Appendix C:
Methodology of Textbook Evaluations

Textbook Selection

All textbooks assigned in educational psychology, general methods and secondary subject-specific methods courses in the sample of 48 elementary and secondary teacher preparation programs were screened to determine if they address cognitive science and/or instructional strategies in any way.

We note that textbooks unique to subject-specific elementary methods courses were not reviewed in depth. What examination we did of these textbooks indicated that had we reviewed them, none would have received credit for covering the strategies. The reason for this failure to cover the strategy: the textbooks present the strategies as relevant for the subject at hand, not as universally applicable. Because elementary teachers teach across all subjects, this presentation could lead to misunderstandings that adversely affect the teachers' instruction. However, because secondary teachers will only teach a single subject — and the suggestion that strategies have subject-specific applicability has fewer pragmatic implications — we did not require that coursework and relevant textbooks assigned in secondary subject-specific methods courses convey universal applicability.

A textbook was purchased if its title, the publisher's text description, the table of contents, and/or the index mentioned topics such as information processing, cognitive science, memory, metacognition, learning theories, the work of individual theorists (such as Piaget or Bloom), advice on how to plan or deliver instruction, instructional activities, teaching strategies, or assessment.

In total, 48 textbooks were selected for analysis, including 9 from educational psychology courses, 24 from general methods courses, and 15 from secondary subject-specific methods courses (5 math, 4 English/language arts, 4 science, and 2 social studies/history). The texts are listed in Appendix A.

In addition, we searched for evidence that instructors are compensating for weak coverage of the fundamental instructional strategies in textbooks by substituting strong reading packets, but found no such evidence. Of the 10 courses in the sample that don't assign a text but do require other readings, only one set of readings mentions a strategy other than **posing probing questions**. In addition, when courses used both a text and supplementary readings, the readings introduced fundamental instructional strategies that were not already covered in the text in only 7 percent of situations. Credit was given for coverage of fundamental instructional strategies in readings whenever appropriate.

Textbook Scoring

As discussed in the body of this report, the textbooks assigned in the relevant courses in our sample are a major focus of our analyses. The textbooks were examined to determine the accuracy and extent of their coverage of each strategy. As subsidiary issues, we also collected data on whether the textbooks address (a) cognitive science, specifically the information processing model that underlies the fundamental instructional strategies, and (b) modifying instruction to accommodate variation in student learning styles.

Four analysts, all of whom have completed undergraduate and/or graduate coursework or degrees in cognitive and/or educational psychology, comprised the textbook review team. Two analysts independently reviewed each text in full. One of the authors of this study or a third analyst who had not completed one of the two initial reviews prepared a combined review that integrated the initial reviewers' notes and reconciled any differences in evaluations.

The reviews used a combination of summaries and quotes from the text to record every mention of a strategy (or what could be construed as a mention of a strategy), no matter how brief, within the approximately 14,000 pages of text in the books in the sample. A typical review was 5-10 pages in length.

Analysts noted the composite effect on the reader from the often-scattered mentions of each strategy: Did the text consistently support the use of the strategy, or present conflicting recommendations? Did the text convey the strategy's general applicability or recommend its use only with certain types of students or in combination with a particular approach to teaching?

Analysts also used a five-point coding system to note the emphasis given each strategy:

Coverage	Points
None	0
1-2 sentences	1
3-6 sentences/1 small paragraph	2
2-3 small paragraphs/1 large paragraph	3
1 page or more/inclusion in chapter summary	4

See Figure C1 for an example of how a single text was reviewed for the strategy of distributed practice. Similar information was recorded for each of the six strategies in each textbook.

Figure C1. Excerpt from review of Bohlin, L., Durwin, C. C., & Reese-Weber, M. (2009). *EdPsych: Modules.* Boston, MA: McGraw-Hill.

TOPIC/STRATEGY	Text mentions	Coverage code	Summary of coverage
Distributing practice	**p. 118** (Learning goals, Module 7) – Refers to five principles of effective instruction; "Provide multiple exposures to content" is one of the principles, specified on p. 129. **p. 129** (Module 7) – "Applications: Principles for effective teaching" (one short paragraph) – Emphasizes returning to same topic over time: *'Provide multiple exposures to content*. Returning to content at different times, in different contexts, for different purposes, and from different perspectives will enhance students' knowledge acquisition.' (Haskell, 2001; Spiro, Feltovich, Jacobson, & Coulson, 1991). 'Examining content from different perspectives…may lead students to restructure or modify their existing knowledge. Revisiting content over time and in different contexts also encourages transfer of knowledge by preventing learned information from being tied to specific situations or contexts' (Salomon & Perkins, 1989)." **p. 130** (Module 7) – "Summary…Discuss five principles of effective instruction based on constructivist theories" (two sentences) – "(4) Provide multiple exposures to content." [Next sentence restates the rest of the excerpt from p. 129.] **p. 200** (Module 11) – "Helping students store and retrieve information effectively" (two sentences – third bullet point) – "Distribute practice opportunities over time within a single unit, and strive to cover the same material several times in different contexts over the course of the semester or year. This additional processing leads to elaboration, building stronger connections to other information and increasing the likelihood that students will be able to transfer their knowledge effectively to new situations (Murray, 2006)." **p. 363** (Module 20) – "Direct instruction" (one short paragraph – third bullet point on page) – "Teachers provide weekly and monthly reviews and reteaching as necessary in order for long-term learning to occur. Students also need to engage in distributed practice once they have achieved mastery at independent practice. These short and frequent practice periods are more effective than fewer but longer practice opportunities, especially for children in early elementary grades."	4	Text includes multiple recommendations for use. P. 363 quote is not relevant for analysis because it describes distributed practice only in the context of direct instruction. However, this mention does not contradict other places in the text where distributed practice is presented as a universally useful strategy.

Finally, Dr. John Dunlosky, a professor in the Department of Psychological Sciences at Kent State University whose research focuses on learning strategies, was provided with the combined review and all relevant pages of the texts to provide feedback.

Dr. Dunlosky's comments often clarified situations in which we were unsure whether the ideas conveyed in a particular excerpt were sufficiently accurate to receive credit. He also helped us understand how a text's multiple references to a strategy might or might not fit together. For example, was a recommendation for massed practice while learning a new idea contradictory to the concept of distributed practice?

To "accurately teach" a strategy, a textbook's coverage had to satisfy three criteria:

First, it had to convey 75 percent of the *key elements* of each strategy. These key elements were taken directly from the description of the strategies in the IES practice guide. For each strategy, the key elements included at minimum 1) a definition of the strategy and 2) a statement of the primary cognitive purpose for the strategy. For most strategies, the key elements also included one to three more important guidelines which explain how to best implement the strategy.

Each key element was worth 1-2 points, with a total of 3-7 points possible per strategy. For each strategy in each text, points awarded were divided by total possible points and the strategy was judged to meet the first criteria for accuracy if the score was 75 percent or greater. The key elements for all of the strategies, and their point values are listed within Figure C3 below.

Second, the text had to convey the strategy in a *consistently accurate manner*. Using the example of distributed practice, a textbook may have several scattered references about the importance of practice that total a page or more. However, in two references, the discussion implies that practice is most productive when it immediately follows instruction, whereas in subsequent discussion several pages later, discussion implies that practice should be spaced at greater intervals. In this case, the textbook has not consistently conveyed the strategy in an accurate manner.

Third, the text had to convey the *general applicability* of the standard. Strategies should be described as having broad applicability or — if the text presents strategies in the context of a particular type of instruction, such as teacher-directed instruction, cooperative learning, reciprocal peer teaching, and so on — they should be re-emphasized in all such contexts. A large proportion of texts do not convey general applicability. For example, 90 percent of texts that mention distributed practice do so only within the context of teacher-directed instruction and make no mention of how it can improve retention of material learned in any type of instruction.

Figure C2 shows a key element scoring overlay onto the information already presented in Figure C1. Because all of the key elements were addressed in this example, the textbook's score on the strategy was 100 percent.

Furthermore, because the strategy is presented in a manner that is consistently accurate and its general applicability is conveyed, this textbook is deemed to "accurately teach" the strategy.

Figure C2. Excerpt from review of Bohlin, L., Durwin, C. C., & Reese-Weber, M. (2009). *EdPsych: Modules.* Boston, MA: McGraw-Hill.

TOPIC/STRATEGY	Text mentions	Coverage code	Summary of coverage
Distributing practice	**p. 118** (Learning goals, Module 7) – Refers to five principles of effective instruction; "Provide multiple exposures to content" is one of the principles, specified on p. 129. **p. 129** (Module 7) – "Applications: Principles for effective teaching" (one short paragraph) – Emphasizes returning to same topic over time: *'Provide multiple exposures to content.* Returning to content at different times, in different contexts, for different purposes, and from different perspectives will enhance students' knowledge acquisition.' (Haskell, 2001; Spiro, Feltovich, Jacobson, & Coulson, 1991). 'Examining content from different perspectives…may lead students to restructure or modify their existing knowledge. Revisiting content over time and in different contexts also encourages transfer of knowledge by preventing learned information from being tied to specific situations or contexts' (Salomon & Perkins, 1989)." **p. 130** (Module 7) – "Summary…Discuss five principles of effective instruction based on constructivist theories" (two sentences) – "(4) Provide multiple exposures to content." [Next sentence restates the rest of the excerpt from p. 129.] **p. 200** (Module 11) – "Helping students store and retrieve information effectively" (two sentences – third bullet point) – "Distribute practice opportunities over time within a single unit, and strive to cover the same material several times in different contexts over the course of the semester or year. This additional processing leads to elaboration, building stronger connections to other information and increasing the likelihood that students will be able to transfer their knowledge effectively to new situations (Murray, 2006)." **p. 363** (Module 20) – "Direct instruction" (one short paragraph – third bullet point on page) – "Teachers provide weekly and monthly reviews and reteaching as necessary in order for long-term learning to occur. Students also need to engage in distributed practice once they have achieved mastery at independent practice. These short and frequent practice periods are more effective than fewer but longer practice opportunities, especially for children in early elementary grades."	4	Text includes multiple recommendations for use. P. 363 quote is not relevant for analysis because it describes distributed practice only in the context of direct instruction. However, this mention does not contradict other places in the text where distributed practice is presented as a universally useful strategy.

Key element A: Teacher should provide at least two exposures to content.

Key element B: There should be a delay of several weeks to several months between exposures.

Key element C: Delayed re-exposure to content promotes retention.

Complete scores for all texts on all strategies are found in Appendix A.

Figure C3 depicts the key elements for each of the six fundamental instructional strategies, and notes issues that had to be addressed in evaluation, points given for the key element, and examples from textbooks of statements that did and did not receive credit on each key element.

Figure C3. Key elements of the six fundamental strategies and their evaluation

STRATEGY	Key element taken from IES guide	Points	Example(s) that meet standard (credit awarded). Key aspects of each strategy are underlined.	Example not sufficiently comprehensive, explicit or on-target (no credit)
1) Pairing graphics with words	1a) Teachers should provide both graphics that convey information (not just engaging pictures) and verbal description (spoken or written) when presenting key processes or concepts.	2	Explains that dual code theory states that "information represented both visually and verbally is recalled better than information represented only one way." *– from Slavin (2009, Ch. 6, pg. 167)*	"Pictures, concrete aids, films, and other audiovisual materials are especially useful because they enhance the sensory richness of the associations." *– from Elliott (2005, Ch. 4, p. 66)* *What's missing*: A specific recommendation to combine graphic and verbal information or to have visuals convey information.
	1b) These combinations promote learning. (Must be an explicit statement of the purpose of the strategy.)	1	The authors describe the visual-spatial sketchpad, a "short-term storage system for visual and spatial information" (p.200) and the phonological loop, "a short-term system for words and sounds" (p.199) and conclude that, "This suggests that students learn more if verbal explanations are combined with visual representations (Clark & Mayer, 2003; Moreno & Duran, 2004). The visual processor supplements the verbal processor and vice versa" (p.201). *– from Eggen & Kauchak (2010, Ch. 7, p.201)*	"The brain remembers images more easily than words, which makes graphic organizers, pictures, charts, and graphs effective tools for organizing patterns." *– from Feinstein (2004, Ch. 2, p. 45)* *What's missing*: A focus on a combination of visual and verbal information.
2) Linking abstract concepts with concrete representations	2a) Teachers should present both abstract and concrete representations when teaching a concept.	2	"Students need to have abstract ideas illustrated with concrete examples, and this is true for older as well as younger students." *– from Eggen & Kauchak (2010, p.7)*	In discussing "discovery learning" the text states: "…the teacher's role is to gather and provide equipment and materials related to a concept that the students are to learn…the teacher's role is to monitor and observe as the students discover the properties and relationships inherent in the materials, asking occasional questions or making suggestions that will guide the students in seeing the relationship and understanding the concepts." *– from Eby, Herrell, & Jordan (2009, Ch. 7, p. 248)* *What's missing*: Discussion limits applicability to one activity (discovery learning) rather than general applicability, and emphasizes students finding connections rather than the teacher designing the activity to ensure that students see relationships between the materials provided and the abstract principles that connect them.
	2b) Connecting abstract and concrete representations promotes learning. (Must be an explicit statement of the purpose of the strategy.)	1	At the end of a case study, "[The teacher]…provided the specific, concrete experiences [her students] needed to understand the concept and ultimately advance their development. " *– from Eggen & Kauchak (2010, p.36)*	"Students' understanding of mathematical ideas is broadened when concrete representations are used." (Coggine et al, 2007) *– from Tate (2010, Strategy 7, p. 56)* *What's missing*: The discussion is limited to the subject of math. The general applicability of the strategy is not conveyed.

STRATEGY	Key element taken from IES guide	Points	Example(s) that meet standard (credit awarded). Key aspects of each strategy are underlined.	Example not sufficiently comprehensive, explicit or on-target (no credit)
3) Posing probing questions	3a) Teachers should ask deep questions once students have basic topic knowledge.	2	"We teachers ask a lot of questions … but far too often, our questions simply require factual recall and only a literal level of comprehension – the lowest level of cognitive functioning…. <u>To elicit thought, ask questions such as why? What if …? How do you know that? Are there other ways of looking at this?</u>" – from Shalaway, L. (2005).p. 123	"[Questions] support inquiry in a classroom; poor questions create an atmosphere that stifles risk-taking. Good questions provide ongoing assessment, helping our decisions about instruction be more effective. And as questioning teachers, we become valuable models for our students." – from Texley, J. & Wild, A. (Eds.). (2004). p. 17 *What's missing*: The purpose of questions is to promote engagement and serve as a formative assessment, not to deepen student thinking.
	3b) Text defines deep questions, describes at least three types, and gives multiple examples of deep questions. (Deep questions include questions such as why, why-not, how, what-if, how does X compare to Y, and what is the evidence for X?)	2	Text includes two "resource pages" with eight strategies for asking "good questions" – questions that "help your students become better thinkers…[by] convert[ing] simple questions into more challenging ones." The suggestions relate to asking "why" and "what if" questions, asking for evidence, comparing and contrasting, as well as prompting for creative answers. For example, one strategy is to ask for proof of an answer; doing so "requires that the student both formulate the answer and offer support of it" – e.g., "Does the formula you are using to find the area of a triangle always work? Why?" (Essentially, <u>eight types of higher-order questions are described, with several examples for each</u>). – from Shalaway (2005, Ch. 3, pp. 127-128)	In thinking-based questioning, the teacher asks questions that stimulate thinking and discussion. For example, the teacher may ask "Compare the French and American revolutions. How were they similar? How were they different? Make a point to include thinking-based questions in your teaching. They will help your students construct a deeper understanding of a topic". – from Santrock (2009, p. 322) *What's missing*: A few examples of appropriate questions are given, but they are not categorized or defined in a way that would help the reader to understand what makes them appropriate.
	3c) Answering deep questions helps students build understanding and promotes learning. (Must be an explicit statement of the purpose of the strategy.)	1	"<u>It is through this process [of questioning and discussion] that students integrate new knowledge with prior knowledge, build more complete knowledge structures, and come to understand more complex relationships.</u>" – from Arends (2004, Ch. 7, p. 283)	"Posing questions is an effective instructional tool for stimulating students' thinking….it's important to consider the kind of questions, both oral and written, that serve to provide insights into how students think." The text gives an example of a student who answers a question on fractions correctly, but his reasoning is incorrect. This suggests that asking the right questions can help in uncovering the mistake. – from Burns (2007, Part 1, p. 47) *What's missing*: Questions are asked in order to reveal students' thinking and serve as a form of formative assessment, instead of deepening students' understanding.
4) Repeatedly alternating solved and unsolved problems	4a) During problem-solving sessions and assignments, worked examples should be alternated with problems to be solved.	2	"<u>Research on worked examples generally finds that they are effective if they alternate with problems students do on their own</u> (e.g. one worked example followed by several problems of the same type)" – from Slavin (2009, Ch. 7, p. 206)	Use worked-out examples for practice at problem solving…." – from Bohlin, Durwin, & Reese-Weber (2009, Module 13, p. 237) *What's missing*: This recommends providing worked examples, but does not mention interleaving them with problems to solve.

STRATEGY	Key element taken from IES guide	Points	Example(s) that meet standard (credit awarded). Key aspects of each strategy are underlined.	Example not sufficiently comprehensive, explicit or on-target (no credit)
	4b) Alternating worked examples and problems to be solved promotes learning. (Must be an explicit statement of the purpose of the strategy.)	1	"…But when students were given 'worked examples' (such as presolved problems) interspersed with problems to solve, studying the worked examples freed up cognitive resources that allowed students to see the key features of the problem and to analyze the steps and reasons behind problem-solving moves…." – from Ambrose, Bridges, DiPietro, Lovett, & Norman (2010, Ch. 4, pp. 105-106) *Note*: No text in the sample explained why worked examples should be alternated with problems to be solved, so this example is taken from another book.	"Phase three, structured practice, comes next. The teacher leads students through practice examples, working through each step…. A good way to accomplish the lockstep technique is to use an overhead projector, doing practice examples on a transparency so that all students can see the generation of each step…. By referring to it while working the practice examples, the teacher is ensuring that students understand it so that they can use it as a resource during their semi-independent practice phase." – from Joyce, B., Weil, M., & Calhoun, E. (2008). P. 363 *What's missing*: This explains why it's useful for the teacher to problem-solve before students solve problems on their own, but does not recommend that students' problem sets incorporate worked examples.
5) Distributing practice	5a) Teacher should provide for at least two exposures to important content.	2	"Provide multiple exposures to content. Returning to content at different times, in different contexts, for different purposes, and from different perspectives will enhance students' knowledge acquisition (Haskell, 2001; Spiro, Feltovich, Jacobson, & Coulson, 1991)." – from Bohlin et al. (2009, Module 7, p. 129)	"…A spiral curriculum acknowledges that concepts are revisited periodically during the period of formal schooling, with each new exposure incorporating and building on the previous one, while moving to a more sophisticated understanding." – from Jordan, A.J, & Porath, M.J. (2005). p. 46 *What's missing*: Recommendation of multiple exposures by the teacher who introduced the content.
	5b) There should be a delay of "several weeks to several months" between exposures.	2 (Half credit is given when a shorter delay is suggested)	A sample schedule of practice covers the whole school year and shows month-by-month practice opportunities for specific skills, such as "Nov: Three practices with feedback during unit on photosynthesis" for the skill of using a microscope. – from Dean et al. (2012)	"To minimize memory loss, you can…frequently review to encourage automaticity (rapid automatic response)." – from Shorall, C. (2009). Chapter 5, p.28. *What's missing*: There is no mention that delay between reviews is often appropriate.
	5c) Delayed re-exposure to key content promotes retention. (Must be an explicit statement of the purpose of the strategy.)	1	"…This additional processing [from distributed practice] leads to elaboration, building stronger connections to other information and increasing the likelihood that students will be able to transfer their knowledge effectively to new situations (Murray, 2006)." – from Bohlin et al. (2009, Module 11, p. 200)	"Implications for Planning" – "…If two topics are taught at each grade, it follows that each second-order concept will be revisited at least once each year and that planning for systematic progression across grades is possible." – from Donovan & Bransford (2005, Ch. 3, p. 171) *What's missing*: There is no mention of the fact that re-exposure promotes retention.

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STRATEGY	Key element taken from IES guide	Points	Example(s) that meet standard (credit awarded). Key aspects of each strategy are underlined.	Example not sufficiently comprehensive, explicit or on-target (no credit)
6) Assessing to boost retention	6a) Teachers should give closed-book quizzes or tests to re-expose students to key material.	2	Section entitled "Guidelines: Helping students understand and remember" includes "Provide for repetition and review of information," with one example being, "Give frequent, short tests." *– from Woolfolk (2010, Ch. 7, p. 260)*	The purposes of assessment included "to help educators determine the strengths, weaknesses, and overall progress of students…to provide documented results that teachers need to explain their actions…to improve instruction, and to provide accurate reports to students, parents, and school officials." *- from Manning, M.L., & Bucher, K.T. (2009) p. 201* *What's missing*: Retention is not noted as a purpose of assessment.
	6b) Quizzes and tests that require active recall of correct answers are preferable to those that just require recognition of correct answers.	2	"…Tests that require the learner to supply the answer, like an essay or short-answer test, or simply practice with flashcards, appear to be more effective than simple recognition tests like multiple choice or true/false tests…the implication seems to be that where more cognitive effort is required for retrieval, greater retention results." *- from Brown et al. (2014, Ch. 2, pp. 40-41)* *Note*: No text in the sample received credit for this point, so this example is taken from another book.	"Learning is supported by frequent testing using cumulative questions that ask students to apply and integrate knowledge." *– from Woolfolk (2010, Ch. 7, p. 532)* *What is missing*: There is no explicit statement that questions should require recall as well as asking for application and integration.
	6c) Feedback including the correct answers is essential when using quizzes or tests to cement learning.	2	"…providing feedback from either formal or informal assessments increases student motivation and learning (Brookhart, 1997; Brookhart & Durkin, 2003; Dempster, 1991). As will be described in detail in Chapter 8, to be most effective, feedback must be clear and direct rather than general and ambiguous." [Note: follows comment about positive impact of frequent, brief assessment on learning.] *– from Arends (2004, p. 218)*	"An assessment activity can help learning if it provides information to be used as feedback by teachers, and by their students in assessing themselves and each other, to modify the teaching and learning activities in which they are engaged" *– from Black et al. (2003, Ch. 1, p. 2)* *What's missing*: This statement conveys that feedback to students can suggest changes in learning activities, but not that it helps students cement learning.
	6d) Practice in actively recalling information promotes retention. (Must be an explicit statement of the purpose of the strategy.)	1	"Fourth, frequent testing aids retention." *– from Orlich (2010, p. 327)*	"The caution is that it may not be the frequency of test taking but that frequent test taking made the learning intentions and success criteria more specific and transparent…" *– from Hattie (2009, Ch. 9, pp. 178-179)* *What's missing*: There is no accurate information on "test effect" and this suggests that something other than recall is promoting learning.