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Mathematics Grade 8 LEAP scores: a predictor of student success in dimensional analysis?

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MATHEMATICS GRADE 8 LEAP SCORE: A PREDICTOR OF STUDENT SUCCESS IN DIMENSIONAL ANALYSIS?

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I dedicate this thesis to my papaw. You were always there to offer the warmest hugs and kindest words. I love you and I am so proud to be your granddaughter.

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ABSTRACT

This study investigates whether the Mathematics Grade 8 LEAP score can be used to predict student success in a key concept of chemistry, dimensional analysis. Mathematics Grade 8 LEAP scores of 106 ninth grade students enrolled in physical science during the 2008-09 school year were tested for correlations with student performance on a pre-test of dimensional analysis, a post-test of dimensional analysis, and student learning gain. Significant, positive correlations were observed between the Mathematics Grade 8 LEAP scores and the pre-test scores of dimensional analysis scores, the post-test scores of dimensional analysis scores, and the dimensional analysis student learning gain. To test whether student success in dimensional analysis is dependent upon mathematical ability, student performance in another academic area not related to dimensional analysis, English Language Arts mid-term grades were analyzed. The English midterm grades were not correlated with dimensional analysis. The Mathematics LEAP scores account for 12.4% of the variance in pre-test of dimensional analysis scores, 21.5% of the variance in post-test of dimensional analysis scores, and 6.1% of the variance in student learning gains, suggesting that the LEAP scores are not a stronger predictor of student success in dimensional analysis.

Students were separated into ability groups based on their Mathematics Grade 8 LEAP scores to test how mathematics ability relates to student performance in dimensional analysis. Mean pre-test scores of dimensional analysis, post-test scores of dimensional analysis, and student learning gains were compared in high ability and low ability groups using a Mann-Whitney test. Significant differences were observed in all three measures tested, mean pre-test scores of dimensional analysis, mean post-test scores of dimensional analysis, and mean dimensional analysis student learning gain.

INTRODUCTION

Mathematics ability plays an important role in student success in chemistry. In fact, the chemistry course is often regarded by students as an additional mathematics course. Tai *et al.* (2006) reviewed studies of the connection between mathematics and chemistry, and many predictors of chemistry success, such as standardized test scores, placement tests, mathematics coursework, prior chemistry content knowledge, gender, ethnicity, and grade point average. Repeatedly the results have shown that mathematics ability, no matter the mathematics ability predictor used (the mathematics components of the SAT (College Board Scholastic Aptitude Test) and ACT (American College Testing Program) scores, the Mathematics Skills Test (MAST), final grades in mathematics courses, mathematics background, and pre-course mathematics skills tests), has the strongest correlation to student success in chemistry (Fletcher, 1978; Mann, 1976; Denny, 1974; Pickering, 1978; Ozsogomonyan *et al.*, 1979; Spencer, 1996).

For decades researchers have sought correlations between student success in chemistry and predictors of the success with the main goal usually being to identify and offer counseling to those students who are at risk for failing chemistry (Pickering, 1975). Most of this work has been used to predict chemistry success for incoming college freshmen; very few studies have been done to predict success for high school chemistry students (Denny, 1974).

Pickering (1975) found there to be a strong correlation between the mathematics portion of the SAT, the SAT-M, and college freshman chemistry grades. He used these results to design an experimental course at Columbia University for at-risk students, and only students with low SAT-M scores were chosen. The course was primarily a "how to" course on solving basic problems encountered in the first semester chemistry course; the students were taught problems stepwise and repetitively. Students chosen for the study "suffered primarily from an inability to do chemical problems that were mathematical", and had difficulty translating words into algebra (Pickering, 1975, p.514).

Ozsogomonyan *et al.* (1979) also found a strong positive correlation between the SAT-M and the grades earned by college general chemistry students. They also tested other possible predictors: high school chemistry grades and pre-course tests. The students chosen for their study took a 10 minute chemistry/algebra pre-test during the first few days of class. The pre-test included questions on calculating molecular weight, balancing equations, stoichiometry, and very basic algebra equations (solving for *x*). Although a positive correlation was found for the algebra portion of the chemistry/algebra pre-test, they found that the best independent predictors of success were the SAT-M scores, high school chemistry grades, and the score obtained on the chemistry portion of the pre-test. The SAT-M score had the strongest correlation.

Spencer (1996) reiterated the same results: students with high SAT-M scores tend to achieve higher chemistry grades, and students with low SAT-M scores tend to achieve lower chemistry grades. A SAT-M score of 500 predicts a “C” in chemistry, a SAT-M score of 600 predicts a “C+”, and a SAT-M score of 700 predicts a “B” (Spencer, 1996). However, a high SAT-M score cannot guarantee a high chemistry grade, but a low SAT-M score has been found to be a strong indicator of a low chemistry grade (Andrews *et al.*, 1979).

Tai *et al*. (2006, p.1707) found that “mathematics background is the most powerful predictor of student performance”. High school calculus enrollment, SAT-M score, and last high school mathematics grade were highly significant in predicting success in college. Although upper level mathematics is not used in beginning chemistry, the significance of high school calculus enrollment should come as no surprise considering enrollment in calculus increases the odds that students are fluent in algebra without much help from a teacher (Tai *et al*., 2006).

In a study conducted at Mississippi Gulf Coast Community College, Mann (1976) found a strong correlation between ACT scores and first semester college chemistry midterm grades and a strong correlation between IQ scores and first semester college chemistry grades. ACT scores were the best predictor of success, and when analyzed together, ACT and IQ scores were only slightly more predictive than just the ACT scores.

A pre-course mathematics test is often administered as a means of predicting student success in chemistry. Leopold *et al*. (2008) studied the results of a mathematics assessment administered at the beginning of a second semester general chemistry course for science and engineering majors at the University of Minnesota. The assessment included questions from four mathematical areas: logarithms, scientific notation, graphing, and algebra. Significant correlations were reported between the pre-course mathematics assessment and final course grades ($r=0.41$; $P < 0.001$) (Leopold *et al*., 2008).

One of the few studies conducted with the intention to predict student success in high school chemistry is the Mathematics Skill Test (MAST). This is a 60-question 45-minute timed mathematical test developed for the Philadelphia Public School System as a means for placement (Denny, 1974). The MAST was found to be a strong predictor (Pearson's $r = 0.967$; $P = 0.01$) of student success in chemistry (Denny, 1971), so it was thought to be a useful aid in high school chemistry scheduling. Based on MAST scores taken in the tenth grade, students were advised to either enroll in advanced or regular chemistry, advised to take remedial mathematics, or advised not to enroll in chemistry for their eleventh grade year. The results of this study reported there to be a significant correlation between the MAST and final high school chemistry grades obtained from placement (Denny, 1974).

Noncognitive predictors of student success in chemistry have also been of interest. It was found that gender differences, prior college experience (including number of years in college), and ethnic background were not good predictors of student success in chemistry (Spencer, 2006; Mann 1976; Wagner *et al*., 2002); however, age has been found to significantly correlate with chemistry success (Wagner *et al*., 2002).

The present study utilizes the Mathematics Grade 8 Louisiana Educational Assessment Program (LEAP) test scores to quantify the mathematics ability of ninth grade physical science students and to test whether these scores are a predictor of their success in dimensional analysis (a significant aid to solving many chemistry problems). The LEAP test is administered to all eighth grade public school students in

Louisiana as a prerequisite for promotion. Because all students must take this test, this could serve as a convenient predictor of student success in chemistry.

The Louisiana Educational Assessment Program (LEAP)

The LEAP is a criterion-referenced test administered at grades 4 and 8. With respect to the present study, the LEAP test administered at grade 8 will be discussed. The LEAP is directly aligned with the state content standards and is a measure of how well students have mastered the state content standards in the four core subjects: English Language Arts, Mathematics, Social Studies, and Science. There is a separate test for each of the core subjects. The students are required to pass the LEAP tests to be promoted to the next grade. The students receive more than a pass/fail score, earning one of the five achievement ratings: Advanced, Mastery, Basic, Approaching Basic, and Unsatisfactory (Louisiana Department of Education, 2007).

The Louisiana Department of Education defines each achievement rating as follows:

"<u>Advanced</u>: A student at this level has demonstrated superior performance beyond the level of mastery.

<u>Mastery</u>: A student at this level has demonstrated competency over challenging subject matter and is well prepared for the next level of schooling.

<u>Basic</u>: A student at this level has demonstrated only the fundamental knowledge and skills needed for the next level of schooling.

<u>Approaching Basic</u>: A student at this level has only partially demonstrated the fundamental knowledge and skills needed for the next level of schooling.

<u>Unsatisfactory</u>: A student at this level has not demonstrated the fundamental knowledge and skills needed for the next level of schooling" (Louisiana Department of Education, 2007, p.1).

To earn promotion to ninth grade, students must pass the English Language Arts and Mathematics Grade 8 tests. As of spring 2006, passing is defined as scoring a *Basic* or above on one of the tests

(English Language Arts or Mathematics) and scoring an *Approaching Basic* or above on the other. Summer remediation is offered to those who do not meet the requirements for promotion, and those students have the opportunity to retest after summer remediation (Louisiana Department of Education, 2007). Summer remediation classes focus mainly on English Language Arts and Mathematics along with test-taking strategies. An attending student receives a letter grade for the class. One does not have to attend summer remediation to be allowed to retest in the summer. However, first time eighth graders who fail, do not attend summer remediation, take the retest, and fail at least one part (English or Mathematics) of the LEAP, must repeat the eighth grade (East Baton Rouge Parish School System, 2008).

The LEAP test is in scale-scored form, ranging between 100 and 500. The performance bands are different for every content area. Table 1 lists the grade 8 LEAP test scaled score range for each of the four core subjects and for each of five achievement levels (Louisiana Department of Education, 2007, p. 8). Furthermore, the Louisiana Department of Education offers achievement level descriptors for the Mathematics Grade 8 LEAP test (Appendix A).

Table 1. The Grade 8 LEAP test scaled score ranges for each of the component subject area tests and for each achievement level (*LEAP/GEE, Section 1*, 2007, p. 8).

Achievement Level	**English Language Arts**	**Mathematics**	**Science**	**Social Studies**
Advanced	402-500	398-500	400-500	404-500
Mastery	356-401	376-397	345–399	350–403
Basic	315-355	321-375	305–344	297–349
Approaching Basic	269-314	296-320	267–304	263–296
Unsatisfactory	100-268	100-295	100-266	100-262

The Mathematics Grade 8 LEAP test consists of two parts: A and B. Part A is broken down into two sections: one in which a calculator can be used and one in which it cannot be used. Both sections of Part A contain all multiple choice type questions. Part B consists of four mathematical tasks, each containing multiple steps. Each task is scored analytically on a 0-to 4-point scale. The questions in Part B are open-ended, requiring numerical answers, short written answers, and other types of constructed responses, such as drawing graphs. Partial credit is given and calculators are permitted on Part B. Both parts of the Mathematics Grade 8 Leap test assess student ability in six strands of the content standards: number and number relations; algebra; measurement; geometry; data analysis, probability, and discrete mathematics; and patterns, relations, and functions (Louisiana Department of Education, 2007, p. 5).

Dimensional Analysis

Because of its use throughout the chemistry course and because it is taught early in the secondary science curriculum, dimensional analysis is a significant tool needed in order to succeed in chemistry (McClure, 1995). Measurement, problem solving, and algebraic skills are not only major mathematical concepts in dimensional analysis and used throughout the chemistry curriculum, but they are also part of the six strands tested on the Mathematics Grade 8 LEAP test.

Sometimes called the factor label method, dimensional analysis is a problem solving method used to convert one unit of measurement to another. It involves setting up a problem by analyzing the units of the known quantities and manipulating them to obtain the desired units and hence, the unknown quantity. The manipulation that takes place is a series of conversion factors multiplied together, canceling out unwanted units to obtain the desired units. It condenses "multi-step problems into one orderly extended solution", reducing the possibility of error (Goodstein, 1983). The conversion factors are written as ratios equal to one. For example, the conversion factor 1 yard = 3 feet can be written as the ratios: $\frac{1\ yard}{3\ feet}$ and $\frac{3\ feet}{1\ yard}$. Since 1 yard is the same as 3 feet, when written as a ratio, like $\frac{2}{2}$, the ratio is equal to one.

Suppose one needed to know how many *inches* were in 20 *yards*, the following conversion using dimensional analysis would take place:

$$\frac{20\ \cancel{yards}}{1} \times \frac{3\ \cancel{feet}}{1\ \cancel{yard}} \times \frac{12\ inches}{1\ \cancel{foot}} = 720\ inches$$

Notice the ratio: $\frac{3\ feet}{1\ yard}$ was used instead of the ratio: $\frac{1\ yard}{3\ feet}$. The given unit *yard* had to cancel out in order to obtain the desired unit *feet*. The units behave like numbers and can cancel out when a unit is in both the numerator and denominator. Similarly, the ratio: $\frac{12\ inches}{1\ foot}$ had to be used instead of $\frac{1\ foot}{12\ inches}$ so that feet would cancel out. The desired unit (inches) must be in the numerator, without having been cancelled, at the end of dimensional analysis.

Dimensional analysis is important in a chemistry classroom because the units of measurement needed to solve problems are not always readily available. For example, one cannot physically measure out *kilometers*; instead, a conversion factor (1 *kilometer* = 1000 *meters*) is needed to convert from a unit of measurement that is readily available (*meters*) to one that is not (*kilometers*). This is especially relevant when teaching the concept of stoichiometry, which has been determined to be the one chemistry topic (among a group of eight) to be an important predictor of college chemistry performance (Tai *et al.*, 2006). Owing to the fact that students cannot physically measure out *moles* of substances, a conversion factor linking moles to a unit that can be measured in a laboratory is needed. Students come across similar setbacks when solving word problems in many different chemical concepts, i.e. gas laws, molarity, and density, where unit conversions are needed prior to solving the actual problem.

In Louisiana public schools, physical science is the science course students take in the ninth grade. Physical science, which serves as an introductory course to chemistry and physics, is the time when dimensional analysis as a problem solving method is initially learned. For this reason, ninth grade students were studied for this project. Without a certain level of mathematical ability, students will find dimensional analysis difficult to master. Louisiana students generally enroll in chemistry their eleventh grade year, which is the same year students are scheduled to take algebra II. Owing to the rigor and demand of both courses, the lower mathematics ability students tend to struggle with both courses, often failing one if not both. Having an early predictor of success could give students more effective scheduling options geared towards achievement in both mathematics and chemistry, meaning low ability students could be counseled against taking chemistry and algebra II in the same academic school year.

The purpose of this study is to investigate whether the Mathematics Grade 8 LEAP score can be used to predict student success in dimensional analysis, a key concept required to master chemistry. To test the idea that student success in dimensional analysis is dependent upon mathematical ability or simply general academic ability, student performance in another academic area unrelated to dimensional analysis, English Language Arts, will be used to determine if it has a correlation to dimensional analysis.

MATERIALS AND METHODS

The participants in this study were all true freshman (non-repeater) ninth grade physical science students, ages 14-15, in an urban public high school, Broadmoor High School in Baton Rouge, Louisiana during the 2008-2009 school year. The students were all part of a freshman academy program, which means they all had the same four core (mathematics, social studies, science, and English language arts) teachers. The ethnicity of the students is similar to that of the school (Table 2). Of the school's students 61% are classified as eligible for free/reduced lunch, which means the students chosen for this study were from a "high needs" school (eSchoolPlus+, 2009).

Table 2. The 2008-2009 ethnicity of Broadmoor High School in Baton Rouge, LA compared to the participants in the study from the same school (eSchoolPlus+, 2009).

	School Population (n ≈ 1020)	Participating Students (n = 106)
African American	80%	81.13%
Caucasian	11%	12.26%
Asian	5%	2.83%
Hispanic	3%	2.83%
Other	1%	0.94%

To earn promotion to ninth grade, students must pass the English Language Arts and Mathematics Grade 8 tests. As of spring 2006, passing is defined as scoring a *Basic* or above on one of the tests (English Language Arts or Mathematics) and scoring an *Approaching Basic* or above on the other. According to East Baton Rouge Parish policy, first time eighth graders who fail, attend and pass summer remediation class, take the retest, and score an *Approaching Basic* on both the English and Mathematics tests, may be granted a waiver from a School Building Learning Committee (SBLC) to proceed to the ninth grade (East Baton Rouge Parish School System, 2008). An SBLC usually consists of a principal, one or more referring teachers, and an SBLC chairperson (East Baton Rouge Parish School System, 2009). A policy override can be obtained from the SBLC for students who score a *Basic* or above on either the Mathematics or English tests and an *Unsatisfactory* on the other. In order to gain the override and obtain promotion to the ninth grade, the student must have met the following criteria: a minimum of an *Approaching Basic* on both the Science and Social Studies tests, an overall GPA of 2.5 during their eighth grade school year, 92% attendance during the school year (missed less than 19 days), obtained parental consent, attended and passed summer remediation class, and retested. If granted promotion from the SBLC, the student must enroll and pass a high school remedial class (in the *Unsatisfactory* component) (East Baton Rouge Parish School System, 2008).

Those students who have already repeated the eighth grade and fail the LEAP have three choices: remain in the eighth grade (for a third time), proceed to the ninth grade with remediation upon approval from the SBLC, or enter a Pre-General Equivalency Diploma (GED) Skills Option program that includes preparation for the GED and job skills training (East Baton Rouge Parish School System, 2008).

Of the students in the study, 74.5% met the LEAP requirements for promotion to the ninth grade; 21.7% were granted a waiver and promotion from the SBLC for achieving two *Approaching Basics* on the English Language Arts and Mathematics tests; and 3.8% were granted a policy override and promotion from the SBLC after scoring a *Basic* or above on the English or Mathematics test and an *Unsatisfactory* on the other. Overall, 13.2% of the students in the study had to repeat the eighth grade at least once.

The students were grouped into two ability groups based on their Mathematics Grade 8 LEAP test scores, which were obtained from the individual students' records. The High Ability group (44.3 % of students) includes those students whose scores were in the *Basic*, *Mastery*, and *Advanced* ranges (321-500); and, the Low Ability group (55.7% of students) includes those in the *Approaching Basic* and *Unsatisfactory* range (100-320).

The students were pre-assessed on dimensional analysis by a fifteen-question multiple choice test (Appendix B). The same fifteen-question multiple choice test was used to post-assess the students after the teacher taught the dimensional analysis content. The students were allowed to use a four function calculator for both tests, and the students were offered bonus points for each question answered correctly to ensure effort on every student's part. The students were given 30 minutes to complete the tests. The questions used in the pre-test and post test were obtained from various sources, including *Holt Science Spectrum* and *Glencoe Physical Science*, which are the physical science textbooks the students use throughout the course, a chemistry textbook, *Addison-Wesley Chemistry*, and a website containing dimensional analysis quiz questions, http://chem.lapeer.org/Exams/DimAnalQuiz.html (Table 3). Question 8 was made up to go along with question 7.

Table 3. Sources used for each question on the pre-test and post-test of dimensional analysis.

Source	**Questions**
Holt Science Spectrum	1, 3, 5, 6, 9
Glencoe Physical Science	4, 7
Addison-Wesley Chemistry	2, 10, 11
Website	12, 13, 14, 15

Between the two tests, the dimensional analysis content was taught using various methods and activities for a total of six 55-minute class periods. The students were first given a list of unit conversions to learn (Appendix D). The students were required to make flashcards of each conversion, and quizzes and daily warm-ups were given during the unit to check for student progress. Hands-on experience with measuring equipment and tools, such as varying sizes of graduated cylinders and beakers, metric masses, meter sticks, and rulers, was incorporated throughout the unit. The students completed the Metric Scavenger Hunt (Appendix E), unit conversion practice worksheets (Appendix F), as well as other measuring activities geared toward the understanding of dimensional analysis.

To investigate possible correlations between Mathematics Grade 8 LEAP scores and other variables, linear regression analyses were performed using GraphPad Prism for Widows version 5.02. To further test the idea that student success in dimensional analysis is dependent upon mathematical ability and not general academic performance, correlations between the students' first semester English averages and pre-test scores, post-test scores, and the dimensional analysis student learning gains, were analyzed by linear regression.

To test how mathematics ability affects student performance in dimensional analysis, mean pre-test of dimensional analysis scores, post-test scores, and student learning gains were compared between ability groups by the Mann-Whitney Test using GraphPad InStat for Windows version 3.1.

Learning gain is a measure of what a student learned based on how much they could have learned. Learning gain is calculated by subtracting the pre-test of dimensional analysis score from the post-test of dimensional analysis score. Then, the difference between the tests is divided by the pre-test of dimensional analysis subtracted from 100 (Hake, 1998).

All students in this study were required to have a parent or guardian sign a letter of consent (Appendix C). The parental consent form and this study were approved by the Institutional Review Board at Louisiana State University.

RESULTS

In order to ensure that the dimensional analysis test would be a valid, fair test and would have a broad range of difficulty levels, the questions were tested on an entry level college chemistry class, CHEM 1201, in the summer session 2008 at Louisiana State University prior to administering the test to the ninth grade students. In addition to answering each question, the CHEM 1201 students were asked to rate each question a 1, 2, or 3 on increasing level of difficulty. The percent of CHEM 1201 students who ranked each question a 1, 2, or 3 along with the percent of students who answered each question incorrectly can be found in Table 4.

When determining the difficulty level of each question, the following criteria were set for classification:

- **Easy**: 60% of CHEM 1201 students rated the question a 1 and at least 60% of students answered correctly
- **Medium**: 60% of CHEM 1201 students rated the question a 2
- **Hard**: 60% of CHEM 1201 students rated the question a 3 and less than 60% of students answered correctly

At least 60% of the CHEM 1201 students rated questions 1, 2, 3, 4, 5, 6, 7, 8, and 9 as being level 1 difficulty (0% rated the questions a 3) and at least 60% of the students answered those questions correctly, so it was determined that those questions were classified as Easy. At least 60% of the CHEM 1201 students rated question 13 as a level 2 difficulty; so, it was classified as Medium. At least 60% of the CHEM 1201 students rated questions 14 and 15 as level 3 difficulty (0% rated the questions a 1) and less than 60% of the students answered either question correctly, so it was determined that questions 14 and 15 were classified as Hard. Questions 10, 11, and 12 were more difficult to classify because they did not fully meet the criteria of one difficulty level. Only 50% of the CHEM 1201 students rated questions 10 and 11 as level 2 difficulty, but at least 60% of the students answered them correctly, so both questions

Table 4. Louisiana State University CHEM 1201 student ratings of dimensional analysis questions and the results of the CHEM 1201 tests. Students were asked to rate each question on increasing level of difficulty (1 to 3) (n=8).

Question	**Level of Difficulty**			**% who answered correctly**
	1	**2**	**3**	
1	100%	0%	0%	88%
2	100%	0%	0%	88%
3	75%	25%	0%	75%
4	75%	25%	0%	88%
5	63%	37%	0%	75%
6	75%	25%	0%	88%
7	100%	0%	0%	100%
8	100%	0%	0%	63%
9	88%	12%	0%	100%
10	37%	50%	13%	63%
11	50%	50%	0%	63%
12	50%	25%	25%	25%
13	0%	75%	25%	63%
14	0%	37%	63%	25%
15	0%	37%	63%	37%

were classified as Medium. 50% of the CHEM 1201 students rated question 12 as a level 1 difficulty (25% level 2 and 25% level 3), but only 25% of students answered the question correctly. Although it was initially perceived as being easy, question 12 contained multiple steps, increasing the chance for a calculation error, and two of the answer choices (one of them being the correct answer) were almost identical, so perhaps the low passing percentage is due to the nature of the problem. It was determined that question 12 is classified as Medium. Ultimately, the test contained 9 Easy questions, 4 Medium questions, and 2 Hard questions.

There was a normal distribution of CHEM 1201 student grades, so the test was determined to be valid. An invalid test would be one in which there is great shift towards the high end or the low end of the grade distribution. The grade distribution for the ninth grade physical science students was similar to that of the CHEM 1201 students. The ninth grade students performed better on those questions classified as Easy and struggled with those questions classified as Medium or Hard (Table 5). The high ability group performed better than the low ability group overall, especially on those questions classified as Hard (Table 6 and Table 7).

Table 5. Percentage of ninth grade students who answered each question correctly on the pre-test and post-test of dimensional analysis (n=106).

Question	Pre-Test	Post-Test		Question	Pre-Test	Post-Test
1	41%	77%		**9**	38%	44%
2	31%	86%		**10**	13%	14%
3	35%	41%		**11**	57%	31%
4	34%	75%		**12**	35%	26%
5	82%	85%		**13**	17%	23%
6	56%	58%		**14**	15%	20%
7	79%	82%		**15**	48%	50%
8	16%	11%				

Table 6. Percentage of High Ability ninth grade physical science students who answered each question correctly on the pre-test and post-test of dimensional analysis (n=47). High Ability is defined as scoring a Mathematics Grade 8 LEAP score ≥ 321 on a 100 to 500 point scale.

Question	Pre-Test	Post-Test		Question	Pre-Test	Post-Test
1	44%	89%		**9**	56%	63%
2	30%	95%		**10**	86%	20%
3	30%	43%		**11**	14%	50%
4	53%	84%		**12**	65%	32%
5	84%	91%		**13**	74%	25%
6	65%	66%		**14**	93%	95%
7	79%	91%		**15**	40%	44%
8	14%	7%				

There was a significant, positive correlation between the Mathematics Grade 8 LEAP scores and the pre-test of dimensional analysis (r = 0.353, n = 106, P = 0.001), indicating as Mathematics LEAP scores increase, pre-test of dimensional analysis scores also increase (Figure 1). Mathematics LEAP scores account for 12.4% of the variance in pre-test of dimensional analysis scores.

The Mathematics Grade 8 LEAP scores and the post-test of dimensional analysis were also positively correlated (r = 0.464, n = 106, P = 0.001), indicating that as Mathematics LEAP scores

Table 7. Percentage of Low Ability ninth grade physical science students who answered each question correctly on the pre-test and post-test of dimensional analysis (n=59). Low Ability is defined as scoring a Mathematics Grade 8 LEAP score ≤ 320 on a 100 to 500 point scale.

Question	**Pre-Test**	**Post-Test**		**Question**	**Pre-Test**	**Post-Test**
1	38%	69%		**9**	33%	31%
2	31%	79%		**10**	11%	9%
3	38%	40%		**11**	88%	17%
4	17%	50%		**12**	35%	22%
5	81%	81%		**13**	10%	21%
6	48%	52%		**14**	21%	14%
7	79%	76%		**15**	38%	40%
8	17%	14%				

increase, post-test of dimensional analysis scores also increase (Figure 2). Mathematics LEAP scores account for 21.5% of the variance in post-test of dimensional analysis scores.

There was a significant, positive correlation between the Mathematics Grade 8 LEAP scores and the dimensional analysis student learning gain (r = 0.247, n = 106, P = 0.011), indicating that as Mathematics Grade 8 LEAP scores increase, dimensional analysis student learning gain also increases (Figure 3). Mathematics LEAP scores account for 6.1% of the variance in dimensional analysis student learning gain.

Success in mastering dimensional analysis does not seem related to general academic ability. There was no significant correlation between the English midterm grades and the pre-test of dimensional analysis variables (r = 0.168, n = 106, P = 0.084) (Figure 4). There was no significant correlation between the English midterm grades and the dimensional analysis post test (r = 0.152, n = 106, P = 0.119) (Figure 5). There was no significant correlation between the English midterm grades and the dimensional analysis student learning gain (r = 0.053, n = 106, P = 0.589) (Figure 6).

The comparison of mean pre-test of dimensional analysis scores between mathematical ability groups is shown in Figure 7. There was a significant difference in mean pre-test of dimensional analysis scores and ability group (39.433 ± 1.834 for High Ability; 33.107345 ± 1.619 for Low Ability; P =

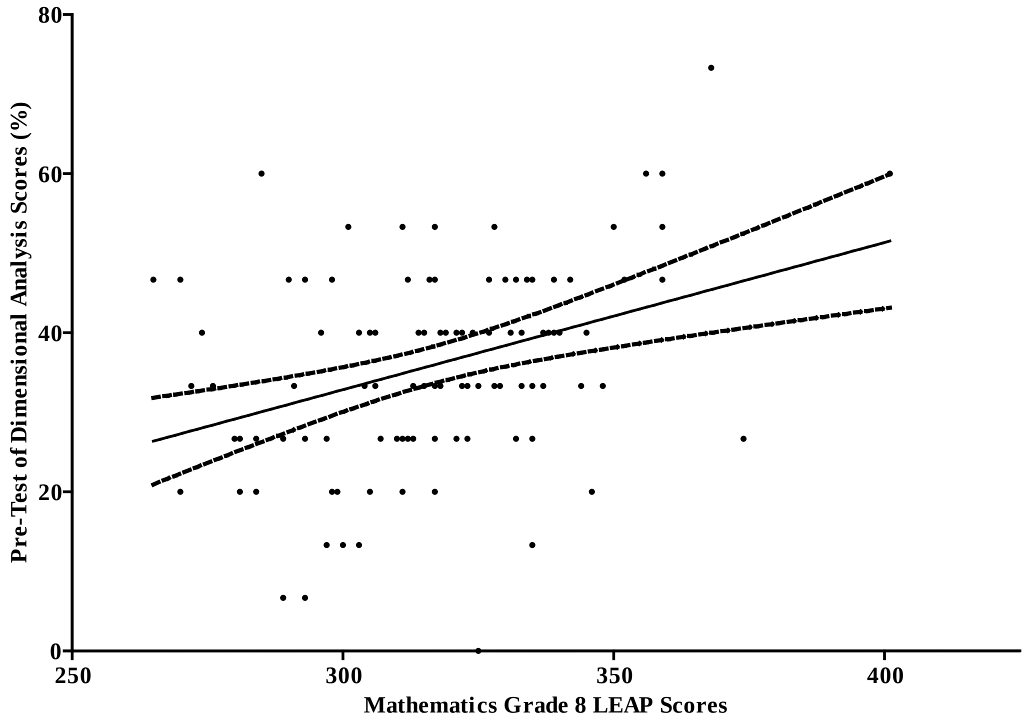

Figure 1. The relationship between Mathematics Grade 8 LEAP scores and pre-test of dimensional analysis scores. There was a significant, positive relationship between Mathematics LEAP scores and pre-test of dimensional analysis scores ($P = 0.001$, $r = 0.353$, $n = 106$). The line ($y = 0.1849x-22.622$) represents a linear regression. The 95% confidence band around the regression line is shown. Mathematics Grade 8 LEAP scores greater than 321 are considered passing.

0.0117). The comparison of mean post-test of dimensional analysis scores between mathematical ability is shown in Figure 8. There was a significant difference in mean post-test of dimensional analysis scores and ability group (50.780 ± 2.369 for High Ability; 40.564972 ± 1.435 for Low Ability; $P < 0.0001$). Figure 9 shows the comparison of mean dimensional analysis student learning gain between the ability groups. There was a significant difference in mean dimensional analysis student learning gain and ability group (0.183 ± 0.032 for High Ability; 0.085 ± 0.031 for Low Ability; $P = 0.0236$).

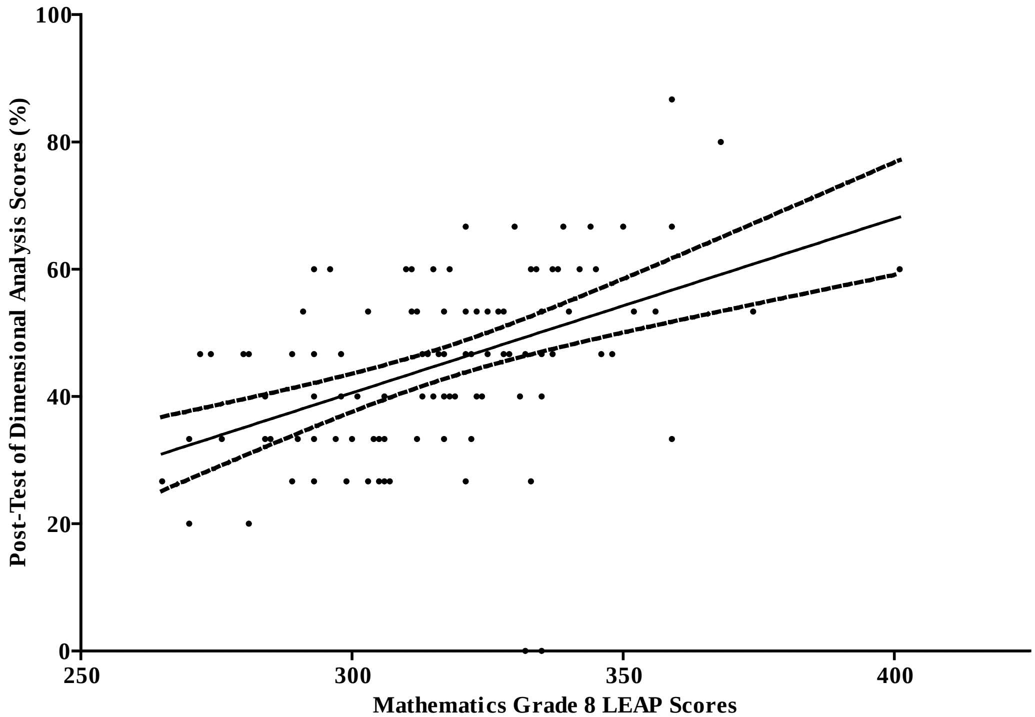

Figure 2. The relationship between Mathematics Grade 8 LEAP scores and post-test of dimensional analysis scores. There was a significant, positive correlation between Mathematics LEAP scores and dimensional analysis post test scores (P = 0.001, r = 0.464, n = 106). The line (y= 0.2736x – 41.532) represents a linear regression. The 95% confidence band around the regression line is shown. Mathematics Grade 8 LEAP scores greater than 321 are considered passing.

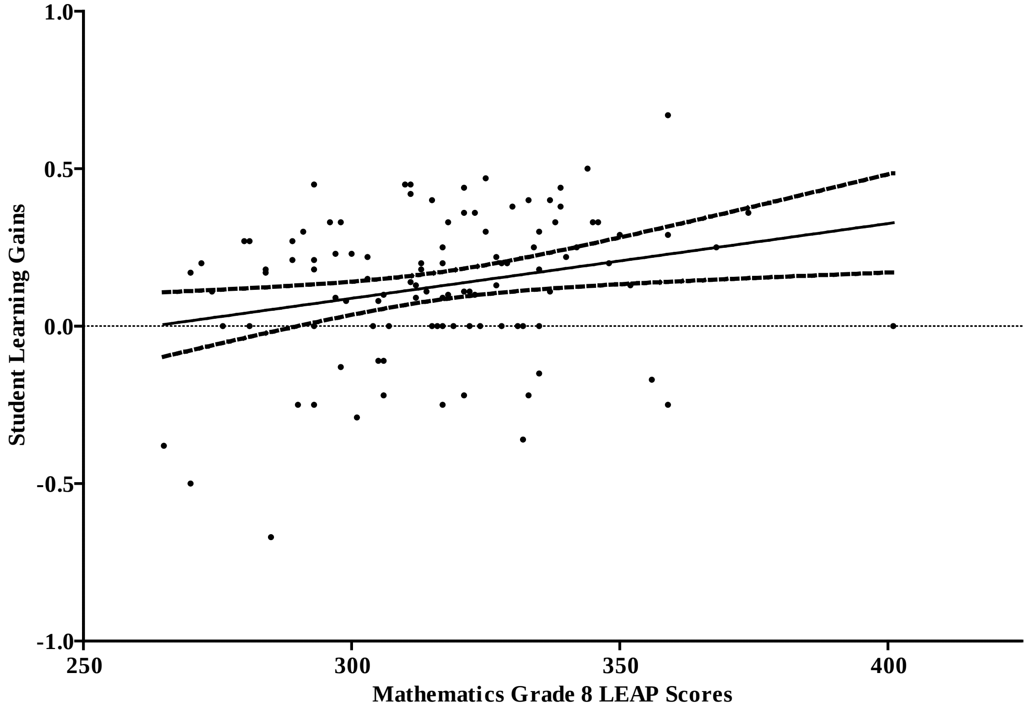

Figure 3. The relationship between Mathematics Grade 8 LEAP scores and dimensional analysis student learning gain. There was a significant positive correlation between Mathematics Grade 8 LEAP scores and dimensional analysis student learning gain ($P = 0.011$, $r = 0.247$, $n = 106$). The line ($y = 0.0024x – 0.6156$) represents a linear regression. The 95% confidence band around the regression line is shown. Mathematics Grade 8 LEAP scores greater than 321 are considered passing.

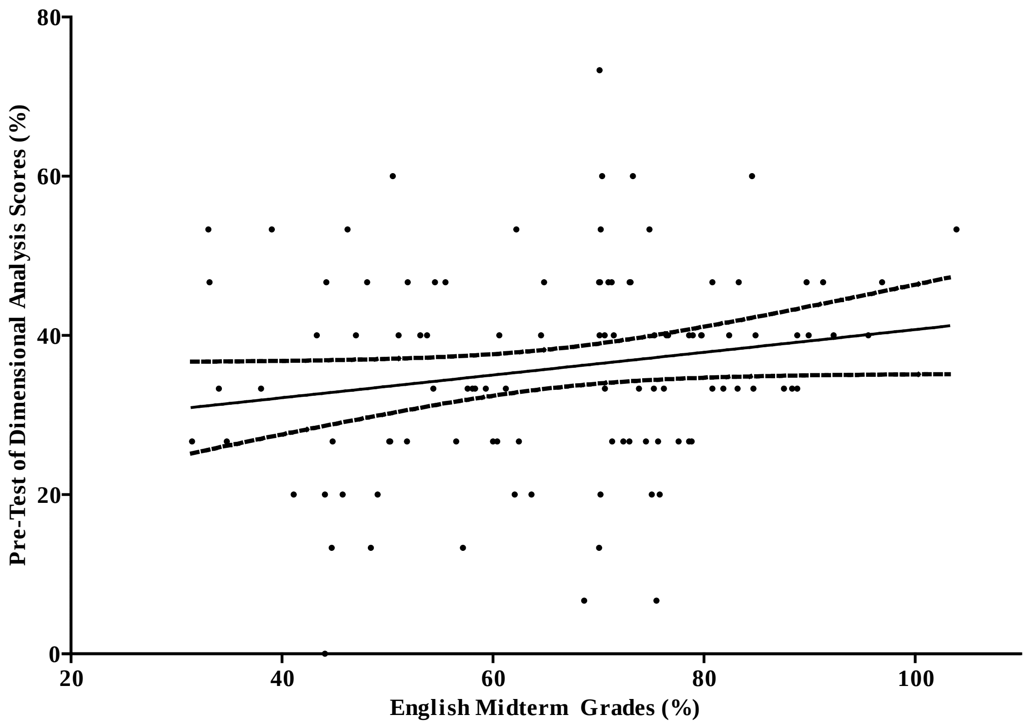

Figure 4. The relationship between midterm grades in English class and pre-test of dimensional analysis scores. There was no significant correlation between the midterm grades and pre-test scores (P = 0.084, r = 0.168, n = 106). The line (y = 0.1429x + 26.454) represents a linear regression. The 95% confidence band around the regression line is shown.

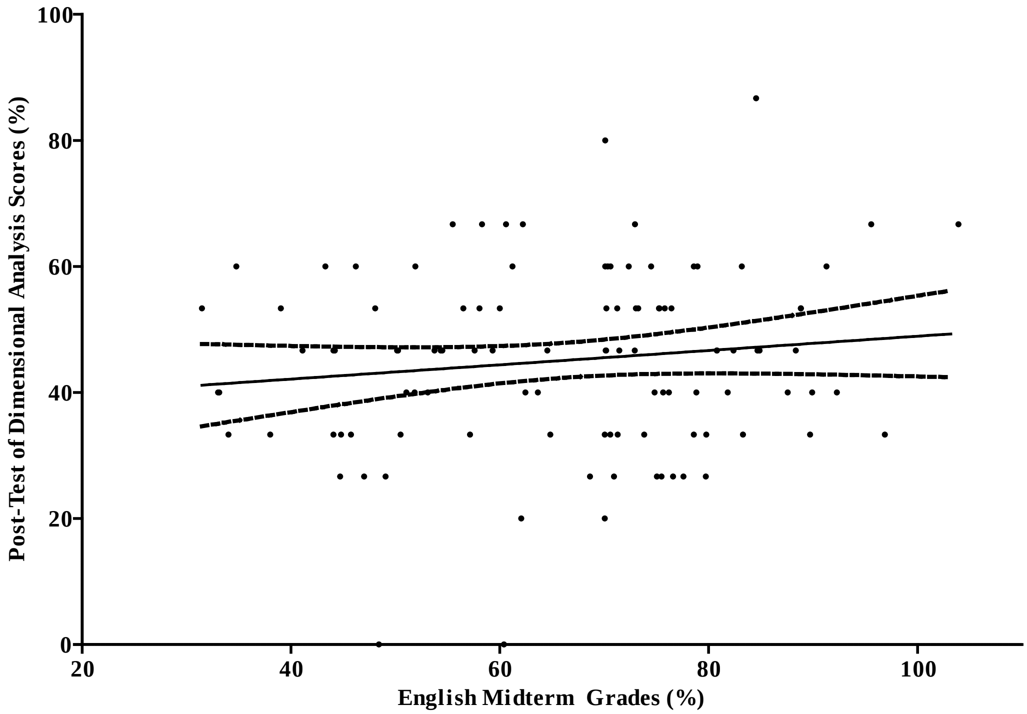

Figure 5. The relationship between English midterm grades in and post-test of dimensional analysis scores. There was no significant correlation between midterm grades and post-test scores (P = 0.119, r = 0.152, n = 106). The line (y = 0.1136x + 37.573) represents the linear regression. The 95% confidence limit band around the regression line is shown.

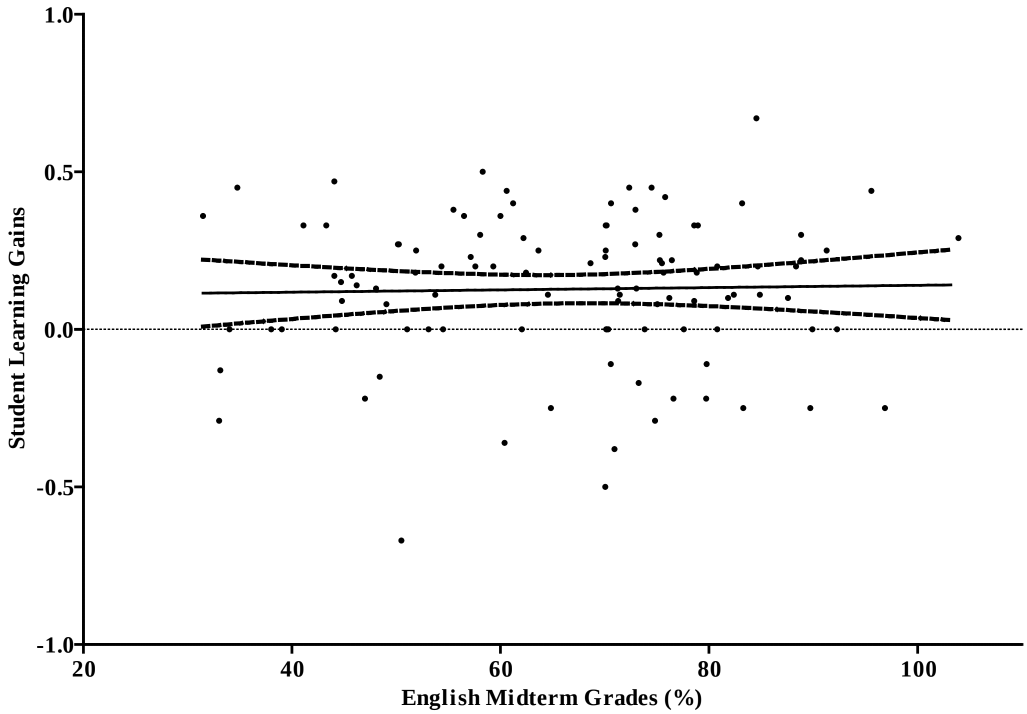

Figure 6. The relationship between midterm grades in English and dimensional analysis student learning gain. There was no significant correlation between midterm grades and student learning gain (P = 0.589, r = 0.053, n = 106). The line (y=0.0004x + 0.1052) represents the linear regression. The 95% confidence band around the regression line is shown.

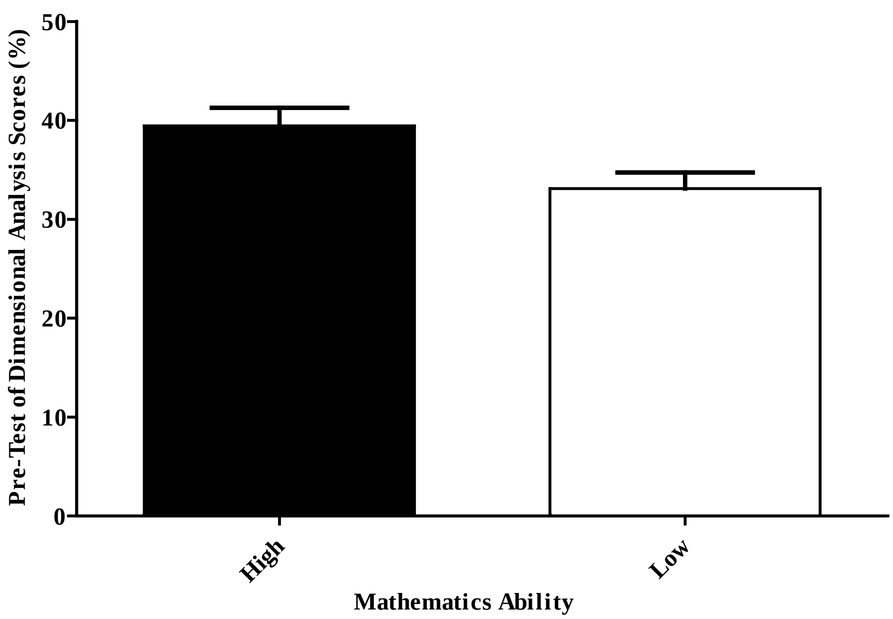

Figure 7. The comparison of mean pre-test of dimensional analysis scores between mathematical ability groups (39.433 ± 1.834, n = 47 for High Ability; 33.107345 ± 1.619, n = 59 for Low Ability). The values were different between the two groups (P = 0.0117). High Ability is defined as scoring a Mathematics Grade 8 LEAP score ≥ 321; whereas, Low Ability is defined as scoring a Mathematics Grade 8 LEAP score ≤ 320 on a 100 to 500 point scale.

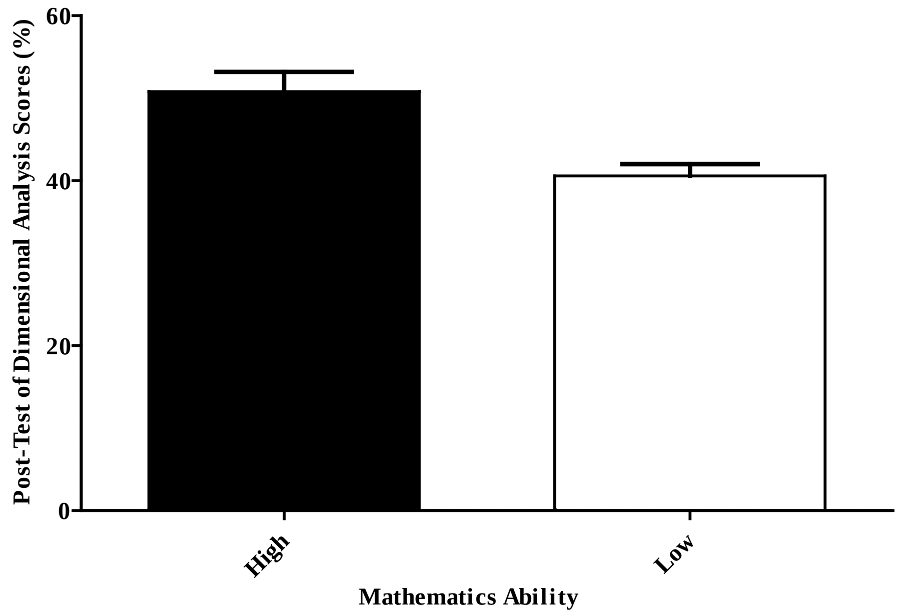

Figure 8. The comparison of mean post-test of dimensional analysis scores between mathematical ability groups (50.780 ± 2.369, n = 47 for High Ability; 40.564972 ± 1.435, n = 59 for Low Ability). The values were different between the two groups ($P < 0.0001$). High Ability is defined as scoring a Mathematics Grade 8 LEAP score ≥ 321; whereas, Low Ability is defined as scoring a Mathematics Grade 8 LEAP score ≤ 320 on a 100 to 500 point scale.

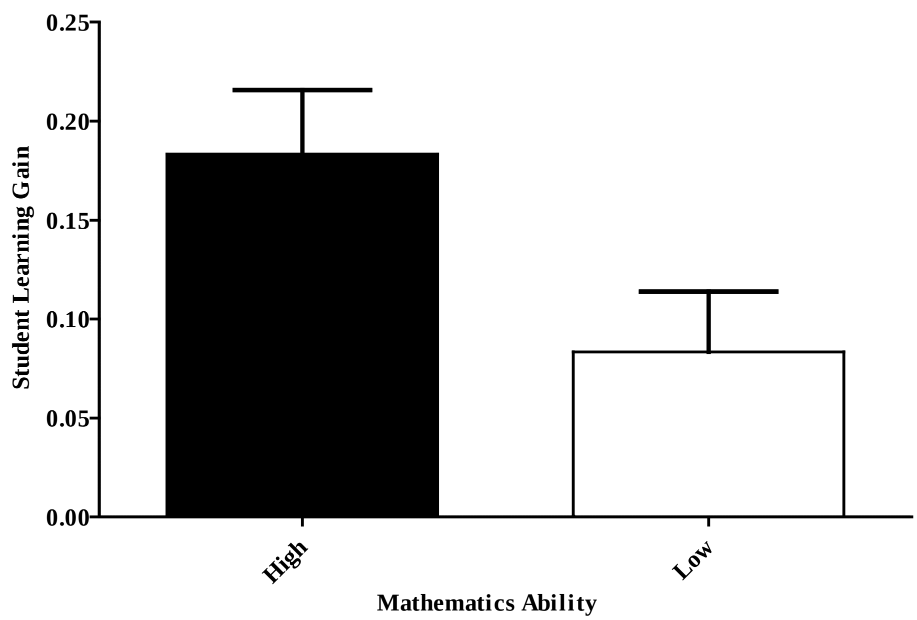

Figure 9. The comparison of mean dimensional analysis student learning gain between mathematical ability groups (0.183 ± 0.032, n = 47 for High Ability; 0.085 ± 0.031, n = 59 for Low Ability). The values were different between the two groups ($P = 0.0236$). High Ability is defined as scoring a Mathematics Grade 8 LEAP score ≥ 321; whereas, Low Ability is defined as scoring a Mathematics Grade 8 LEAP score ≤ 320 on a 100 to 500 point scale.

DISCUSSION

The purpose of this study was to investigate whether the Mathematics Grade 8 LEAP score has value as a predictor of student success in dimensional analysis, a key concept required to master chemistry. Other studies (Fletcher, 1978; Mann, 1976; Denny, 1974; Pickering, 1978; Ozsogomonyan *et al.*, 1979; Spencer, 1996) have correlated mathematical ability with success in chemistry courses. Because the Mathematics Grade 8 LEAP test is required of all Louisiana public school students, if the LEAP score is related to success in chemistry, it would be of value in setting course prerequisites to chemistry and guiding instructional strategies.

There were positive correlations between Mathematics Grade 8 LEAP scores and student performance in dimensional analysis (Figs. 1, 2, and 3). Mathematics LEAP scores account for 12.4% of the variance in pre-test of dimensional analysis scores, 21.5% of the variance in post-test of dimensional analysis scores, and 6.1% of the variance in student learning gains. This correlation does not appear to be a general reflection of academic ability because student mid-term scores in an English class did not appear to correlate with learning gains in dimensional analysis (Figs. 4, 5, and 6). Students were assigned to high and low mathematics ability groups. There were significant differences in student performance of dimensional analysis between these mathematical ability groups.

The correlation between mathematics ability and student performance in chemistry in this study was not as strong as found for the predictors investigated in past studies. Denny (1971) tested the relationship of mathematics skill and chemistry performance using the Mathematics Skills Test (MAST) as an indicator of mathematical ability. She observed a strong correlation between the MAST and final chemistry grades. The MAST scores accounted for 93.5% of the variance in final chemistry grades. One reason for the strong correlation maybe that the MAST was designed specifically to test student competence in the mathematics skills needed for high school chemistry in order to place students in appropriate courses (Denny, 1974).

Wagner *et al*. (2002) sought to identify at-risk first-semester general chemistry (CHEM 1251) students at the University of North Carolina at Charlotte by using a student pre-semester assessment that included mathematical, chemical, conceptual, and demographical questions. The mathematics questions on the test included simple algebra and unit conversion problems. The chemistry questions were designed to give students enough information so that they could arrive at the answer even with minimal chemistry background knowledge. The demographic questions included information on mathematics and chemistry background, number of years of college experience, age, population of hometown, school involvement, major, and number of weekly hours spent at work. The student pre-semester assessment accurately predicted 74.1% of the students who ended up failing CHEM 1251, and was a better predictor of success than the SAT (69.2%).

Although there was variability in the relationship of chemistry success and the Mathematics Grade 8 LEAP test scores, for this study and its location in Louisiana, it was the most readily accessible information on student mathematical ability. A possible reason for variability in the predictive value of LEAP scores is the fact that this population is a much more diverse group of participants, public high school students, than students in previous studies who were college chemistry students. Also the ninth grade physical science students were tested in this study rather than the eleventh grade chemistry students, suggesting an even more diverse group of students considering the fact that physical science is required for high school graduation from the study site and chemistry is not. Chemistry in Louisiana is regarded as a course taken only by those students who are college bound, and college bound students generally have higher mathematics abilities.

The information presented in this study only included a small portion of the content covered in a high school chemistry classroom and not the entire chemistry curriculum. Because one does not have the mathematical skills to perform well in dimensional analysis does not mean one lacks the ability to learn other chemical concepts (i.e. nomenclature, bonding, reactions, and acid/base chemistry). Further studies could be conducted to investigate possible correlations between the Mathematics Grade 8 LEAP scores and final high school chemistry grades.

There were significant differences in student performance of dimensional analysis among the mathematical ability groups. If low mathematical ability students were identified as early as the ninth grade, using Mathematics Grade 8 LEAP scores, there could be significant changes in course scheduling geared towards student achievement. The goal is to not discourage at-risk students from taking chemistry, but to offer an alternate path in order to increase student achievement. Instead of enrolling in both algebra II and chemistry in the eleventh grade, the low mathematics ability students could be advised to complete algebra II their eleventh grade year and enroll in chemistry their twelfth grade year.

SUMMARY AND CONCLUSIONS

Mathematics Grade 8 LEAP scores were used as a measure of student mathematical ability to test whether these scores could predict student success in dimensional analysis, a problem solving method used in chemistry. The Mathematics Grade 8 LEAP scores correlated with student success in dimensional analysis. There was a positive correlation between the Mathematics Grade 8 LEAP scores and the pre-test of dimensional analysis. This correlation suggests that students either have an innate mathematical ability to perform well on tests of dimensional analysis. There was a stronger correlation between the Mathematics Grade 8 LEAP scores and the post-test of dimensional analysis scores, which suggests that mathematics ability plays an important role in how well students are able to master dimensional analysis.

The positive correlation with Mathematics Grade 8 LEAP scores is not a reflection of general academic performance. For example, there was no significant correlation between English midterm grades and dimensional analysis performance, meaning how well a student performs in English has no effect on how well he or she performs in dimensional analysis.

Mathematics LEAP scores account for 12.4% of the variance in pre-test of dimensional analysis scores, 21.5% of the variance in post-test of dimensional analysis scores, and 6.1% of the variance in student learning gains, indicating that the LEAP score is not a strong predictive tool for dimensional analysis. However, for future studies, looking at LEAP score and performance in a chemistry course rather than performance in mastering a single concept may find a stronger predictive value.

Finally, when comparing students grouped by performance on the Mathematics Grade 8 LEAP scores, the mean dimensional analysis scores for the groups were significantly different. This suggests that the High Ability group as defined by the Mathematics Grade 8 LEAP scores will consistently outperform the Low Ability group in dimensional analysis.

Because there was a positive correlation between LEAP scores and mastery of dimensional analysis, and presumably success in a chemistry course, one might be able to use these scores to provide student guidance on a path to successful completion of chemistry. These scores could be used to aid in scheduling courses more effectively to maximize student success. For example, one could have the lower performing students take algebra II first, during their junior year, then enroll in chemistry their senior year, increasing the chances of success in both courses.

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APPENDIX A
MATHEMATICS GRADE 8 LEAP ACHIEVEMENT LEVEL DESCRIPTORS

Students scoring at the *Advanced* level in Mathematics generally exhibit the ability to:

1. probe examples and counterexamples in order to shape generalizations from which they can develop models
2. use number sense and geometric awareness to consider the reasonableness of an answer
3. use abstract thinking to create unique and/or alternative problem-solving techniques
4. explain the reasoning processes underlying their conclusions

Students scoring at the *Mastery* level generally exhibit the ability to:

1. logically create and defend their ideas, as well as give supporting examples
2. understand the connections between fractions, percents, decimals, and other mathematical topics such as algebra and functions
3. thoroughly understand basic-level arithmetic operations in order to problem solve in practical situations
4. use quantity and spatial relationships in problem solving and reasoning
5. convey underlying reasoning skills beyond the level of arithmetic
6. compare and contrast mathematical ideas and generate their own examples
7. apply properties of informal geometry
8. accurately use the tools of technology
9. understand the process of gathering and organizing data and be able to make inferences, calculate, evaluate, and communicate results within the domain of statistics and probability

Students scoring at the *Basic* level generally exhibit the ability to:

1. complete problems correctly with the help of prompts such as diagrams, charts, and graphs
2. solve routine, real-world problems through the appropriate selection and use of strategies and technological tools—including calculators and geometric shapes
3. use fundamental algebraic and informal geometric concepts in problem solving
4. determine which available data are necessary and sufficient for correct solutions and use them in problem solving
5. show limited skill in communicating mathematically

Students scoring at the *Approaching Basic* level generally exhibit the ability to:

1. complete problems correctly with the help of prompts such as diagrams, charts, and graphs
2. solve one-step problems involving basic computation (+, −, x, ÷) and follow procedural steps with instructional assistance
3. recognize basic geometric figures
4. recognize simple, obvious patterns
5. use the tools of technology
6. apply conceptual knowledge inconsistently

7. demonstrate difficulty in transferring knowledge and skills to problem-solving situations

Students scoring at the *Unsatisfactory* level have not demonstrated the fundamental knowledge and skills needed for the next level of schooling. Students scoring at this level generally have not exhibited the ability to:

1. complete problems correctly with the help of prompts such as diagrams, charts, and graphs
2. solve one-step problems involving basic computation (+ , – , x , ÷) and follow procedural steps with instructional assistance
3. recognize basic geometric figures
4. recognize simple, obvious patterns
5. use the tools of technology
6. apply conceptual knowledge on a limited basis
7. transfer knowledge and skills to problem-solving situations

Note: Based on the Louisiana Department of Education Achievement Level Descriptors

APPENDIX B
DIMENSIONAL ANALYSIS TEST

1. Maria is 123 centimeters tall. Her height in meters is

a.	0.0123 m.	c.	1.23 m.
b.	0.123 m.	d.	12.3 m.

2. What is the quantity 7896 milligrams expressed in grams?

a. 7.896 g

b. 78.96 g

c. 789.6 g

d. 789,600 g

e. 7,896,000 g

3. A cubic meter is about the same as the volume occupied by ___________.

a. a washing machine   b. a cup of milk

c. a basketball arena   d. a kilogram of water

4. Arrange each of the following in order from largest to smallest.

1. centimeter
2. kilometers
3. meters
4. micrometers
5. millimeters

a. 3, 2, 1, 4, 5
b. 2, 3, 1, 5, 4
c. 3, 2, 5, 1, 4
d. 2, 3, 5, 4, 1
e. none of the above

5. Imagine you need to transport 5 gallons of water from one place to another. Which of the following container sizes would get the job done in the least amount of time?

a. cup   b. pint   c. quart   d. tablespoon

6. Which of the following units is the most appropriate if you are measuring the mass of a bowling ball?
a. kilogram b. gram c. milligram d. microgram

7. A box is 25 cm long, 6 cm wide, and 4 cm high. How many cubic centimeters of water can it hold?

a. 25 b. 70 c. 150 d. 600 e. 6000

8. Based on your answer to the previous question, how many milliliters of water can the box hold?

a. 0.07 b. 0.600 c. 70 d. 600 e. 6000

9. Which of the following units of measurement are there the most of in one mile?

a. kilometers b. yards c. inches d. feet e. meter

10. Which of the following linear measures is the longest?

a. 6×10^4 cm b. 6×10^6 mm c. 0.06 km d. 6×10^9 nm

11. Match the approximate mass with each item.

a. quarter	(1) 400 cg
b. pear	(2) 50 mg
c. stamp	(3) 60 kg
d. person	(4) 150 g

12. How much would it cost Craig Marcus in dollars to buy nails used to build a fence 125 meters long if it requires 30 nails per meter? Assume that 40 nails are sold per box at a cost of $0.75 per box.

a. $6.75 b. $70.31 c. $70.50 d. $125.00

13. Mark McGuire hit 70 home runs in the 1998 season. Given that there are 4 bases with 90.0 feet between each base, how many miles did he run last season just from home runs?

a. 4.77 mi b. 8.40 mi c. 35.6 mi d. 50.45 mi

14. How many miles could you drive for $7.90 if your car gets 14 km/liter of gas and the price is $3.29/gal? (1.61 km = 1 mile, 4 qt = 1gal, 1.1 qt = 1L)

a. 2.40 mi　　b. 4.75 mi　　c. 37.97 mi　　d. 75.93 mi

15. At one time Rigel IV, a class M planet, had a system of weights and measures called the Bozo system. This system was created and used by the Bozonians, who lived on a continent in the Northern hemisphere, and had all of the deficiencies of the current English system on earth. The relationships between the various units used for length in the Bozo system are: 325 cubebs = 1 furbish; 6 furbishes = 1 nautical smile; 20 nautical smiles = 1 minor league; 3 minor leagues = 1 major league. Using the above conversion factors determine the number of furbishes a Bozonian would have to walk if his doctor recommended that he walk 2 major leagues each day to maintain cardiovascular health.

a. 2.22　　b. 390　　c. 720　　d. 1560

APPENDIX C
PARENTAL PERMISSION FORM

I agree to allow my child, ______________________________, to take part in a research study titled, "Mathematics Grade 8 LEAP Scores: A Predictor of Student Success in Dimensional Analysis?", which is being conducted by Ms. Lauren Baggett, Broadmoor High School, (225) 926-1420, under the direction of Dr. William Wischusen, LSU, (225)578-8239. I do not have to allow my child to be in this study if I do not want to. My child can refuse to participate or stop taking part at any time without giving any reason, and without penalty or loss of benefits to which she/he is otherwise entitled. I can ask to have the information related to my child returned to me, removed from the research records, or destroyed.

• The reason for the study is to find out if mathematics ability has any effect on student performance in dimensional analysis, a vital concept in science.

• The participating student will not be doing any extra work. The tests involved in the research are mandatory for the student's regular physical science or chemistry coursework.

• The researcher hopes to learn something that may help students succeed in this and other courses.

• The research is not expected to cause any harm or discomfort. My child can quit at any time. My child's grade will not be affected if my child decides not to participate or to stop taking part.

• Any individually-identifiable information collected about my child will be held confidential unless otherwise required by law. My child's identity will be coded, and all data will be kept in a secured location.

• The researcher will answer any questions about the research, now or during the course of the project, and can be reached by telephone at: (225) 926-1420 on Wednesdays during the times 8:15-8:45 a.m. I may also contact the professor supervising the research, Dr. William Wischusen, LSU (225)578-8239.

• I understand the study procedures described above. My questions have been answered to my satisfaction, and I agree to allow my child to take part in this study.

_______________________	___________________________	________________
Name of Parent or Guardian	Signature	Date

Please sign both copies, keep one and return one to the researcher. Additional questions or problems regarding your child's rights as a research participant should be addressed to Dr. Robert Mathews, Chair, Institutional Review Board, Louisiana State University, 203 B-1 David Boyd Hall, Baton Rouge, LA 70803; Telephone (225)578-8692; E-Mail Address irb@lsu.edu

APPENDIX D
LIST OF UNIT CONVERSIONS

Metric Prefixes:

tera	T	1 T = 10^{12} (or 1,000,000,000,000) **base units**
giga-	G	1 G = 10^{9} (or 1,000,000,000) **base units**
mega-	M	1 M = 10^{6} (or 1,000,000) **base units**
kilo-	k	1 k = 10^{3} (or 1000) **base units**
hecto-	h	1 h = 10^{2} (or 100) **base units**
deka-	da	1 da = 10 **base units**
Base Unit	meter, liter, gram, mole, second, joule, Pascal	
deci-	d	1 **base unit** = 10 d
centi-	c	1 **base unit** = 10^{2} (or 100) c
milli-	m	1 **base unit** = 10^{3} (or 1000) m
micro-	µ	1 **base unit** = 10^{6} (or 1,000,0000) µ
nano-	n	1 **base unit** = 10^{9} (or 1,000,000,000) n
pico-	p	1 **base unit** = 10^{12} (or 1,000,000,000,000) p

Length Conversion Factors:

Customary Conversions		Metric Conversions
1 mile (mi) = 5280 ft 3 ft = 1 yard (yd) 12 in = 1 ft	1 inch = 2.54 cm	1 terameter (Tm) = 1 × 10^{12} meters (m) 1 gigameter (Gm) = 1 × 10^{9} meters (m) 1 megameter (Mm) = 1 × 10^{6} meters (m) 1 kilometer (km) = 1000 meters (m) 1 hectometer (hm) = 100 meters (m) 1 dekameter (dam) = 10 meters (m) 1 meter (m) = 10 decimeters (dm) 1 meter (m) = 100 centimeters (cm) 1 meter (m) = 1000 millimeters (mm) 1 meter (m) = 1 × 10^{6} micrometers (µm) 1 meter (m) = 1 × 10^{9} nanometers (nm) 1 meter (m) = 1 × 10^{12} picometers (pm)

Weight and Mass Conversion Factors:

Customary Conversions		Metric Conversions
16 ounces (oz) = 1 pound (lb) 2000 lb = 1 ton	1 oz = 28.35 grams	1 teragram (Tg) = 1 × 10^{12} grams (g) 1 gigagram (Gg) = 1 × 10^{9} grams (g) 1 megagram (Mg) = 1 × 10^{6} grams (g) 1 kilogram (kg) = 1000 grams (g) 1 hectogram (hg) = 100 grams (g) 1 dekagram (dag) = 10 grams (g) 1 gram (g) = 10 decigrams (dg) 1 gram (g) = 100 centigrams (cg) 1 gram (g) = 1000 milligrams (mg) 1 gram (g) = 1 × 10^{6} micrograms (µg) 1 gram (g) = 1 × 10^{9} nanograms (ng) 1 gram (g) = 1 × 10^{12} picograms (pg)

Volume of liquids Conversion Factors:

Customary Conversions		Metric Conversions
8 fl. Oz. = 1 cup 2 cups = 1 pint 2 pints = 1 quart 4 quarts = 1 gallon	1 fl. Oz. = 29.6 mL	1 teraliter (TL) = 1 × 10^{12} liters (L) 1 gigaliter (GL) = 1 × 10^{9} liters (L) 1 megaliter (ML) = 1 × 10^{6} liters (L) 1 kiloliter(kL) = 1000 liters (L) 1 hectoliter (hL) = 100 liters (L) 1 dekaliter (daL) = 10 liters (L) 1 liter (L) = 10 deciliters(dL) 1 liter (L) = 100 centiliters (cL) 1 liter (L) = 1000 milliliters (mL) 1 liter (L) = 1 × 10^{6} microliters (µL) 1 liter (L) = 1 × 10^{9} nanoliters (nL) 1 liter (L) = 1 × 10^{12} picoliters (pL)

Time Conversion Factors:

1 millennium = 1000 years

1 century = 100 years

1 decade = 10 years

1 year = 365 days

1 day = 24 hours

1 hour = 60 minutes

1 minute = 60 seconds

Temperature Conversions:

Kelvin (K) = °Celsius + 273

°F = (9/5) °C + 32

APPENDIX E
METRIC SCAVENGER HUNT

METRIC SCAVENGER HUNT

Try to find objects of these lengths	Name of Object	Actual Measurement	Difference
1. 40 cm			
2. 87 cm			
3. 3 cm			
4. 1 m			
5. 31 cm			
6. 1.5 m			
7. 65 mm			
8. 240 mm			
9. 28 cm			
10. 2 mm			
		Total Differences	

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APPENDIX F
UNIT CONVERSION PRACTICE WORKSHEETS

Measurement Conversions
[Metric to Metric]

1. 3.68 kg = ___________g

2. 568 cm = ___________m

3. 8700 ml = ___________l

4. 25 mg = ___________g

5. 0.101 cm = ___________mm

6. 250 ml = ___________l

7. 600 g = ___________kg

8. 8900 mm = ___________m

9. 0.000004 m = ___________mm

10. 0.250 kg = ___________mg

Measurement Conversions
[Metric to English]

1. 74 cm = ___________in.

2. 25 ml = ___________tsp.

3. 50 kg = ___________lbs.

4. 160 km = ___________mi.

5. 3.6 l = ___________gal.

6. 500 g = ___________oz.

7. 100 m = ___________yds.

8. 300 ml = ___________cups.

9. 600 g = ___________lbs.

10. 523 mm = ___________in.

VITA

Martha Lauren Baggett was born to Bill and Pamela Baggett in Hattiesburg, Mississippi in June 1984. She attended primary and secondary schools in the Stone County School District, and she graduated with highest honors from Stone High School in May 2002. The following August, she entered Mississippi Gulf Coast Community College and in May 2004 earned an Associate of the Arts Degree, graduating with a 4.0. In August 2004, Martha entered Louisiana State University and earned a Bachelor of Science Degree in chemistry in May 2007. She entered Louisiana State University Graduate School in June 2007 and is a candidate for the Master of Natural Science Degree. She currently teaches chemistry and coaches cheerleading at Broadmoor High School in Baton Rouge, Louisiana, where she was named Teacher of the Year 2010.