EDUCATION GOALS: RESULTS SHOWN BY THE TIMSS-99 FOR PARTICIPATING G8 COUNTRIES

Canda Mueller Engheta
University of Kansas, USA

Abstract

The United States outperformed only one of the six participating G8 countries on eighth grade mathematics portion of TIMSS-99. There is a great deal of concern in the United States about how the nation compares to other countries in areas such as mathematics and science. The research study proposed utilizes the background questionnaires to analyze disparities that might explain the scoring differences. The purpose of this study is to examine the factor structures of the responses to the 8th grade background questions for each G8 country that participated in TIMSS-99. Using a Principal Components Analysis, items relating to mathematics common to the six countries on the background questionnaires will be analyzed separately for each country. The resulting factor structures will then be compared for the countries. Past studies have shown that there are many factors that influence student mathematic achievement, so it is expected that the broad factors will be similar for the countries. However, it is expected that there will be differences within the factors that could begin to explain differences in performance among countries. It is the variation within the factors that will be of key policy interest in the countries and to developers of TIMSS assessments.

INTRODUCTION

Results for TIMSS-99 show that the United States performed significantly less well than three of the participating G8 countries at the eighth grade level in mathematics. As is widely known, there is a tremendous concern about how this country compares to its international peers in the areas of science and mathematics. As No Child Left Behind begins to truly take hold in the United States, mathematics achievement is again at the educational forefront. Is this national policy any different than the policies of past Presidents? TIMSS serves as an external measure of achievement for participating countries. The data gathered by TIMSS allows for comparison of relevant data in many countries, including the United States. While No Child Left Behind was not in effect in 1999, its predecessor, Goals 2000 had a similar purpose. Utilizing the information provided by the TIMSS studies, one must wonder what factors other than those directly controlled by the educational system could affect student mathematics achievement.

The international average for the eighth grade population in 1999 was 487. The average mathematics achievement scale score in Japan was 579, 92 points greater than the international average and significantly greater than the scores in any other participating G8 country. The average scale scores in Canada, 531, and the Russian Federation, 526, were not significantly different from one another; however, both scores were significantly greater than those in the United States, England, and Italy. Similarly, the average scale scores in the United States, 502, and England, 496, were not significantly different from one another. Both scores were significantly greater than the average mathematics scale score in Italy, 479 (Mullis et al., 2000). As in the 1995 TIMSS assessment, students, teachers, school principals, and countries provided a wide range of background information by responding to background questionnaires for the exam (Mullis et al., 2000). Results of the 1999 student surveys for all six nations were utilized in this study.

The objective of this study was to use the responses from the eighth grade mathematics background questionnaire in examining the factor structures for the six participating G8 countries in TIMSS-99. Only those questions that were the same for all six countries were included in the analyses. The factor structures for the countries were compared in an effort to determine similarities and differences for the six countries in terms of the background variables. The comparison was expected to indicate ways in which students in the three higher performing countries, Canada, Japan, and the Russian Federation, differed from the students in the three lower performing countries, England, Italy and the United States, that could begin to explain achievement variation. The research hypotheses for the factor groupings were:

1. The overall factor structures for the six countries will be similar.

2. The within factor structure will differ for the six countries.

Past research provides some indication of what types of factors should be expected for the six countries. Categories were created for each country based on the factor structures indicated in the Principal Components Analysis and past research. The factors in each country mainly fell into the general categories of self-efficacy, student centered instruction, teacher centered instruction, peer influences, leisure activities, reasons to succeed, and external influences. This validates the comments on particular areas of research interest made in the questionnaire development section of the technical report (Martin, Mullis, & Stemler, 2000).

Strong family support is a known factor in explaining high attainment in mathematics. Students with better-educated parents and those whose parents offer quality homework assistance have been shown to be more successful in mathematics (Tomoff, Thompson, and Behrens, 2000; Nadon and Normandeau, 1997). Out-of-school learning activities, such as tutoring and completing homework, have been shown to increase student achievement (Baker, Akiba, LeTendre, and Wiseman, 2001). Finally, technology was found by Wenglinsky in 1998 to have a positive effect on student achievement if used appropriately. Using NAEP 1996 results, he found that computer use had a significant positive impact on eighth graders, but little bearing for fourth graders.

There have also been investigations that have shown there are variables that negatively affect student success. Extracurricular activities that are not mathematically stimulating- such as sports, jobs, spending time with friends- have a negative impact on testing achievement (Olsen and House, 1997). A negative effect was also found by Webster, Young, and Fisher (1999) regarding classroom work centered around the teacher instead of the student.

Other studies have shown that some variables have inconclusive relationships with high attainment. Both positive and negative attitudes have been found between student achievement and self-efficacy. Schreiber (2000) found that the more a student believed natural talent was the key to mathematical success, the less likely the student scored above the international average on the 1995 administration of the TIMSS. Further, students who did not feel hard work was important in achieving mathematical success were more likely to score above the international average. However, Olsen and House (1997) found that affirmative self-appraisals of mathematical ability were positively correlated with achievement. Classroom activities that centered primarily on the students have been shown both to positively affect achievement (Webster et al., 1999) and to have little effect on achievement (Tomoff et al., 2000).

METHOD

Sample

The sample for this study was based on Canadian, English, Italian, Japanese, Russian and United States students who were in grade 8 in 1999 for TIMSS-99. The TIMSS used a two-stage stratified cluster sample design to gather students to be tested in each country (Foy, Rust, & Schleicher, 1996; Foy & Joncas, 2000). In 1999, 8770 Canadian eighth graders, 2960 English eighth graders, 3328 Italian eighth graders, 4745 Japanese eighth graders 4332 Russian Federation eighth graders, and 9072 U.S. eighth graders were assessed (Mullis et al., 2000). Data was determined to be missing at random. Since the samples were so large in each country, cases with missing data were deleted. Typically, students did not respond to questions with which they were not comfortable, and while it is possible that deleting cases eliminated a specific subgroup, the focus of this study is on the general student. Thus, it was determined that deletion of cases would not introduce new issues of concern.

Approximately 51% of the Canadian students were female. Ninety- one percent of the eighth grade students were born in Canada, and approximately 85% speak the language of the assessment at home. In England, about 48% of the participants were female. Of the sampled students, close to 95% were born in England and 96% spoke the language of the assessment at home. Fifty- two percent of the Italian eighth grade participants were female. Approximately 97% were born in Italy; however, only 80% spoke the language of the assessment at home. In Japan, 48% of the participants were female. Ninety- nine percent of the participants were born in Japan, and 97% reported speaking the language of the assessment at home. In the Russian sample, 56% were female. Ninety- four percent were born in the country, and about 95% spoke the language of the assessment at home. Fifty- three percent of the United States eighth graders were female. Approximately 92% were born in the country, while 91% spoke the language of the assessment at home.

Data Analysis

Ninety-six items from the mathematics background questionnaire were used for each country. The analyses were carried out multiple times in each country with each requiring a new random sample of 1100 cases. The multiple analyses with different random samples indicated that choosing subsets in this way led to stable estimates of variance and factor loadings in the analysis. Both oblique and orthogonal rotations were attempted. Since the results were quite similar for the two techniques, an orthogonal procedure was chosen for ease of interpretation.

Initial estimates indicated that 23 factors accounted for approximately 60% of the variance in Canada. Twenty- four factors accounted for roughly 61% of the variance in England. In Italy, 22 factors accounted for nearly 58% of the variance. Twenty-five factors accounted for almost 61% of the variance in Japan. Sixty percent of the variance was accounted for by 24 factors in the Russian Federation. In the United States, 22 factors accounted for about 60% of the variance.

Many of these factors were highly related in each country. Thus, further analyses with fewer factors were used to determine the most parsimonious model in each country that still accounted for a considerable amount of variance.

Results

Using a Principal Components Analysis extraction with Varimax rotation on ninety-six items from the TIMSS-99 eighth grade background questionnaire, factor structures were determined for each of the six participating G8 countries. Preliminary analyses indicated between 22 and 25 factors accounted for approximately 60% of the variance in each country. The number of factors was reduced by combining some specific factors into broader categories in individual countries. Three of the countries, Canada, Italy, and the Russian Federation, required six factors to account for about 30% of the variance. Seven factors were needed in England, Japan, and the United States to account for roughly the same amount of variance. Similar factors for the countries included student self- efficacy, student centered instruction, teacher centered instruction, and reasons for success. Other factors, such as peer influence, leisure activities, and external influences, seemed somewhat different for each country since different variables showed significant loadings depending on the country.

Using the practical significance loading of greater than or equal to |0.4|, forty- nine of the 96 variables loaded significantly on at least one of the six factors in Canada. Forty- five of the 96 variables loaded significantly on at least one of the seven factors in England. Significant loadings on at least one of the six factors were found for 45 of the variables in Italy. In Japan, 40 variables showed significant loadings on at least one of the seven factors. Forty variables showed a significant loading on at least one of the six factors in the Russian Federation. In the United States, 50 of the 96 variables loaded significantly on at least one of the seven factors. Descriptions of the questions, significant loadings, communalities, and percents of variance accounted for are shown in Table 1 for Canada, Table 2 for England, Table 3 for Italy, Table 4 for Japan, Table 5 for the Russian Federation, and Table 6 for the United States.

Some variables loaded on dual factors in each country. In Canda, England and the United States, the two items "friends think it is important to do well in math" and "friends think it is important to do well in the language used for the assessment" loaded significantly on reasons for success and peers. Similarly in Italy, the item "friends think it is important to do well in math" loaded significantly on both peers and reasons for success. There were no significant dual loadings in Japan or the Russian Federation.

Table 1: Canadian Factor Structure

Factor	*Indicators*	*Loading*	*Communality*	*% variance*
Self- efficacy	Math not a strength	-0.853	0.731	7.967
	I'm not talented at math	-0.813	0.684	
	Math more difficult for me	-0.782	0.642	
	I usually do well in math	0.764	0.605	
	I like math	-0.736	0.661	
	I think math is an easy subject	0.727	0.552	
	I will never really understand it	-0.644	0.481	
	I enjoy learning math	0.620	0.592	
	I think math is boring	-0.564	0.527	
	I'd like a job involving math	0.564	0.498	
Teacher centered	Teacher shows how to do probs	0.549	0.351	5.224
	Teacher explains rules in new	0.531	0.309	
	Solve related prob in new topic	0.504	0.326	
	Discuss completed homework	0.503	0.325	
	Ask what students know in new	0.452	0.387	
	Begin homework in class	0.449	0.219	
	Teacher uses board	0.434	0.228	
	Teacher gives homework	0.423	0.246	
	Work alone on worksheets	0.421	0.204	
	Look at textbook on new topic	0.419	0.210	

Table 1: (Condinued)

Factor	*Indicators*	*Loading*	*Communality*	*% variance*
Reasons for success	Impt to self to do well in math	0.621	0.586	5.140
	Do well to please self	0.576	0.436	
	Impt to self to do well in lang.	0.549	0.491	
	Do well to enter desired school	0.539	0.372	
	Do well to get desired job	0.526	0.345	
	Must study hard to do well	0.502	0.339	
	Friends impt do well math *	0.448	0.539	
	Think math is impt in life	0.443	0.357	
	Impt to friends to do well in lang*	0.412	0.475	
Student centered	Teacher uses computer	0.534	0.296	5.099
	Work in groups on new topic	0.529	0.429	
	Students use overhead	0.521	0.336	
	Use computers in math	0.510	0.288	
	Work in pairs or small groups	0.447	0.327	
	Work on projects	0.427	0.251	
	Discuss practical prob in new	0.417	0.368	
	Students use board	0.411	0.313	
External influences	Impt to self good at sports	0.631	0.558	4.084
	Impt to self have time for fun	0.609	0.400	
	Impt to friends good at sports	0.575	0.425	
	Impt to mom good at sports	0.559	0.490	
	Impt to mom have time for fun	0.513	0.290	
	Impt to friends have time for fun	0.501	0.289	
	Impt mom good at lang	0.447	0.417	
	Impt mom do well math	0.442	0.449	
Peers	Students orderly and quiet	0.561	0.356	
	Friends impt to do well math *	0.551	0.539	
	Students do exactly as told	0.529	0.353	
	Impt to friends to do well in lang*	0.519	0.475	
	Teacher gets interrupted	-0.429	0.218	
	Students neglect work	-0.402	0.184	
Total variance				31.398

**Dual loading factor*

Table 2: English Factor Structure

Factor	*Indicators*	*Loading*	*Communality*	*% variance*
Self- efficacy	Math not a strength	0.801	0.663	6.535
	I like math.	0.752	0.654	
	I'm not talented at math	0.724	0.573	
	I enjoy learning math	-0.701	0.632	
	Math is boring	0.641	0.524	
	Math more difficult for me	0.625	0.459	
	I usually do well in math	-0.604	0.406	
	I'd like a job involving math	-0.570	0.443	
	I will never really understand it	0.513	0.345	
	I think math is an easy subject	-0.488	0.305	
Reasons for success	Impt to self do well in math	0.745	0.604	5.584
	Impt to mom do well in math	0.737	0.568	
	Impt to self do well in lang	0.722	0.535	
	Impt to mom do well in lang	0.716	0.550	
	Do well to enter desired school	0.489	0.343	
	Friends impt do well in math *	0.489	0.477	
	Impt to friends do well in lang *	0.478	0.455	
	Impt to do well to get desired job	0.418	0.378	
	Think math impt in life	0.408	0.226	
Student centered	Work in groups on new topic	0.676	0.474	4.173
	Work in pairs or small groups	0.653	0.432	
	Students use overhead	0.593	0.372	
	Teacher uses overhead	0.480	0.247	
	Students use board	0.471	0.272	
	Use computers in math	0.428	0.203	
	Teacher uses computer	0.427	0.202	
Teacher centered	Solve related example new topic	0.540	0.340	3.949
	Teacher shows how to do	0.472	0.260	
	Copy notes from board	0.443	0.226	
	Teacher gives homework	0.439	0.248	
	Discuss completed homework	0.426	0.321	
	Teacher explains rules in new	0.405	0.263	
Sports	Impt to self good at sports	0.813	0.676	3.915
	Impt to mom good at sports	0.775	0.628	
	Impt to friends good at sports	0.675	0.497	
	Time outside school in sports	-0.629	0.416	
External influences	Impt to self have time for fun	-0.604	0.479	3.464
	Impt to mom have time for fun	-0.471	0.291	
	Impt to friends have time for fun	-0.454	0.301	
	Need good luck to do well	0.431	0.297	
Peers	Students orderly and quiet	0.654	0.457	3.455
	Students do exactly as told	0.642	0.441	
	Student neglect school work	-0.538	0.376	
	Friends impt to do well in math*	0.446	0.477	
	Impt to friends to do well in lang*	0.417	0.455	
Total variance				31.075

**Dual loading factor*

Table 3: Italian Factor Structure

Factors	*Indicators*	*Loading*	*Communality*	*% variance*
Self- efficacy	I like math	0.845	0.740	8.112
	Math not a strength	0.840	0.718	
	I am not talented at math	0.781	0.640	
	I enjoy learning math	-0.776	0.694	
	I usually do well in math	0.733	0.567	
	I think math is boring	-0.733	0.515	
	Math more difficult for me	0.700	0.570	
	I'd like a job involving math	-0.661	0.506	
	I'll never really understand math	0.581	0.403	
	I think math is an easy subject	-0.514	0.291	
Reasons for success	Impt to self do well in lang	0.737	0.569	5.609
	Impt to self do well in math	0.731	0.622	
	Impt to mom do well in math	0.668	0.485	
	Impt to mom do well in lang	0.652	0.447	
	Must study hard to do well	0.518	0.297	
	Do well to please self	0.502	0.442	
	I think math is impt in life	0.453	0.302	
	Impt to friends do well in math*	0.422	0.534	
	Do well to enter desired school	0.417	0.329	
Student centered	Work on projects	0.600	0.380	5.117
	Work in groups on new topic	0.564	0.335	
	Have quiz or test	0.492	0.254	
	Work in pairs or small groups	0.480	0.247	
	Ask what student know of new	0.479	0.254	
	Discuss practical prob in new	0.454	0.231	
	Solve with everyday things	0.404	0.205	
Teacher centered	Teacher uses overhead	-0.734	0.573	4.448
	Students use overhead	-0.701	0.547	
	Teacher uses board	0.651	0.453	
	Teacher gives homework	0.603	0.387	
	Students use board	0.575	0.380	
	Teacher uses computer	-0.552	0.397	
	Teacher explains rules in new	0.424	0.204	
	Teacher checks homework	0.404	0.240	
Sports and fun	Impt to self good at sports	0.671	0.495	3.736
	Impt to self have time for fun	0.609	0.399	
	Impt to mom be good at sports	0.593	0.404	
	Impt to friends be good at sports	0.555	0.359	
	Impt to mom have time for fun	0.458	0.239	
	Time outside school in sports	-0.453	0.280	
	Impt to friends have time for fun	0.430	0.297	
Peers	Students do exactly as told	0.695	0.506	3.372
	Students quiet and orderly	0.666	0.462	
	Impt to friends do well in math*	0.587	0.534	
	Impt to friends do well in lang	0.567	0.504	
	Students neglect school work	-0.520	0.323	
Total variance				30.394

**Dual loading factor*

Table 4: Japanese Factor Structure

Factor	*Indicator*	*Loading*	*Communality*	*% variance*
Self- efficacy	I like math	0.823	0.730	6.025
	I enjoy learning math	-0.767	0.675	
	Math is not my strength	0.692	0.488	
	I think math is an easy subject	-0.664	0.452	
	I usually do well in math	-0.643	0.458	
	I think math is boring	0.610	0.502	
	Math is more difficult for me	0.585	0.398	
	I'd like a job involving math	-0.549	0.417	
	I am not talented at math	0.503	0.270	
Reasons for success	Impt to self do well in lang	0.734	0.571	5.645
	Impt to self do well in math	0.734	0.609	
	Impt to friends do well in math	0.720	0.570	
	Impt to friends do well in lang	0.682	0.524	
	Impt to mom do well in math	0.668	0.457	
	Impt to mom do well in lang	0.659	0.447	
Student centered	Teacher gives homework	0.596	0.431	4.407
	Check each other's homework	0.583	0.352	
	Discuss completed homework	0.578	0.356	
	Teacher checks homework	0.575	0.349	
	Begin homework in class	0.500	0.290	
	Work in groups on new topic	0.496	0.442	
	Work in pairs or small groups	0.473	0.387	
	Students use board	0.417	0.212	
Teacher centered	Teacher explains rules in new	0.575	0.354	3.927
	Solved related example in new	0.566	0.370	
	Look at textbook on new topic	0.491	0.270	
	Teacher shows how to do probs	0.469	0.244	
	Must study hard to do well	0.426	0.370	
Sports and fun	Impt to self good at sports	0.668	0.568	3.607
	Impt to friends good at sports	0.600	0.479	
	Impt to mom good at sports	0.580	0.407	
	Time outside school in sports	-0.537	0.340	
	Impt friends have time for fun	0.441	0.285	
	Impt to self have time for fun	0.409	0.240	
	Impt to mom have time for fun	0.400	0.256	
Technology	Use computers in math	0.592	0.377	3.182
	Teacher uses computer	0.578	0.346	
Peers	Students orderly and quiet	0.718	0.547	3.144
	Students neglect school work	-0.710	0.522	
	Students do exactly as told	0.664	0.500	
Total variance				29.888

Table 5: Russian Federation Factor Structure

Factor	*Indicator*	*Loading*	*Communality*	*% variance*
Self- efficacy	I like math	0.759	0.625	7.598
	Math is not a strength	0.756	0.606	
	Math more difficult for me	0.734	0.621	
	I usually do well in math	-0.731	0.552	
	I am not talented in math	0.727	0.588	
	I enjoy learning math	-0.706	0.612	
	I think math is boring	0.638	0.531	
	I will never really understand math	0.593	0.413	
	I'd like a job involving math	-0.579	0.439	
	I think math is an easy subject	-0.539	0.338	
Student centered	Work in groups on new topic	0.640	0.428	5.419
	Work in pairs or small groups	0.543	0.318	
	Ask what students know about new	0.521	0.318	
	Students use overhead	0.480	0.338	
	Solve probs with everyday things	0.476	0.258	
	Discuss practical prob in new	0.470	0.243	
	Work on projects	0.454	0.229	
	Check each other's homework	0.430	0.194	
	Look at textbook on new topic	0.414	0.251	
Reasons for success	Impt to self do well in math	0.665	0.541	5.321
	Impt to mom do well in math	0.643	0.491	
	Impt to friends do well in math	0.632	0.444	
	Impt to self do well in lang	0.619	0.397	
	Impt to friends do well in lang	0.610	0.421	
	Impt to mom do well in lang	0.591	0.385	
	Do well to get desired job	0.404	0.351	
Sports and fun	Impt to mom good at sports	0.690	0.514	4.314
	Impt to self good at sports	0.680	0.515	
	Impt to friends good at sports	0.651	0.478	
	Time outside school in sports	-0.554	0.379	
	Impt to self have time for fun	0.508	0.371	
	Impt to mom have time for fun	0.455	0.274	
	Impt to friends have time for fun	0.446	0.315	
Peers	Students neglect school work	0.660	0.454	3.562
	Students quiet and orderly	-0.601	0.426	
	Students do exactly as told	-0.524	0.358	
Teacher centered	Students use board	0.539	0.297	3.178
	Teacher gives homework	0.515	0.285	
	Teacher uses board	0.504	0.265	
	Teacher uses computer	-0.420	0.299	
Total variance				29.393

Table 6: United States Factor Structure

Factor	*Indicator*	*Loading*	*Communality*	*% variance*
Self- efficacy	Math is not a strength	0.837	0.708	7.684
	I like math	0.778	0.667	
	I am not talented at math	0.775	0.632	
	Math is more difficult for me	0.721	0.584	
	I think math is an easy subject	-0.711	0.539	
	I usually do well in math	-0.703	0.515	
	I enjoy learning math	-0.701	0.652	
	I'll never really understand math	0.648	0.487	
	I think math is boring	0.605	0.507	
	I'd like a job involving math	-0.596	0.457	
Reasons for success	Impt to self do well in math	0.668	0.597	6.139
	Impt to self do well in lang	0.651	0.527	
	Do well to enter desired school	0.627	0.470	
	Impt to mom to do well in math	0.607	0.476	
	Do well to please self	0.590	0.483	
	Impt to mom do well in lang	0.581	0.434	
	Do well to get desired job	0.549	0.409	
	Math is impt in life	0.520	0.384	
	Must study hard to do well	0.516	0.341	
	Impt to friends do well in lang*	0.429	0.531	
	Impt to friends do well in math*	0.426	0.514	
	Do well to please parents	0.415	0.241	
Student centered	Students use overhead	0.665	0.473	5.223
	Work in groups on new topic	0.619	0.457	
	Work in pairs or small groups	0.612	0.413	
	Teacher uses computer	0.591	0.370	
	Use computers in math	0.576	0.353	
	Work on projects	0.509	0.341	
	Solve with everyday things	0.439	0.336	
	Teacher uses overhead	0.429	0.263	
	Student uses board	0.415	0.239	
	Ask what students know in new	0.407	0.357	
Teacher centered	Teacher shows how to do	0.595	0.394	4.710
	Solve related example in new	0.581	0.387	
	Teacher explains rules	0.558	0.333	
	Teacher checks homework	0.486	0.352	
	Teacher gives homework	0.485	0.302	
	Discuss completed homework	0.480	0.301	
	Copy notes from board	0.451	0.251	
	Look at textbook on new topic	0.427	0.199	
	Take a quiz or test	0.416	0.211	
Sports	Impt to self to be good at sports	0.794	0.661	3.709
	Impt to mom to be good at sports	0.733	0.564	
	Impt to friends to be good at sports	0.689	0.504	
	Time outside school in sports	-0.628	0.431	
Peers	Students do exactly as told	0.606	0.440	3.527
	Students quiet and orderly	0.587	0.396	
	Impt to friends do well in lang *	0.571	0.531	
	Impt to friends do well in math*	0.562	0.514	
	Students neglect school work	-0.490	0.301	
Home environment	Possess computer	0.551	0.336	3.453
	Number of books in home	-0.499	0.301	
Total variance				34.444

**Dual factor loading*

DISCUSSION

This study examines the factor structures of the responses to the eighth grade mathematics background questionnaire for the six G8 countries that participated in the 1999 TIMSS for discrepancies that could explain student achievement differences. It was expected that the overall categories would be similar for the 6 countries; however, this was not the case. The results for three countries, Canada, Italy, and Russia, seemed to be best represented by six factors, while the other three countries, England, Japan, and the United States seemed to be best represented by seven factors. Using all questions common to the six countries, this particular factor structure accounts for approximately one third of the variance in any one country. Further, out of ninety- six variables, roughly half showed loadings significant at the |0.4| level. Hence, interpretations should be made with great caution.

The factor structures for the six countries differ, however, there are some common factors. In every country, self-efficacy is the variable grouping accounting for the highest amount of variance. Within this factor, variables such as "I like math," "I'm not talented at math," and "math is not a strength" appear in every country. Students in Japan seem more likely to report feelings of negative self-efficacy. More than half of the Japanese students reported not liking math, found math boring, and did not want a job involving math. Students in the other five countries did not report having the same feelings. The self-efficacy results perpetuate the contradictory results found by Schreiber (2000) and Olsen and House (1997). The variables within the self-efficacy factor fall within two broad categories of positive self-efficacy ("I usually do well in math") and negative self-efficacy ("I will never really understand math").

The second factor differs by country. In Canada, teacher centered instruction accounts for the second highest amount of variance. Variables within this factor include beginning homework in class, explaining the rules when introducing a new topic, and asking what students know about a new topic.

The second factor for England, Italy, Japan, and the United States is reasons for success. Variables within this factor include items on the importance to the student, the student's mom, and friends on doing well in math and the language of the assessment. Also included here are variables indicating the student wants to do well to enter a desired school or to get a desired job. The amount of encouragement received by students has been shown to positively affect student achievement (Tomoff et al., 2000; Nadon & Normandeau, 1997). As was previously discussed, however, interpretations of this factor should be made cautiously since the amount of variance explained by the second factor is about 5% for any country.

In the Russian Federation, the factor accounting for the second most variance is student- centered instruction. Variables included indicate students working in groups, discussing practical problems, and solving problems with everyday things.

Moving to factors three through six or seven, one finds that little variance is accounted for by any one factor. However, the loadings within the factors are fairly high in many instances. This leads to the thought that maybe more targeted questions on the background questionnaire could better explain some differences between the countries in terms of student achievement.

The student centered instruction and teacher centered instruction factors were not clearly defined among the countries. Variables such as use of overhead, use of board, and classroom discussion of practical problems occurred in different factors depending on the country. Since the factors were not clear, the results of Webster et al. in 1999 and Tomoff et al. in 2000 cannot be discussed in detail. It is possible that more questions of this type would offer a better sense of the effects instruction is having on mathematics achievement.

It should be noted that in Japan the factor technology was kept even though only two variables loaded significantly on that factor. The home environment factor was kept in the structure for the United States even though it too had only two significant loadings. Analyses were run without these two factors, but the amount of overall variance accounted for dropped by a fairly significant amount. Further, both factors do have a number of other loadings in the 0.32 to 0.39 range. Had more specifically targeted questions been included, it seems likely that both factors would have provided more interesting data.

CONCLUSION

The purpose of this study was to determine if differences in student achievement in the six participating G8 countries could be partially explained by differences in backgrounds as reported on the student background questionnaire. There were several issues that hampered this goal. Not all countries responded to all the background questions. This meant that many questions, including those relating to the education levels of family members, had to be discarded from the comparison. There were several questions for which more than 50% of students within a particular country had no response, including items related to using the internet for mathematics projects. One more issue is the fact that many questions failed to load at all on any of the factors. This indicates heterogeneity among the questions. Even though the research questions mentioned in the background questionnaire development chapter of the 1999 technical report indicate that the items were derived to provide the most comprehensive information about such notions as self concept and internet access, the results provided here show more question development may be needed (Martin et al., 2000). This brings up the question of why so many background questions are necessary if they do not relate strongly enough to one another to be used in secondary data analysis. Of course, this is a policy issue that at some time might be discussed by developers of the TIMSS questionnaires.

Providing a background questionnaire in which the items are more succinctly related to one another will not be a complete solution since countries and students still have the option to not answer questions. However, a background questionnaire composed in this way will allow for rich discussion within countries about how students responded to background questions in relation to national achievement. Revisions of background questionnaires are already underway in at least one large scale assessment. The National Assessment Governing Board, the governing body for the National Assessment of Educational Progress (NAEP) in the United States is determining the best way to move forward with a background questionnaire framework recently developed (NAGB). For countries with some type of national assessment accompanied by a student background questionnaire, for example, NAEP, the TIMSS results allow for an external validation provided similar questions are asked. Of course discussions among the developers for the national and international assessments could make this idea a reality especially with the creation of the background questionnaire framework to accompany the NAEP assessments. Similar background questionnaire content would provide a new wealth of information for secondary analysis researchers.

Further study in this area could include using other statistical procedures such as Structural Equation Modeling. More study could also be done by including other countries, choosing countries for different reasons such as similar demographics or similar achievement. Comparisons could also be made between the factor structures of males and females or between teacher responses and the results reported by students. Since data for TIMSS-03 will be available in approximately two years, additional analyses could also be conducted comparing cohorts of eighth graders in 1995 to those in 1999 to those in 2003.

What factors external to a national educational system affect student achievement? The question is becoming more and more of an issue in the United States at least, and presumably in other G8 countries. Since the TIMSS assessments allow for comparison of countries using a common measure, it is important that researchers within the countries gain as much information as possible from the assessment and its attached data gathering tools.

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