



Learning as Thinking and Thinking as Learning

A Review of

Learning as a Generative Activity: Eight Learning Strategies That Promote Understanding

by Logan Fiorella and Richard E. Mayer

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Reviewed by

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Learning as a Generative Activity is a hard book to read. The writing is formulaic and dull. Much of the presentation consists of paragraph after paragraph describing one study after another. Included in the 206 pages of text are 21 pages of effect-size tables and 25 pages of references. Most of the chapters are overly repetitive. There is almost nothing new in the book. Yet, every teacher of students from elementary school through university should probably read it, not because I wish a dreary mental exercise on everyone else, but because the central message of this book is so important: Learning is not what most students and many teachers think it is.

Learning and Thinking

There is a long but sometimes rocky relationship between psychology and education. Some of psychology's greatest lights, including William James, E. L. Thorndike, B. F. Skinner, and Jean Piaget, have had major influences on the thinking of educators. Textbooks of educational psychology have been staples in the preparation of teachers since the late 19th century. However, there is surprisingly little evidence that psychological research has influenced what goes on in most educational settings (Lageman, 2000).

In the past few decades, there have been occasional signs of psychology–education synergy. Psychology's interests in cognitive modes of memory and learning and educators' interests in evidence-based practice have led to more collaboration (e.g., Bransford, Brown, & Cocking, 1999; Darling-Hammond & Bransford, 2005), and some psychologists have directly applied their research on cognition to learning (e.g., Brown, Roediger, & McDaniel, 2014; Willingham, 2009). Theorists with a cognitive view of learning have employed various terms to describe the kind of learning that leads to transferrable knowledge (knowledge that can be applied outside of the immediate context in which it is learned). Terms used have included elaboration, deep processing, meaning making, inference generation, and adaptive

intelligence. Those concepts share the notion that the kind of learning that leads to transfer is actively constructive, not a passive association of stimuli and responses. Fiorella and Mayer's term for this constructive process is "generative activity."

Unlike some broader applications of cognitive learning principles, Fiorella and Mayer's book focuses exclusively on eight learning strategies that they deem to be supported by experimental research. These eight learning strategies have been defined specifically enough that they fit comfortably into Fiorella and Mayer's particular simplified, three-process theory of cognitive learning. In their theory, the first process, selection, involves attention. Material to be learned, in the form of verbal propositions, images, sounds, etc., is selected on the basis of relevance to a goal. Selected material is active in working memory, and it can be subjected to the second process, organization, to create a coherent cognitive structure of the material. While in working memory, new material can also be connected to already-learned material in long-term memory through the third major process of integration.

Fiorella and Mayer also see metacognition and motivation as important to learning. Metacognition involves the monitoring and controlling of the selection, organization, and integration processes. Motivation is construed cognitively as the mental states that initiate, engage, and maintain generative activities. Motivation is particularly important to generative learning because of the effort required to apply strategies. Unlike associative or rote learning, generative activities require mental work.

The Eight Learning Strategies

After describing their learning theory, the authors provide separate chapters for each of the eight learning strategies. Four of the strategies involve the learner in changing or translating the form of representation of the material: summarizing, mapping, drawing, and imagining. The other four strategies involve elaboration of the material: self-testing, self-explaining, teaching, and enacting. The structure of each of the eight chapters is the same. Brief summaries, overviews, and outlines (in the form of questions) tell what is coming. Then participative exercises give the reader first-hand experiences with the strategy and how it works. A narrative description of the strategy is followed by a section connecting the components of the strategy to the processes of selecting, organizing, and integrating.

The longest segment in most of the chapters summarizes the evidence for the effectiveness of the strategy in producing recall, comprehension, and transfer. Typically, only studies that included random assignment to experimental and control groups are included. A summative effect-size estimate is provided for each strategy (one criterion for inclusion of the strategy among the eight was a median effect size of at least $d = 0.40$ across studies). The final two sections summarize illustrative research on conditions that limit the effectiveness of the strategy and the appropriate applications of the strategy in learning environments. The latter two sections in each chapter elaborate on the nature of the strategy and the groups of students for whom it works best, particularly in terms of ability level, how much the students already know, or age. A conclusion informs readers where they have been in each chapter.

The Role of the Teacher

In their introductory chapter, Fiorella and Mayer argue that there are two major ways to improve learning. One is to change how instruction is presented. Teachers can design instruction in ways that prime selecting, organizing, and integrating. The alternative is to change learners by teaching them how to engage in appropriate cognitive processing. Educators of students from preschool through university are interested in students learning how to learn. As Fiorella and Mayer argue in their concluding chapter, there is often an implicit assumption on the part of educators that somehow learners will magically discover the learning strategies that allow independent learning. To counter this notion, in each of their chapters on strategies, the authors explain how teachers can directly teach or model strategy use or provide support through scaffolding or structuring tasks. The execution of many of the strategies adds to the learner's cognitive load (particularly drawing, mapping, and enacting); so, to the extent teachers can help reduce that load, learners, especially younger and less experienced learners, will be more successful.

What Is Missing?

There are several strengths of this book that justify its wide use: (a) a clear theoretical focus on what needs to be done to produce learning that leads to transfer; (b) an appropriate selection and description of learning strategies (or sometimes a family of strategies) that have a solid base in theory; and (c) a careful weighing of the evidence for the effectiveness of the selected strategies and the conditions under which their use is constrained. However, for teachers looking for ways to get their students to use learning strategies, the book's treatment of several issues is lacking.

First, although metacognition is included in their theory of learning, the authors give little attention to how the individual strategies interact with metacognitive processes or how the metacognitive processes can be taught. All learners tend to have metacognitive intuitions and beliefs about learning that are demonstrably wrong (Bjork, Dunlosky, & Kornell, 2013). One of those beliefs is that we are learning better when we learn easily. A fundamental characteristic of generative activity is that it is effortful. Most, if not all, of the eight generative learning strategies require more effort than those less effective strategies preferred by many learners, such as rereading, recopying, and highlighting (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013). Teachers need to convince learners of the benefits of what Bjork and his colleagues call "desirable difficulties," including those learning strategies that require time and effort (Bjork et al., 2013).

Second, although the importance of motivation is addressed in general in the introductory chapter, there is little or no attention to motivation in regard to the individual strategies. The evidence for the effectiveness of the learning strategies is strong, yet students rarely use them spontaneously. Again, one likely reason is that exercising the strategies requires effort. Learners need to be encouraged to expend the extra effort required to apply a learning strategy. Changing metacognitive beliefs about learning can help, but teachers need help on what forms of motivation might fit with various strategies. Learners are likely to need considerable motivation to change their beliefs. Teachers must support strategy learning by supplying the motivation for students to learn until they start getting intrinsically rewarded by their successes.

Recommendation

There is a small set of books by psychologists that should be recommended to all teachers because of their potential to change how teachers and their students think about learning. In that set, *Why Don't Students Like School?* (Willingham, 2009) and *Make It Stick* (Brown et al., 2014) are more readable, but *Learning as a Generative Activity* is shorter and more focused. At \$99.00, few teachers and administrators are going to buy this book (the online version is only available to institutions, and no price or publication date is listed yet for the paperback edition on the publisher's website; the Kindle version is \$54.99). When it comes out in paperback, it would be a good choice for in-service workshops and seminars and as a complement to textbooks in psychology courses for teachers in training. The central point that the acquisition of transferrable, generalizable knowledge involves an effortful quest for meaning is more important than are the details of isolated strategies. However, that point might be best learned by those who give careful thought to the eight strategies included here.

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