756*
PLAN Math Percentile	.770*
PLAN Overall Score	.671*
PLAN Overall Percentile	.674*

*Correlation is significant at the 0.01 level (2-tailed); N= 59 Students

The intercorrelations between scores from the DT-PAM, scores from the two math subsections of the COMPASS, and the scores from the PLAN math section are shown in Table 13. The low intercorrelation between the PLAN Math Score and the COMPASS Algebra score supports the earlier interpretation of the low correlation between the DT-PAM and the COMPASS Algebra score. It may be noted that the correlations between the COMPASS Pre-Algebra and the DT-PAM and the PLAN Math score and the DT-PAM are higher than the correlation between the COMPASS pre-algebra and the PLAN math score. That is, the DT-PAM correlates better with each of the other two tests than those tests correlate with each other.

Table 13. Intercorrelation of All Math Scores				
	DT-PAM	Compass Pre-Algebra	Compass Algebra	PLAN Math Score
Compass Pre-Algebra	.719*			
Compass Algebra	.280	.008		
PLAN Math Score	.756*	.686*	.249	
PLAN Math Percentile	.770	.655*	.200	.905*

*Correlation is significant at the 0.01 level (2-tailed).

Future Research

Additional research is possible which would contribute to understanding the DT-PAM scores. For example, research might evaluate the correlation of the DT-PAM with:

- Course grades
- Grades on additional math tests
- Grades on the math tests of other states.

Chapter 5. Normative Data for the DT-PAM

Some users may want to compare their students to students at other schools, while other users may want to use local norms. The DT-PAM may be used in either way. School norms may be developed when candidate groups are large enough. This chapter presents scores from several schools, including all data available to date.

The means and standard deviations for each of the scales on the DT-PAM are presented in Tables 14 and 15. Each of these summaries is based on data from two school districts which administered the DT-PAM to all their 8th grade students. The tests were administered in October or November of 2000. The norms in Table 14 include test administrations in which students were given one class perio to complete the test. The norms in Table 15 include test administrations in which students were given two class periods to complete the test.

Additional normative data is expected to be available soon. Contact the test publisher for the latest norm tables.

What is an Acceptable Score?

What is an acceptable score or a high score will depend on the intended use of the diagnostic information. The norm tables provide some guidance. However, if a student gets half or fewer of the questions correct for a competency area, there is reason to suggest additional remedial education in tha area.

Table 14. Descriptive Statistics for the DT-PAM Scales (one period administration)				
Competency Area	**Raw Score Mean**	**Raw Score S.D.**	**% Correct Mean**	**% Correct S.D.**
1. Whole Numbers (3)	1.92	0.97	64.0	32.2
2. Common Fractions (2)	0.62	0.74	30.9	37.0
3. Decimal Fractions (3)	1.28	0.98	42.7	32.5
4. Percentages (3)	1.37	0.91	45.7	30.5
5. Units of Measurement (2)	0.85	0.80	42.4	40.2
6. Signed Numbers (2)	0.78	0.78	39.1	39.1
7. Simple Powers (3)	1.84	1.04	61.4	34.6
8. Substitution (2)	1.03	0.80	51.7	40.0
9. Setting up Equations (3)	1.10	0.92	36.6	30.8
10. Solving Equations (2)	1.07	0.84	53.7	42.1
11. Geometry (3)	0.57	0.85	18.9	28.3
12. Comparisons (2)	0.17	0.45	8.6	22.3
13. Graphs (2)	0.56	0.65	28.2	32.6
14. Tables (2)	1.47	0.67	73.3	33.3
15. Estimation (2)	0.66	0.76	33.0	38.2
16. Probability (2)	0.63	0.54	31.5	27.2
17. Statistics (2)	0.95	0.80	47.4	40.0
18. Order of Operations (2)	1.20	0.75	60.0	37.4
19. Ratios (2)	0.75	0.76	37.7	38.2
20. Math Vocabulary (3)	1.29	1.00	43.0	33.5
21. Word Problems (3)	1.76	0.95	58.8	31.6
Total Score (50)	21.88	10.41	43.8	20.8

Notes: All data above from 8th grade students. (N = 580).

Table 15. Descriptive Statistics for the DT-PAM Scales (two period administration)				
Competency Area	**Raw Score Mean**	**Raw Score S.D.**	**% Correct Mean**	**% Correct S.D.**
1. Whole Numbers (3)	2.17	0.92	72.4	30.5
2. Common Fractions (2)	0.78	0.81	39.0	40.7
3. Decimal Fractions (3)	1.57	1.00	52.2	33.5
4. Percentages (3)	2.01	0.89	67.1	29.8
5. Units of Measurement (2)	1.28	0.76	63.9	38.2
6. Signed Numbers (2)	1.17	0.76	58.7	37.9
7. Simple Powers (3)	2.44	0.84	81.2	28.1
8. Substitution (2)	1.45	0.77	72.6	38.6
9. Setting up Equations (3)	1.59	0.87	53.0	28.9
10. Solving Equations (2)	1.49	0.72	74.5	35.9
11. Geometry (3)	1.10	1.00	36.7	33.5
12. Comparisons (2)	0.50	0.69	24.9	34.5
13. Graphs (2)	0.86	0.75	42.9	37.5
14. Tables (2)	1.73	0.50	86.6	25.1
15. Estimation (2)	1.03	0.81	51.4	40.5
16. Probability (2)	0.75	0.52	37.4	26.0
17. Statistics (2)	1.31	0.71	65.7	35.4
18. Order of Operations (2)	1.54	0.63	77.2	31.3
19. Ratios (2)	1.39	0.73	69.3	36.5
20. Math Vocabulary (3)	1.66	0.88	55.4	29.4
21. Word Problems (3)	2.23	0.82	74.3	27.3
Total Score (50)	30.05	10.41	60.1	20.8

Note: All data above from 8th grade students. (N = 392).

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Appendix A: Order Form for the DT-PAM

Price List for the Diagnostic Test for Pre-Algebra Math
(DT-PAM)

Prices effective September 1, 2001 (Prices are subject to change without notice.)

Description	Price
Less than 100 copies (minimum of 25)	$6.00 per student
100-499 copies	$5.50 per student
500+ copies	$5.00 per student
Technical Manual	$25.00 each
Specimen set including a test, an answer sheet, a technical manual, and sample student, class, and school reports	$55.00 each

Note: This test is offered only to school systems and credentialed personnel.

The test prices above include:

1. Normal shipping of the test materials (expedited and international shipping is extra).
2. Instructions for test administration.
3. Two week turnaround for grading of the test (after receipt of completed answer sheets).
4. Test grading, including student, class, and school-wide reports.
5. The database with all the student scores is available in Excel or dBase formats.
6. Our maintaining anonymous data for normative purposes.

Refund Policy: If you are not satisfied with the Specimen Set you may return it for a full refund. We advise purchasing a Specimen Set before ordering multiple copies of the test.

Order from:

APR Testing Services
27 Judith Road
Newton, Massachusetts 02459-1715
(617) 244-7405 (voice)
(617) 244-8904 (fax)
Support@APRTestingServices.com

(An order form may be found on the next page.)

Order Form for the Diagnostic Test for Pre-Algebra Math (DT-PAM)

Product Needed	Number Ordered	Price
Disposable test booklets 25 to 99 copies at $6.00/student; 100-499 copies at $5.50/student 500+ copies at $5.00/student	(minimum order is 25 copies)	
Technical manuals (at $25 each)		
Specimen sets (at $55 each)		
Database with all student scores (at $0.50 per student)		
Expedited or international shipping (at $50 per shipment)		
	Total Price	

Shipping Address Name and address of the person to whom the test materials should be sent. (Fill in or attach a business card or letterhead)	

Name of person to contact with questions about this order: _____ Telephone #:_____

Name of person authorizing this purchase: _____Signature:_____

Date: _____

Send or fax this order form to:

APR Testing Services
27 Judith Road
Newton, Massachusetts 02459-1715
(617) 244-7405 (voice)
(617) 244-8904 (fax)

Appendix B: Norm Groups and Validity Groups

Table B1. Norm Groups and Validity Groups						
Name	Type of District	Number of Students	Grade	45 minute DT-PAM	90 minute DT-PAM	Took the MCAS
Norm Group 1	Urban/ Suburban	424	8	Y		
Validity Group 1	Urban/ Suburban	184	8			May 2001 official administration
Norm Group 2	Suburban	216	8		Y	
Validity Group 2A	Suburban	97	8			May 2001 official administration
Validity Group 2B	Suburban	207	8			Spring 2000 released
Norm Group 3	Suburban	156	8	Y		
Validity Group 3	Suburban	159	8			May 2000 official administration
Norm Group 4	Suburban	176	8		Y	
Norm Group 5	Suburban	71	10	Y		
Validity Group 5	Suburban	64	10			COMPASS, and PLAN (ACT, 2001), are examined in terms of construct validity of the DT-PAM

Note: Norm Groups took the DT-PAM in the Fall of 2000. Validity Groups took the MCAS (except where noted) and are subgroups of the Norm Groups.

Appendix C: Within Competency Area Inter-Question Correlations for the DT-PAM

Area 1: Whole numbers

		Q1	Q22	Q43
Q1	Pearson Correlation	1.000	.129	.124
	Sig. (2-tailed)	.	.008	.010
Q22	Pearson Correlation	.129	1.000	.376
	Sig. (2-tailed)	.008	.	.000
Q43	Pearson Correlation	.124	.376	1.000
	Sig. (2-tailed)	.010	.000	.

Area 2 - Common Fractions

		Q2	Q23
Q2	Pearson Correlation	1.000	.287
	Sig. (2-tailed)	.	.000
Q23	Pearson Correlation	.287	1.000
	Sig. (2-tailed)	.000	.

Area 3 - Decimal Fractions

		Q3	Q24	Q44
Q3	Pearson Correlation	1.000	.213	.258
	Sig. (2-tailed)	.	.000	.000
Q24	Pearson Correlation	.213	1.000	.183
	Sig. (2-tailed)	.000	.	.000
Q44	Pearson Correlation	.258	.183	1.000
	Sig. (2-tailed)	.000	.000	.

Area 4 - Percentages

		Q4	Q25	Q45
Q4	Pearson Correlation	1.000	.120	.237
	Sig. (2-tailed)	.	.013	.000
Q25	Pearson Correlation	.120	1.000	.255
	Sig. (2-tailed)	.013	.	.000
Q45	Pearson Correlation	.237	.255	1.000
	Sig. (2-tailed)	.000	.000	.

Area 5 - Units of Measurement

		Q5	Q26
Q5	Pearson Correlation	1.000	.353
	Sig. (2-tailed)	.	.000
Q26	Pearson Correlation	.353	1.000
	Sig. (2-tailed)	.000	.

Area 6 - Signed Numbers

		Q6	Q27
Q6	Pearson Correlation	1.000	.292
	Sig. (2-tailed)	.	.000
Q27	Pearson Correlation	.292	1.000
	Sig. (2-tailed)	.000	.

Area 7 - Simple Powers

		Q7	Q28	Q46
Q7	Pearson Correlation	1.000	.311	.261
	Sig. (2-tailed)	.	.000	.000
Q28	Pearson Correlation	.311	1.000	.379
	Sig. (2-tailed)	.000	.	.000
Q46	Pearson Correlation	.261	.379	1.000
	Sig. (2-tailed)	.000	.000	.

Area 8 - Substitution

		Q8	Q29
Q8	Pearson Correlation	1.000	.393
	Sig. (2-tailed)	.	.000
Q29	Pearson Correlation	.393	1.000
	Sig. (2-tailed)	.000	.

Area 9 - Setting up Equations

		Q9	Q30	Q47
Q9	Pearson Correlation	1.000	.257	.066
	Sig. (2-tailed)	.	.000	.177
Q30	Pearson Correlation	.257	1.000	.222
	Sig. (2-tailed)	.000	.	.000
Q47	Pearson Correlation	.066	.222	1.000
	Sig. (2-tailed)	.177	.000	.

Area 10 - Solving Equations

		Q10	Q31
Q10	Pearson Correlation	1.000	.421
	Sig. (2-tailed)	.	.000
Q31	Pearson Correlation	.421	1.000
	Sig. (2-tailed)	.000	.

Area 11 - Geometry

		Q11	Q32	Q48
Q11	Pearson Correlation	1.000	.407	.308
	Sig. (2-tailed)	.	.000	.000
Q32	Pearson Correlation	.407	1.000	.341
	Sig. (2-tailed)	.000	.	.000
Q48	Pearson Correlation	.308	.341	1.000
	Sig. (2-tailed)	.000	.000	.

Area 12 - Comparisons

		Q12	Q33
Q12	Pearson Correlation	1.000	.232
	Sig. (2-tailed)	.	.000
Q33	Pearson Correlation	.232	1.000
	Sig. (2-tailed)	.000	.

Area 13 - Graphs

		Q13	Q34
Q13	Pearson Correlation	1.000	.092
	Sig. (2-tailed)	.	.058
Q34	Pearson Correlation	.092	1.000
	Sig. (2-tailed)	.058	.

Area 14 - Tables

		Q14	Q35
Q14	Pearson Correlation	1.000	.241
	Sig. (2-tailed)	.	.000
Q35	Pearson Correlation	.241	1.000
	Sig. (2-tailed)	.000	.

Area 15 - Estimation

		Q15	Q36
Q15	Pearson Correlation	1.000	.343
	Sig. (2-tailed)	.	.000
Q36	Pearson Correlation	.343	1.000
	Sig. (2-tailed)	.000	.

Area 16 - Probability

		Q16	Q37
Q16	Pearson Correlation	1.000	.123
	Sig. (2-tailed)	.	.011
Q37	Pearson Correlation	.123	1.000
	Sig. (2-tailed)	.011	.

Area 17 - Statistics

		Q17	Q38
Q17	Pearson Correlation	1.000	.265
	Sig. (2-tailed)	.	.000
Q38	Pearson Correlation	.265	1.000
	Sig. (2-tailed)	.000	.

Area 18 - Order of Operations

		Q18	Q39
Q18	Pearson Correlation	1.000	.269
	Sig. (2-tailed)	.	.000
Q39	Pearson Correlation	.269	1.000
	Sig. (2-tailed)	.000	.

Area 19 - Ratios

		Q19	Q40
Q19	Pearson Correlation	1.000	.248
	Sig. (2-tailed)	.	.000
Q40	Pearson Correlation	.248	1.000
	Sig. (2-tailed)	.000	.

Area 20 - Math Vocabulary

		Q20	Q41	Q49
Q20	Pearson Correlation	1.000	.313	.206
	Sig. (2-tailed)	.	.000	.000
Q41	Pearson Correlation	.313	1.000	.278
	Sig. (2-tailed)	.000	.	.000
Q49	Pearson Correlation	.206	.278	1.000
	Sig. (2-tailed)	.000	.000	.

Area 21 - Word Problems

		Q21	Q42	Q50
Q21	Pearson Correlation	1.000	.279	.233
	Sig. (2-tailed)	.	.000	.000
Q42	Pearson Correlation	.279	1.000	.209
	Sig. (2-tailed)	.000	.	.000
Q50	Pearson Correlation	.233	.209	1.000
	Sig. (2-tailed)	.000	.000	.

Note: All the correlations reported in this Appendix are based on Norm Group 1 (n=424).

Appendix D: Intercorrelation of Area Scores

Appendix D: Intercorrelation of Area Scores

		SUM	AREA1	AREA2	AREA3	AREA4	AREA5	AREA6	AREA7	AREA8	AREA9	AREA10	AREA11	AREA12	AREA13	AREA14	AREA15	AREA16	AREA17	AREA18	AREA19	AREA20	AREA21
SUM	Pearson Correlation	1.000	.663(**)	.594(**)	.650(**)	.762(**)	.667(**)	.447(**)	.740(**)	.728(**)	.695(**)	.759(**)	.668(**)	.509(**)	.495(**)	.578(**)	.680(**)	.451(**)	.620(**)	.616(**)	.676(**)	.645(**)	.690(**)
	Sig. (2-tailed)	.	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA1	Pearson Correlation	.663(**)	1.000	.370(**)	.465(**)	.449(**)	.386(**)	.238(**)	.467(**)	.463(**)	.410(**)	.486(**)	.352(**)	.235(**)	.259(**)	.361(**)	.428(**)	.250(**)	.383(**)	.412(**)	.386(**)	.420(**)	.494(**)
	Sig. (2-tailed)	.000	.	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA2	Pearson Correlation	.594(**)	.370(**)	1.000	.456(**)	.416(**)	.404(**)	.269(**)	.374(**)	.364(**)	.376(**)	.366(**)	.407(**)	.352(**)	.281(**)	.275(**)	.386(**)	.250(**)	.331(**)	.298(**)	.306(**)	.337(**)	.346(**)
	Sig. (2-tailed)	.000	.000	.	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA3	Pearson Correlation	.650(**)	.465(**)	.456(**)	1.000	.446(**)	.368(**)	.242(**)	.457(**)	.423(**)	.410(**)	.408(**)	.379(**)	.325(**)	.257(**)	.343(**)	.414(**)	.251(**)	.364(**)	.366(**)	.349(**)	.399(**)	.409(**)
	Sig. (2-tailed)	.000	.000	.000	.	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA4	Pearson Correlation	.762(**)	.449(**)	.416(**)	.446(**)	1.000	.508(**)	.333(**)	.492(**)	.533(**)	.471(**)	.558(**)	.514(**)	.442(**)	.394(**)	.421(**)	.558(**)	.320(**)	.429(**)	.428(**)	.500(**)	.434(**)	.498(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA5	Pearson Correlation	.667(**)	.386(**)	.404(**)	.368(**)	.508(**)	1.000	.259(**)	.466(**)	.452(**)	.415(**)	.513(**)	.443(**)	.357(**)	.352(**)	.320(**)	.457(**)	.277(**)	.352(**)	.378(**)	.438(**)	.376(**)	.401(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA6	Pearson Correlation	.447(**)	.238(**)	.269(**)	.242(**)	.333(**)	.259(**)	1.000	.241(**)	.287(**)	.255(**)	.276(**)	.255(**)	.243(**)	.220(**)	.212(**)	.264(**)	.138(**)	.242(**)	.209(**)	.340(**)	.211(**)	.284(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA7	Pearson Correlation	.740(**)	.467(**)	.374(**)	.457(**)	.492(**)	.466(**)	.241(**)	1.000	.559(**)	.516(**)	.612(**)	.422(**)	.305(**)	.298(**)	.445(**)	.441(**)	.245(**)	.486(**)	.508(**)	.421(**)	.500(**)	.478(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA8	Pearson Correlation	.728(**)	.463(**)	.364(**)	.423(**)	.533(**)	.452(**)	.287(**)	.559(**)	1.000	.544(**)	.671(**)	.432(**)	.306(**)	.315(**)	.396(**)	.449(**)	.284(**)	.437(**)	.403(**)	.480(**)	.434(**)	.447(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA9	Pearson Correlation	.695(**)	.410(**)	.376(**)	.410(**)	.471(**)	.415(**)	.255(**)	.516(**)	.544(**)	1.000	.562(**)	.459(**)	.312(**)	.300(**)	.393(**)	.452(**)	.260(**)	.394(**)	.388(**)	.456(**)	.386(**)	.437(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972

Appendix D: Intercorrelation of Area Scores (continued)

		SUM	AREA1	AREA2	AREA3	AREA4	AREA5	AREA6	AREA7	AREA8	AREA9	AREA10	AREA11	AREA12	AREA13	AREA14	AREA15	AREA16	AREA17	AREA18	AREA19	AREA20	AREA21
AREA10	Pearson Correlation	.759(**)	.486(**)	.366(**)	.408(**)	.558(**)	.513(**)	.276(**)	.612(**)	.671(**)	.562(**)	1.000	.481(**)	.321(**)	.340(**)	.433(**)	.471(**)	.315(**)	.441(**)	.454(**)	.502(**)	.445(**)	.454(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA11	Pearson Correlation	.668(**)	.352(**)	.407(**)	.379(**)	.514(**)	.443(**)	.255(**)	.422(**)	.432(**)	.459(**)	.481(**)	1.000	.373(**)	.311(**)	.311(**)	.447(**)	.344(**)	.354(**)	.360(**)	.425(**)	.392(**)	.413(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA12	Pearson Correlation	.509(**)	.235(**)	.352(**)	.325(**)	.442(**)	.357(**)	.243(**)	.305(**)	.306(**)	.312(**)	.321(**)	.373(**)	1.000	.273(**)	.213(**)	.353(**)	.236(**)	.228(**)	.259(**)	.341(**)	.253(**)	.300(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA13	Pearson Correlation	.495(**)	.259(**)	.281(**)	.257(**)	.394(**)	.352(**)	.220(**)	.298(**)	.315(**)	.300(**)	.340(**)	.311(**)	.273(**)	1.000	.245(**)	.304(**)	.195(**)	.273(**)	.247(**)	.318(**)	.260(**)	.299(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.	.000	.000	.000	.000	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA14	Pearson Correlation	.578(**)	.361(**)	.275(**)	.343(**)	.421(**)	.320(**)	.212(**)	.445(**)	.396(**)	.393(**)	.433(**)	.311(**)	.213(**)	.245(**)	1.000	.353(**)	.217(**)	.390(**)	.368(**)	.364(**)	.360(**)	.422(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.	.000	.000	.000	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA15	Pearson Correlation	.680(**)	.428(**)	.386(**)	.414(**)	.558(**)	.457(**)	.264(**)	.441(**)	.449(**)	.452(**)	.471(**)	.447(**)	.353(**)	.304(**)	.353(**)	1.000	.267(**)	.379(**)	.377(**)	.460(**)	.383(**)	.438(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.	.000	.000	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA16	Pearson Correlation	.451(**)	.250(**)	.250(**)	.251(**)	.320(**)	.277(**)	.138(**)	.245(**)	.284(**)	.260(**)	.315(**)	.344(**)	.236(**)	.195(**)	.217(**)	.267(**)	1.000	.256(**)	.256(**)	.322(**)	.321(**)	.298(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.	.000	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA17	Pearson Correlation	.620(**)	.383(**)	.331(**)	.364(**)	.429(**)	.352(**)	.242(**)	.486(**)	.437(**)	.394(**)	.441(**)	.354(**)	.228(**)	.273(**)	.390(**)	.379(**)	.256(**)	1.000	.357(**)	.408(**)	.379(**)	.407(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.	.000	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA18	Pearson Correlation	.616(**)	.412(**)	.298(**)	.366(**)	.428(**)	.378(**)	.209(**)	.508(**)	.403(**)	.388(**)	.454(**)	.360(**)	.259(**)	.247(**)	.368(**)	.377(**)	.256(**)	.357(**)	1.000	.398(**)	.394(**)	.408(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.	.000	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA19	Pearson Correlation	.676(**)	.386(**)	.306(**)	.349(**)	.500(**)	.438(**)	.340(**)	.421(**)	.480(**)	.456(**)	.502(**)	.425(**)	.341(**)	.318(**)	.364(**)	.460(**)	.322(**)	.408(**)	.398(**)	1.000	.380(**)	.483(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.	.000	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972

Appendix D: Intercorrelation of Area Scores (continued)

		SUM	AREA1	AREA2	AREA3	AREA4	AREA5	AREA6	AREA7	AREA8	AREA9	AREA10	AREA11	AREA12	AREA13	AREA14	AREA15	AREA16	AREA17	AREA18	AREA19	AREA20	AREA21
AREA20	Pearson Correlation	.645(**)	.420(**)	.337(**)	.399(**)	.434(**)	.376(**)	.211(**)	.500(**)	.434(**)	.386(**)	.445(**)	.392(**)	.253(**)	.260(**)	.360(**)	.383(**)	.321(**)	.379(**)	.394(**)	.380(**)	1.000	.421(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.	.000
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
AREA21	Pearson Correlation	.690(**)	.494(**)	.346(**)	.409(**)	.498(**)	.401(**)	.284(**)	.478(**)	.447(**)	.437(**)	.454(**)	.413(**)	.300(**)	.299(**)	.422(**)	.438(**)	.298(**)	.407(**)	.408(**)	.483(**)	.421(**)	1.000
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.
	N	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972

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** Correlation is significant at the 0.01 level (2-tailed).

Appendix E: Predicting Statewide Test Results

It is possible to develop a formula to predict the scores of individual students on statewide tests based on their DT-PAM scores. This formula must be based on the results of a criterion-related validity study done in that jurisdiction or state. An example using the Massachusetts statewide test is given here. First the development of the general method for prediction is described, and then an example is provided using the DT-PAM data from one school district.

Developing a mathematical system to use the DT-PAM to predict the MCAS scores involves conducting a statistical analysis known as a linear regression analysis. A regression formula was computed to do this based on Validity Group 2B (n=97). The resulting formula to predict the MCAS score is:

MCAS Multiple Choice Score = .904 (DT-PAM Score) - .777

This equation can be used to predict the MCAS scores for students who have not yet taken the MCAS but who have taken the DT-PAM. For example, for a student with a raw score of 32 on the DT-PAM, the predicted score on the MCAS is calculated as follows:

MCAS Multiple Choice Score = .904 (32) - .777 = 28.15

The correlation of .88 between the DT-PAM and the MCAS gives an indication of the level of accuracy of the predictions. This relationship is shown in Figure E1.

In a similar fashion, it is possible to develop predictive equations for any state or school district

Figure E1. Relationship Between the DT-PAM and the MCAS