

motivation, and classroom experiences as did their teachers and school administrators. An extensive document analysis examined official curriculum content standards and commonly used textbooks. Nearly fifty countries participated in one or more aspects of the TIMSS, allowing for the collection of a large amount of information about education, schooling, the curriculum, and student attainments.

## Conceptions of Curriculum

For the purposes of our investigations we conceive of curriculum as a sequence of opportunities to learn specific disciplinary content, in our case in science and mathematics. Even this limited concept of curriculum considered holistically involves issues of topic selection, topic emphasis, and the sequencing of topics, whether within a given year's schooling or across all the years of students' schooling experiences. Such a conception of curriculum leads to a focus on the specific topics selected for instruction, the amount of time spent on these topics, and the company topics keep in the course of the instructional sequence. Those aspects of educational systems and schooling become the objects for study.

The perspective on curriculum used for our investigations here is not meant to exclude or diminish other conceptions of curriculum. Indeed, there is a "bewildering" array of definitions for curriculum.<sup>3</sup> One conception of curriculum focuses on it as a cultural artifact.<sup>4</sup> Others take a more investigative approach to curriculum, using a variety of concepts of curriculum for that purpose.<sup>5</sup> Still others take a public policy approach to curriculum that leads to a focus on issues of public education and school organization and reform.<sup>6</sup> Still others take a more political or philosophical approach, seeing curriculum as an issue of power and access.<sup>7</sup>

In short, any investigation that focuses on curriculum focuses only on certain aspects and conceptions of this multifaceted centerpiece of schooling. We have chosen a formal approach to curriculum as learning opportunities focused around specific topics in school mathematics and science because this is appropriate to our investigation of actual learning as achievement change for science and mathematics.

## Models Relating Curriculum and Achievement

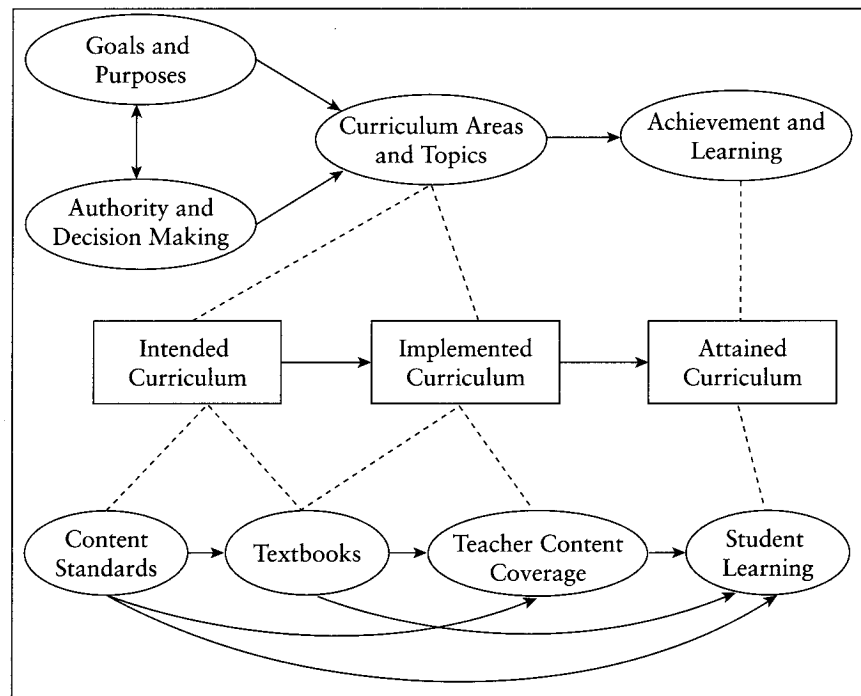
The present TIMSS study is firmly rooted in the tradition of comparative education studies carried out by the International Association for the Evaluation of Educational Achievement (IEA). Historically, the IEA has

from: Schmidt, William H. *Why Schools Matter : A Cross-National Comparison of Curriculum and Learning*, The Jossey-Bass Education Series. San Francisco, Calif.: Jossey-Bass A Wiley, 2001.

explored issues of schooling's organization and structure, along with investigations of specific subject matter pedagogy and achievement. At least since the IEA's Second International Mathematics Study (SIMS), an informal model identifying three faces of curriculum has informed its studies. These faces are the intended, implemented, and attained curriculum.<sup>8</sup> Figure 2.1 embeds the tripartite IEA curriculum model into our model of the four education institutions.

The TIMSS benefited from previous IEA studies and drew upon that work to inform and guide the clarification of issues to be studied and the development of research instruments. The National Science Foundation and the U.S. Department of Education supported a research and

Figure 2.1. Conceptual Model Relating Curriculum and Achievement.



Note: Solid lines with arrows represent possible empirical links between model constructs; dashed lines identify definitional links between models.