Reading and Mathematics connection: English Language Learner Students' Perspective

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Abstract

The National Council of Teachers of Mathematics has acknowledged the integration between the domains of mathematics and reading with the inclusion of Standard 2 "Mathematics as Communication" in the "Curriculum and Evaluation Standards for School Mathematics". No one can deny the fact that reading provides both context and motivation for the mathematics students. In the case of English Language Learner students this integration of mathematics and reading is more important than ever before. This study in brief examines the English Language Learner student's performance in TAKS. It also investigates the association between reading and mathematics achievement of school students in Texas. In particular, a special attention has been paid to the performance of English Language Learner students' performance.

Background

A children's rhyme linked the domains of the three R's "reading, 'riting and 'rithmetic"-long before the whole language philosophy or integrated curriculum become focal points for educators. Letters, symbols, and numbers are the primary methods of communication in the world. This includes the universal sharing of ideas, concepts, data, and information. This common role in society creates a natural connection for the integration of reading and mathematics in the school curriculum (Balas, 2000). The National Clearinghouse for English Language Acquisition (NCELA) reported that based on state-reported data, it is estimated that more than 4.8 million English Language Learner (ELL) students were enrolled in public schools (Pre-K through Grade 12) for the 2004-2005 school year. This number represents approximately 9.9% of total school student enrollment, and a 47.6% increase over the reported 1994-95 total public school ELL enrollment. Among the states, California enrolled the largest number of public school ELL students, with 1,951,525 followed by Texas (616.466), Florida (299,346), New York (203,583), Illinois (192,764), and Arizona (155,789). Analyzing the same report it has been found that forty-one states noted a growth in the ELL population in the school year 2004-2005. Several states reported unusual growth of ELL students, for example, Kentucky has reported a growth of 417.4% followed by South Carolina (400.8%), North Carolina (371.7%), Tennessee (369.9%), Alabama (336.8%) and Georgia (291.6). In Texas the number of students identified as ELL grew by 45.1 percent between 1994-95 and 2003-04. By the year 2050, it is highly probable that every teacher in the United States will have ELLs as students (Samway & Mckeon, 1999). These growing numbers suggest the crucial need for adequate preparation of teachers to serve these students.

According to the National Center for Education Statistics (2002), 41% of current teachers in the United States have had English Language Learners as students in their class room, but only 13% of those teachers reported receiving any instruction or professional development on the education of ELLs.

Terminology

Part of the challenge facing researchers on the topic of language minority is understanding the different terminology used to refer to students in this population (U. S. Department of Education, 1997). Non English Proficient (NEP) describes a student who has not yet begun acquiring or who is in an initial stage of learning English. The official term used in federal legislation for students whose proficiency has not yet developed to the point where they can fully participate in an English-only instructional environment is Limited English Proficient (LEP). A native speaker of a language other than English is referred as Language Minority. English Language Learner (ELL) is a term suggested by researchers in the field (Rivera 1997, and August & Hakuta, 1997) as being a more positive alternative to "LEP" or "language minority" student. ELL refers to a student whose first language is not English and encompasses both students who are just beginning to learn English and those who have already developed considerable proficiency (Case, 2003). The other terminology used in this article is related to the standard test taken by Texas public school students. The Texas Assessment of Knowledge and Skills (TAKS) are taken by most Texas public school students in spring each year during grades 3-11. On June 18, 2001, TAAS (Texas Assessment of Academic Skills) was renamed the TAKS, which became the statewide assessment program in 2003.

Data and Methodology

As a result of growing number of students from culturally and linguistically diverse environments, the great number of minority students dropping out and the decreasing achievement levels of these students, educators are converging on more effective learning and instructional methods for language minority students. With the rapid change in the diversity of the student population, the Texas State University System (TSUS) and the Texas Education Agency (TEA) have taken an initiative on the ELL study named as the Texas State University System Mathematics for English Language Learners Initiative (TSUS MELL). This is a multiyear effort focusing on developing instructional resources designed to increase the effectiveness of mathematics instruction for ELL students. Partnering TSUS institutions are Angelo State University, Lamar University, Sam Houston State University, Sul Ross State University, and Texas State University. TEA carries the mammoth responsibility of helping more than 1100 school districts (which is about 7% of total school districts in the United States). TEA publishes in depth TAKS results for ELL students. It has a user-friendly webpage that allows researchers to download various TAKS data for grades 3-11. A total of about 5,641 variables have been studied for every single grade. There are more than 1,250 variables just for the mathematics test. The other tests are: reading/ELA, writing, social studies and science. The data is provided separately for English and Spanish versions of the test for grades 3-6. TEA has made two sets of data available, one is given by campus and the other one is given by region (for several reasons TEA has subdivided the state of Texas into 20 regions). Since SPSS and Minitab has been used for this study the first task was to convert the SAS data to SPSS and Minitab form. Data analysis was conducted in several stages. First, the percentages of the students who met the standard were calculated for several groups. Second, Pearson's correlations and coefficients of determination were calculated to determine the relationship among reading and mathematics performances.

Results

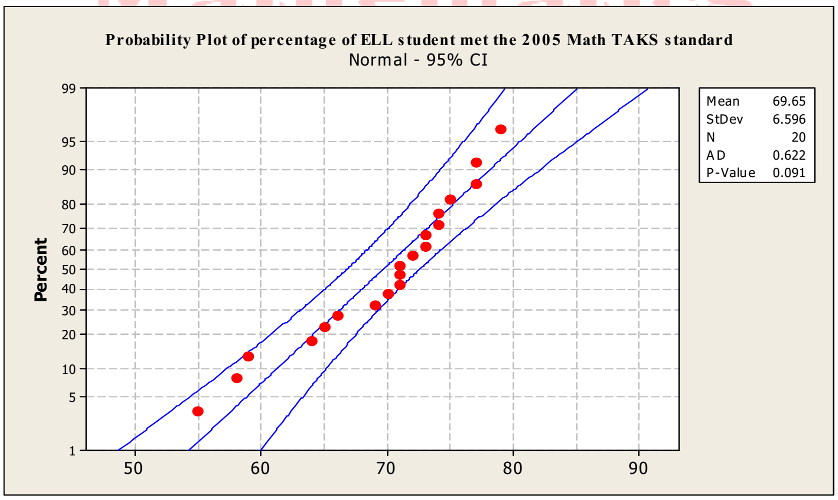
Table I indicates, in the 2006 Mathematics TAKS, only 54% of ELL students (Grade 3-11) met the standard set by the state. For other groups these numbers are: all students (72%), African American (57%), Hispanic (66%), White (84%) and Economically Disadvantaged (64%). This data suggests that all other groups' even Hispanic students in general, are doing better than ELL students, even though most of the ELL students are Hispanic. Economically Disadvantaged group performance (64%) indicates that poverty or economical issue cannot be identified as a primary reason of poor performance. In the spring 2005 Mathematics TAKS test (Grade 3-11) the percentages of students meeting the standard were as follows: all students (69%), African American (53%), Hispanic (60%), White (81%), economically disadvantaged (59%) and ELL (47%). The Met Standard for TAKS in spring 2005 and in spring 2006 was identical and this is known as "Panel's Recommendation". A very slight improvement has been observed from the year 2005 to 2006. The Met Standards for TAKS in spring 2003 and 2004 were different from those of 2005 or 2006. The standard for the year 2003 was 2 SEM (standard errors of measurement) below the panel's recommendation whereas for the year 2004 it was 1 SEM below the panel's recommendation. As expected, for the year 2003 and 2004 the percentages met standard for all the categories were higher than those of year 2005 or 2006. For example, in 2003 TAKS mathematics test 77% of all students met the standard whereas 58% of ELL students met the standard. For the year 2004 those numbers are 75% and 56% respectively.

Table I
Percentage of students who met the TAKS mathematics test (Grade 3-11)

Group	2003 TAKS	2004 TAKS	2005 TAKS	2006 TAKS
All students	77	75	69	72
African American	64	61	53	57
Hispanic	70	68	60	66
White	86	86	81	84
Economically Disadvantaged	69	66	59	64
ELL	58	56	47	54

Pearson Correlation Coefficient

The Pearson correlation coefficient, which can vary from -1 to +1, help to determine both the magnitude and the direction of the linear relationship between two variables. The sign of the coefficient tells whether the relationship is positive or negative, whereas the numerical part of the coefficients indicates the magnitude of the correlation. To find out how the reading performance affects the mathematics performance, the Pearson correlation coefficient was calculated for the relationship between ELL reading rates and ELL mathematics rate (grade 5-9). Because the Pearson correlation coefficient is computed using standard scores (*z*-scores), both variables should be normally distributed. Statistical software Minitab has been used to test the normality of the variables. It has been found that all the involved variables are normally distributed. Figure I is an example of normality test from where it's possible to precisely determine the normality nature of the variable.



Statistical software SPSS has been employed to calculate the Pearson correlation coefficients between the reading and mathematics test performance for different racial/ethnic groups. The targeted groups are 'all students, Hispanic students, White students, ELL students and non-ELL students. These coefficients have been calculated for both the 2005 and 2006 TAKS test (Table II) in order to recognize a pattern.

Table II
Pearson correlations between the percentage of students who met standard in reading and mathematics TAKS test

Grade	All students	Hispanic students	White students	ELL students	Non-ELL students
2005 TAKS	0.879(**)	0.589(**)	0.901(**)	0.675(**)	0.897(**)
Grade-5					
2006 TAKS	0903(**)	0.624(**)	0.785(**)	0.736(**)	0.847(**)
2005 TAKS	0.909(**)	0.528(*)	0.824(**)	0.352	0.905(**)
Grade-6					
2006 TAKS	0.831(**)	0.635(**)	0.893(**)	0.829(**)	0.873(**)
2005 TAKS	0.895(**)	0.622(**)	0.913(**)	0.668(**)	0.879(**)
Grade-7					
2006 TAKS	0916(**)	0.608(**)	0.833(**)	0.732(**)	0.902(**)
2005 TAKS	0.853(**)	0.180	0.834(**)	0.252	0.852(**)
Grade-8					
2006 TAKS	0791(**)	0.440	0.790(**)	0.561(*)	0.782(**)
2005 TAKS	0.836(**)	0.327	0.836(**)	0.724(**)	0.831(**)
Grade-9					
2006 TAKS	0878(**)	0.441	0.716(**)	0.211	0.870(**)

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Interpreting Correlation Coefficient:

The definition of the strength of correlation varies from researcher to researcher, however, generally, correlations greater than 0.7 are considered strong. Correlations less than 0.5 considered weak and correlations between 0.5 and 0.7 considered moderate. The same ranges apply to negative values. Any relationship should be assessed for its significance as well as its strength. The significance of the relationship is expressed in probability levels (p), this tells how unlikely a given correlation coefficient will occur given no relation in the population. As it can be observed from Table II, the correlation coefficient between the percentage of students who met the standard in reading TAKS test and the percentage of students who met the standard in mathematics TAKS test are strong among the 'all students' category in all grades and in both years. In case of both 'white students' and 'non-ELL students' we can observe the identical results as we have seen among the 'all students'. Moreover, all these correlation coefficients are significant at 0.01 levels. For example, if we phrase 2005 TAKS result obtained for 'white students' in grade-5, we could state the following results: 'a Pearson correlation coefficient was calculated for the relationship between the percentage of white students who met the standard in mathematics and the percentage of white students who met the standard in reading. A strong positive correlation was found ($r=0.901$, $p<0.01$), indicating a significant linear relationship between the two variables. That means White students who perform well in reading tend to perform well in mathematics as well'. The similar argument can be applied to the 'all students' and 'non-ELL students' group. But on the other hand, the correlation coefficients between the two same variables for the Hispanic students and ELL students are either weak or moderate in both years. Also, not all these coefficients are significant. For example, if we phrase 2006 TAKS result obtained for ELL students in grade-9, we could state that 'the correlation coefficient was calculated for the relationship between the percentage of ELL students who met the standard in mathematics and the percentage of ELL students who met the standard in reading. A weak positive correlation ($r=0.211$) which is not significant was found. That is, reading and mathematics performance of ELL students is very weakly related to each other . In short, this study suggests that even though the correlations between reading and mathematics performance for the White, non-ELL and all students are significantly strong, the correlations between those two variables for the Hispanic and ELL students are at most moderate. In most grades, these relationships are insignificantly weak. In interpreting correlation coefficients, researchers often infer cause-and-effect relationships, even though such relationships can, at best, only be determined from experimental studies. (Onwuegbuzie, A & Daniel, L, 1999). But this misconception should not be taken to mean that correlation may never be used in drawing conclusions about causal relationships. A high correlation in many uncontrolled studies carried out in different settings can provide support for causality. However, the causes underlying the correlation may be indirect and unknown. Consequently, establishing a correlation between two variables is necessary *but not sufficient* to establishing a causal relationship (in either direction).

Coefficients of Determination

If the correlation coefficient is squared, then the resulting value (r2, the coefficient of determination) will represent the proportion of common variation in the two variables. Table III shows a few of the coefficients of determination obtained from Table I.

Table III
Coefficients of Determination between the percentage of students met standard in reading and mathematics TAKS test

Grade	All students	Hispanic students	White students	ELL students	Non-ELL students
2005 TAKS	0.772	0.346	0.811	0.455	0.804
Grade-5					
2006 TAKS	0.815	0.389	0.616	0.541	0.717

The coefficient of determination is the proportion of variability in a data set that is accounted for by a statistical model. For example, the coefficients of determination (r^2 =0.772) for the 2005 TAKS all fifth graders tells that 77 percent of variance in all students mathematics performance is "explained" by their reading performance. For the 2005 fifth grade ELL students only 45 percent of variance in mathematics performance is "explained" by their reading performance.

Conclusion:

One of the purposes of this study is to investigate the overall performance of ELL students compare to their peer groups. Without any restriction, it can be reported that ELL group is the worst performing group in terms of the percentage of students who met standard in TAKS test. The other purpose was to investigate the correlations between the reading and mathematics performance. It has been argued that there is a strong and positive correlations exists in all grades among the reading and mathematics performance for White, all and non-ELL students, but in case of ELL and Hispanic students these correlations are either moderate or weak.

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