

Joanne Lobato

This article is a response to Foundations for Success: The Final Report of the National Mathematics Advisory Panel (2008) and to one of the task group reports on which it was based, the report of the Task Group on Learning Processes. The author uses Maxwell's two views of causality-regularity and process—to explore three major issues. raised in the report: the nature of what is learned, how learning occurs, and the transfer of learning. She proposes alternative recommendations to those offered by the Panel, by drawing upon the mathematics education literature, which was largely excluded from the reviewed research. Furthermore, by neglecting research grounded in a process view of causality, the report excludes perspectives and findings that would have illuminated what it means to develop conceptual understanding in mathematics-one of three valued outcomes cited by the Panel.

Keywords: learning processes and strategies; mathematics education; policy, transfer

uring a recent trip to China, I was surprised to learn of the keen interest of Chinese researchers in the final report of the National Mathematics Advisory Panel (NMAP: 2008). Such interest speaks to the potential global influence of the report and to the significance of the critiques found in this special issue of Edwartieval Researcher. In this article, I explore the following issues raised in chapter 5 of the report ("Learning Processes"): (a) the nature of what is learned, (b) how learning occurs, and (c) the application or transfer of learning.

I propose alternative interpretations and recommendations to those offered in the report by drawing upon the mathematics education literature, which was largely excluded from the reviewed research. As indicated in the Task Group on Learning Processes report (Geary et al., 2008), all major mathematics education journals were excluded (including the Journal for Research in Mathematics Education, the Journal of Mathematical Behavior, Educational Studies in Machematics, and Mathematical Thinking and Learning). The journals deemed acceptable rely heavily on experimental psychology (e.g., Journal of Experimental Psychology).

Because the NMAP report draws primarily on journals from experimental and educational psychology, it is important to recognize general differences in the goals and assumptions of psychologists and mathematics educators. According to DeCorre, Greer, and Verschaffel (1996), experimental psychologists tend to treat mathematics as the topic that is codified in commonly used textbooks. In contrast, mathematics educators often provide new conceptual analyses of content and create instructional designs to support "what might be" rather than "what is" (Bishop, 1992).

In a related point, Cobb (2007) argues that experimental psychology focuses on how variations in instructional conditions affect the learning outcomes for a statistically constructed collective subject. In contrast, mathematics education research tends to focus on how students come to reason in qualitatively different ways by successively reorganizing their activity. Stated more broadly, Maxwell (2004) would say that experimental psychologists tend to hold a regwlavity view of causality. From this perspective, causality cannot be directly observed but can only be measured in the regularity of relationships between events. This necessitates the determination of a systematic relationship between inputs (e.g., an experimental condition or a curricular treatment) and outputs (e.g., a subject's performance in an experiment or the learning outcomes for a group of students). Mathematics education researchers typically rely on a different but compatible aspect of scientific explanation, which Maxwell calls process consulity. This is based on a conceptual analysis of processes by which some events influence others. Whereas regularity causation is most useful in establishing that something happens, process causality addresses why or how it happened.

These distinctions are important to a discussion of learning. processes. By restricting the criteria for inclusion to those research studies that utilized "experimental, quasi-experimental, or correlational methods" (Geary et al., 2008, p. 153), the task group limited its ability to respond to its stated goal to "address what is known about 60w [italics added] children learn and understand areas of mathematics related to algebra and preparation for algebra" (p. xi).

#### The Nature of What Is Learned

The learning processes chapter of the final report includes the following statement, which suggests a welcome broadening of the types of mathematical knowledge that are valued:

Debates regarding the relative importance of conceptual knowledge, procedural skills (e.g., the standard algorithms), and the commitment of addition, subtraction, multiplication, and division facts to long-term memory are misguided. These capubilities are mutually supportive, each facilitating learning of the others. Conceptual understanding of mathematical operations, fluent execution of

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