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ABSTRACT

Different forms of accommodation have been suggested in the assessment of English language learners (ELL). This study examined the effectiveness of a few accommodation strategies on the performance of ELL students in mathematics. A group of 946 eighth graders participated in this study. Using mathematics test items from the National Assessment of Educational Progress, researchers used four accommodation strategies: (1) modified (simplified) English language of the test items; (2) a glossary; (3) the original English with extra test time; and (4) the glossary with extra time. Students were assigned randomly to the different accommodation forms and to a comparison group within participating classrooms to control for teacher and school effects. The results of the analyses suggest that receiving extra time may have an impact on students' mathematics performance. Students, particularly ELLs, performed slightly higher on the modified version. When students received extra time to work on their mathematics tests, their scores increased about a point, indicating a potential accommodation effect. It appears that the presence of the glossary on nonmathematics-related terms may have had minimal effect on students' mathematics performance. However, when the glossary was combined with receiving extra time, the mathematics performance among the students appears to be the greatest. (Author/SLD)

Examining the Effectiveness of Accommodation on Math Performance of English Language Learners

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Examining the effectiveness of Accommodation on math performance of English Language Learners

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Abstract

Different forms of accommodations have been suggested in the assessment of English language learners. This study examined the effectiveness of a few accommodation strategies on the performance of ELL students in math.

A group of 946 8th-grade students participated in this study. Using mathematics test items from the National Assessment of Educational Progress (NAEP), we employed four accommodation strategies: 1) Modified (simplified) English language of the test items (used for the first time here as a form of accommodation for limited English proficient students); 2) Glossary; 3) Original English with extra time; and 4) Glossary with extra time. Students were assigned randomly to the different accommodation forms and to a comparison group within participating classrooms, to control for teacher and school effects.

The results of the analyses suggest that receiving extra time may impact students' math performance. Students, particularly ELLs performed slightly higher on the modified version. When students received extra time to work on their math tests, their scores increased about a point, indicating a potential accommodation effect. It appears that the presence of the glossary of non-math related terms may have had minimal effect on students' math performance. However, when the glossary was combined with receiving

[1] For a detailed description of the study design, findings, and interpretations, see Abedi, Hofstetter, and Lord, 1998.

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Perspective

Research suggests that content-based knowledge among linguistic minority students can be underestimated if the student is not proficient in the language of instruction and assessment (Abedi, Lord, and Plummer, 1995; Abedi, Lord, and Hofstetter, 1998; Alderman, 1981; Garcia, 1991; LaCelle-Peterson & Rivera, 1994). Recent federal and state legislation, including the reauthorization of the Elementary and Secondary Education Act (ESEA), through the enactment of the Improving America's Schools Act (IASA) of 1994, now state that all children should be given educational experiences to assist them in achieving high standards. This implies that children previously excluded from assessments because of physical or psychological disability or because of limited proficiency in English must have the opportunity to participate in these assessments (LaCelle-Peterson & Rivera, 1994; Zehler, Hopstock, Fleischman, & Greniuk, 1994; August & Hakuta, 1997).

However, achieving the goal of increased inclusion in large-scale assessments requires a complex set of practical and technical decisions. The literature suggests different forms of accommodations for students with limited English proficiency to help increase their participation in assessment. Over half of the states (55%) permit accommodations for limited English proficient (LEP) students. Among the accommodations used by states are: (1) accommodations related to timing, such as allowing extended time and providing more breaks during the test session; (2) accommodations in assessment environment, such as taking the test alone or at home; (3) modifications of response format, such as giving oral responses or responding in sign language; and (4) modifications of the presentation format such as reading the directions out loud or giving directions in sign language (see

Olson & Goldstein, 1997; Hafner, 1995; also, Council of Chief State School Officers & North Central Regional Educational Laboratory, 1996).

This study was the first to employ linguistic clarification of test items as a form of accommodation in comparison with other adaptations for English language learners. Unlike most other forms of accommodation, this form, if shown to be effective, is feasible and easy to implement. It does not create a burden for the test administrators or test takers. The linguistic modification of test items can be done at the item-writing stage; it can help all test takers, particularly those with limited English proficiency. In linguistically modified selected NAEP math items, Abedi, Lord and Plummer (1995) found modest but significant effects among 8th grade students with lower levels of English proficiency and with students enrolled in lower levels of mathematics classes. A follow-up study yielded similar results (Abedi, Lord and Hofstetter, 1998). Abedi et al. (1998) also found that while clarifying the language of math test items helped all students improve their performance, in 34 percent of the items for which a modified version was created, LEP students benefited more than non-LEP students. Further, certain types of items may have contributed more than others to the significant math score differences.[2]

This study examined the effects of students' background characteristics on the degree of impact of accommodations for LEP students on their performance in content-area assessments.

Method

Participants

Data were collected from 946 8th-grade students (ages 13-14) (see Abedi, Hofstetter, Baker, & Lord, 1998 for a detailed description of the sample) from 32 math classrooms in 5 middle schools in southern California. Each student completed a questionnaire providing language background information.

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[2] Although the broader term, "English language learner" (ELL) avoids the negative connotation of the term "limited English proficient" (LEP) (LaCelle-Peterson & Rivera, 1994; Butler & Stevens, 1997), we use the term LEP here to reflect classification by schools according to criteria for participation in NAEP and government-funded programs.

Table 1 presents some of the background characteristics of the subjects in the study. As the data in Table 1 indicate, nearly three-quarters of the students (72%) reported their ethnicity as Hispanic, while the remaining described themselves as Asian or Pacific Islander (14.7%), White (6%), African-American (5.3%), or Other (1.4%). A majority of the students reported that they were from the United States (57.1%), followed by Mexico (23.4%). Among those who indicated that they spoke another language besides English (85.1%), Spanish was the most commonly listed (82%). Over half of the students were designated by their schools as limited English proficient (52.8%), while the others had transitioned into non-LEP programs and were designated Fluent English Proficient (FEP-30.4%), or were Initially Fluent in English (IFE-16.8%).

Table 1 about here

Design

In this study, four different accommodation strategies were used: 1) Modified (simplified) English language of the test items, where items were rewritten to simplify potentially difficult vocabulary and linguistic structures but mathematics vocabulary was not changed (for a detail description of linguistic modification of test items, see Abedi, Lord, and Plummer, 1995); 2) Glossary, where non-math words or phrases identified as potentially difficult for LEP students to understand were defined or paraphrased; 3) English with extra time, where students were given an extra 25 minutes to work on the math test; and 4) Glossary with extra time, where students were given the glossary plus an extra 25 minutes. One test booklet was developed for each of the four forms of accommodation. To create a control or comparison group, a fifth booklet was added which included the original English version of the NAEP math items. Students were assigned randomly to the five different booklets within participating classrooms, to control for teacher and school effects.

Items from the 1996 NAEP Grade 8 Bilingual Mathematics booklet were used. To obtain a measure of students' language proficiency, a NAEP reading test was also used. Students read a 2-page story in English, then responded to 11 questions (7 selected response, 4 constructed response). The passage and items were from a secured 1992 Grade 8 Reading assessment.

In addition to the math and reading tests, each student was also administered a 45-item questionnaire, comprising primarily items from the 1996 NAEP Grade 8 Bilingual Mathematics booklet, relating to students' attitudes toward mathematics, grades in mathematics, self-reports of ability to understand math terminology and in performing computations, and educational and mathematical ambitions. This questionnaire contained additional questions from an earlier language background study (Abedi, Lord, & Plummer, 1995).

Categorization of students into various student designations (students with limited English proficiency, LEP; initially fluent in English, IFE; and fluent English proficient, FEP) was obtained from the participating schools. Designations were based primarily on students' performance on English language proficiency tests administered at the schools upon entrance into the educational program, and were updated periodically.

Overall Results of Accommodations

Math Performance by Accommodation

The results of analyses suggest that test accommodations affect students' test performance. Table 2 presents means and standard deviations of math test scores by students' LEP status and forms of accommodation. As the data in Table 2 indicate, for the entire sample, students who received the standard (original) English math test had a mean math score of 14.68 (SD=6.67), out of 35 points possible. Linguistic modification (M=14.23, SD=6.3) and presence of a glossary of non-technical terms (M=14.53, SD=7.01) appeared to make no overall notable difference in student performance. However, the data suggest that extra time increased students' scores by one point (M=15.64, SD=6.86). Further, the data suggest that students who received the glossary in addition to extra time scored the highest overall (M=17.08, SD=7.68). These students had math scores approximately 2 & half-point (0.36 standard deviation) higher than students who received no accommodation at all.

Table 2 about here

Accommodation effects may also be examined by comparing math performance by LEP status. LEP students performed lower (M=12.30, SD=5.67) than their more English fluent counterparts (M=17.45, SD=6.83) — a difference of over 5 points. This trend was maintained across test booklets. For example, LEP students who received the standard math assessment (original English) reported a mean score of 12.07 (SD=5.47), while FEP/IFE

students had a mean score of 17.56 (SD=6.70) Interestingly, linguistic modification appeared to aid LEP students (M=12.63, SD=5.23 as compared with M=12.07, SD=5.47 for the original version).

In comparison with the standard test (original items), LEP students' scores were lower on the same items when a glossary was provided (M=11.84, SD=5.94), perhaps because of information overload, while scores for FEP/IFE students with the glossary increased (M=17.78, SD=6.84). Extra time appeared to help all students, both LEP and FEP/IFE. LEP student scores increased slightly with extra time (M=12.93, SD=5.99), and even more when they received the glossary with extra time (M=13.69, SD=6.74). For FEP/IFE students, extra time alone increased math scores by more than one point (M=18.88, SD=6.50), and the addition of a glossary resulted in almost a 3-point gain (M=20.37, SD=7.17). Overall, these results suggest that the linguistic modification may help LEP students, as a possible accommodation. Further, all students benefited from extra time and glossary. These trends remained stable, even after controlling for the students' reading achievement scores.

The results of analysis of variance comparing students across the different forms of accommodation and LEP status indicated that student performance across the categories of accommodations differs significantly, $F(4, 886) = 2.71$; $p=0.029$. Similarly, students performed differently across the LEP categories, $F(1,886) = 103.67$; $p < .01$). As indicated earlier, students with limited English proficiency performed lower than the native English speakers.

Results of Overall Reading Performance

The reading test, from the NAEP Grade 8 reading assessment, was administered to obtain a measure of the students' reading proficiency. Because of time constraints in the testing environment, a single section was selected with only one reading passage and 11 responses.

Table 3 summarizes the results of descriptive analyses of the reading test. As the data in Table 3 indicate, overall, the mean reading test scores were fairly low (M=5.07, SD=3.22, n=896). The most notable finding is the difference between the LEP and non-LEP students' performance on the reading assessment. As expected, FEP/IFE students (M=6.35, SD=3.12, n=423) consistently performed higher on the reading test than LEP students (M=3.92, SD=2.86, n=473) — an approximate two & half-point difference, which was statistically significant, $F(1,886) = 79.49$; $p < .01$.

Table 3 about here

This finding provides evidence that the reading achievement test, despite its limitations related to validity and adequacy as a measure of students' reading proficiency, emerged as a suitable predictor of math performance. FEP/IFE students scored higher on reading tests and math tests. Further, students with a better command of English text (FEP/IFE students) were likely more able to read and interpret the math items correctly than students with lower English proficiency levels (LEP students).

As the reading test was the same for all students, regardless of test booklet, we would expect the reading scores to be comparable across test booklet groups. However, the score means in Table 3 suggest that students receiving the "Modified English" test booklet scored lower than students receiving other test booklets.

Among LEP students, the groups that were given the Original English and Modified English booklets showed no significant difference between their scores on the (identical) reading tests (means were 3.78 and 3.84, respectively). However, among the FEP/IFE students, the groups given the Original English and Modified English booklets scored 6.77 and 5.81, respectively on the reading test--nearly a one-point difference. This difference in reading ability

might have contributed to the lower math score on the modified English booklet for the FEP/IFE students. Note that, as Table 2 shows, the FEP/IFE students scored lower on the modified English math test. Among the FEP/IFE students, Table 3 shows, the group with the highest reading score was the group that answered the English math items.

Discussion

In this study, four different forms of accommodation were used in assessing 8th grade students' mathematics performance. Among the accommodation strategies employed in this study was the language clarification of test items, used as form of accommodation for English language learners for the first time in the literature of accommodation. The findings of this study suggested that different forms of accommodation produced different results. In this study, the form of accommodation with the greatest effect on all students was the provision of an English glossary with definitions or paraphrases of potentially difficult non-mathematical words or phrases plus extra time. It is important to note that the English glossary alone (that is, without extra time) did not help the students in this study and in some cases even had a negative impact on student performance. This, we suggest, may be due to information overload. That is, students were presented with more data than they could process in the limited amount of time that they had to answer the test items.

One of the most important findings of this study is that some forms of accommodation may help all students, improving students' performance across all subgroups. This may not be a desirable outcome, since it may impact the validity of the accommodation and may affect the construct under measurement (mathematics understanding in this study).

The provision of Extra Time Only resulted in slightly higher math scores for most students but not for all subgroups; extra time did not produce higher scores for students in lower level math classes (8th grade math, as opposed to pre-algebra and algebra classes).

Among the various forms of accommodation used in this study, the language clarification of test items was the only one, which helped LEP students more than non-LEP students. This difference, though small, suggests that we give further attention to the linguistic modification of test items as a form of accommodation which is less expensive and more feasible logistically than other forms of accommodation for English language learners.

Table 1. Background Characteristics of Students Participating in this Study

Variable name	Frequency	Percent	Cum. Per
Gender			
Male	455	50.1	50.1
Female	453	49.9	100.0
Ethnicity			
White (not Hispanic)	54	6.0	6.0
African American	48	5.3	11.3
Hispanic	650	72.0	83.3
Asian or Pacific Islander	133	14.7	98.0
American Indian-Alaskan	5	0.6	98.6
Other	13	1.4	100.0
Speak Other Language?			
Yes	773	85.1	85.1
No	135	14.9	100.0
LEP Status			
Limited English Proficient (LEP)	473	52.8	52.8
Fluent English Proficient (FEP)	272	30.4	83.1
Initially Fluent in English (IFE)	151	16.8	100.0
Language of Instruction			
English Only	723	76.4	76.4
Spanish Only	18	1.9	78.3
English Shelter	205	21.7	100.0
Country of Origin			
United States	540	57.1	57.1
Mexico	221	23.4	80.4
Other Countries	185	19.5	100.0
Studied Math in Other Language?			
Yes	512	59.4	59.4
No	350	40.6	100.0
Number of Years Lived in U.S.			
1 - 3	69	7.5	7.5
4 - 6	76	8.2	15.7
7 - 9	121	13.0	28.7
10 - 12	59	6.4	35.1
More than 12 years	607	65.0	100.0
Kind of Math Class Taking This Year			
Not Taking Math	12	1.4	1.4
8th-Grade Math	336	38.0	39.3
Prealgebra	215	24.3	63.6
Algebra	244	27.6	91.1
Other	78	8.9	100.0

Note: Totals do not add up to 946 due to missing data

Table 2.

Mean NAEP Math Achievement Scores for 8th Grade Students (35 points possible)

Math Book	LEP Status		
	LEP	FEP/IFE	COLUMN AVERAGE
Original English	12.07 (SD=5.47; n=144)	17.56 (SD=6.70; n=130)	14.68 (SD=6.67; n=274)
Modified English	12.63 (SD=5.23; n=124)	15.94 (SD=6.67; n=117)	14.23 (SD=6.19; n=241)
Glossary only	11.84 (SD=5.94; n=146)	17.78 (SD=6.84; n=121)	14.53 (SD=7.01; n=267)
Extra Time only	12.93 (SD=5.99; n=30)	18.88 (SD=6.50; n=25)	15.64 (SD=6.86; n=55)
Glossary +Extra Time	13.69 (SD=6.74; n=29)	20.37 (SD=7.17; n=30)	17.08 (SD=7.68; n=59)
ROW AVERAGE	12.30 (SD=5.67; n=473)	17.45 (SD=6.83; n=423)	14.73 (SD=6.75; n=896)

Table 3.

Mean NAEP Reading Achievement Scores for 8th Grade Students (11 points possible)

Math Book	LEP Status		
	LEP	FEP/IFE	COLUMN TOTAL
Original English	3.78 (SD=2.80; n=144)	6.77 (SD=2.91; n=130)	5.20 (SD=3.22; n=274)
Modified English	3.84 (SD=2.91; n=124)	5.81 (SD=3.26; n=117)	4.80 (SD=3.23; n=241)
Glossary	4.01 (SD=2.92; n=146)	6.50 (SD=3.01; n=121)	5.13 (SD=3.21; n=267)
Extra Time	3.93 (SD=2.69; n=30)	6.40 (SD=3.34; n=25)	5.05 (SD=3.22; n=55)
Glossary +Extra Time	4.48 (SD=2.87; n=29)	6.10 (SD=3.61; n=30)	5.31 (SD=3.34; n=59)
ROW TOTAL	3.92 (SD=2.86; n=473)	6.35 (SD=3.12; n=423)	5.07 (SD=3.22; n=896)

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