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Abstract
In 1991-97, the International Association for the Evaluation of Educational Achievement (IEA) undertook a Third International Mathematics and Science Study (TIMSS) in which data about the mathematics and science achievement of the thirteen year-old students in more than 40 countries were collected. These data provided the opportunity to search for patterns of students’ answers to the test items: which group of items was relatively more difficult (or more easy) for the students from a particular country (or group of countries). Using this massive data set an attempt was made to measure the similarities among country profiles of how students responded to the test items.
Introduction

In the educational community, folklore has it that "The German education system is quite similar to that of Austria," or "All post-communist countries teach mathematics in the same way," and the like. Sometimes these statements are based on an analysis and comparison of national school structures, the curricula or textbooks. Is it really possible to measure the similarity between the countries? Usually, the phenomena of the similarity of the national educational systems is descriptive and subjective; their features are seldom measured and placed on a scale. Data from the Third International Mathematics and Science Study (TIMSS) provided the opportunity to search for patterns among nations in students' answers to the test items. (Notes 3 and 4)

An attempt to group the TIMSS participating countries had already been undertaken by analyzing national curricula in mathematics and science (Notes 1 and 2). The countries were grouped by a priori geographic and economic conditions, or by investigating statistically some patterns in the national math and science curricula. This last mentioned method of looking for statistical similarities is close to the method described in this article. The difference is in the nature of the data used: the curriculum analyses dealt with the intended curriculum whereas the emphasis in this article is on the achieved curriculum, i.e., what was actually learned by the students in the countries.

Conceptual Framework

Figure 1 presents the difficulty levels (p-values) of 20 items forming a part of the TIMSS mathematics test for three countries X, Y, and Z. These items have been ordered by their difficulty; that is, the actual percentage of students obtaining the right answer for each item.

![Figure 1. Item difficulties for 20 TIMSS items for countries X, Y and Z.](image)

It can be seen that the students in countries X and Y performed this part of the test relatively similarly, despite the fact that country X had higher overall achievement than country Y. The students in these two countries performed in a similar way on the same items relative to other items. Country Z students performed in quite a different way: the overall students scores on this set of items were about the same as in Country X, but the relative national item difficulties for these two countries were quite different.
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