IV. Education

Teaching and Learning Using Evidence-Based Principles

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Abstract

In this chapter, we present several cognitive learning theories relevant for novice, expert, and advanced learning, and discuss their implications for the instructional design and delivery of university management courses. We describe how evidence-based instructional strategies can be derived from cognitive learning theories, and then we apply the strategies to commonly used teaching practices in management courses. We also address a number of challenges that we believe have impeded evidence-based teaching practice.

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Cognitive load
Practice for learning
Scaffolding
Feedback
Meta-cognition
Critical thinking

Many common teaching strategies contradict scientific evidence about how people learn, to the detriment of student learning. Consider these taken-for-granted strategies, widely used in business school classrooms and beyond:

- Making things less cognitively demanding for learners by simplifying content and tasks;
- Assigning activities because they are enjoyable, without assessing their learning outcomes; and
- Providing more feedback and guidance than is truly needed, which can impair learning, even while benefiting immediate performance.

This chapter will provide evidence that the above strategies are actually counterproductive to learning. In contrast, evidence-based teaching strategies like introducing complexity early on and helping students learn to deal with the complexity, while providing only the necessary guidance, are more likely to benefit learning. The latter teaching strategies are less pleasant. They can even impair student performance in the short-term, as they struggle with complexity. But scientific evidence on learning indicates that such demanding strategies ultimately better prepare students for the future.

Recent comments from our colleagues reflect conventional wisdom about teaching and illustrate certain challenges in promoting an evidence-based approach to management teaching:

Us: "I'm working on a chapter on teaching management in evidence-based ways."

Colleague 1: "I do that already…and besides, my evaluations are excellent!"

Colleague 2: "I don't do that. I prefer to use the case method."

Colleague 3: "Hey, it'll take the fun out of class*, and* ruin my evaluations."

In our responses to these colleagues, we point out that student course evaluations are deficient measures of teaching quality and learning, and teaching with cases and other interactive tools is not antithetical to taking an evidence-based approach to teaching. Cases, exercises, and other common teaching practices can be employed in evidence-based ways.

This chapter represents our joint response to skeptical colleagues who tend to think of the problem this chapter addresses as a non-issue. It responds to the blind faith instructors in business schools place in commonly used teaching practices -- unsupported by research evidence. Our purpose is to clarify what an evidence-based approach to teaching is, to present the scientific evidence on which it is based, and to describe its application to management education. Ultimately, we hope to advance the practice of evidence-based teaching in management education.

We would also like to highlight two distinguishing features of our chapter. Most of this handbook is about evidence-based management, which involves combining the best research evidence with professional judgment and local evidence. Some chapters address what our students need to learn to become evidence-based managers (e.g., the application of research evidence to practice, Salipante & Smith, this volume) and the resources required to support efforts to practice evidence-based management (Briner & Denyer; Pearce; Werner, this volume). While we touch on these issues and our context is management education, our primary focus is on evidence-based teaching as a necessary condition for learning and practicing evidence-based management. Additionally, in essence, our chapter is an illustration of evidence-based practice. We provide a model for how educators can use the best available evidence about learning and instruction to take an evidence-based approach in their practice of teaching.

This chapter begins with our explanations of several relevant cognitive learning theories. It describes how evidence-based instructional strategies can be derived from the cognitive learning theories and identifies effective methods of instruction to promote knowledge and skill acquisition and the transfer of learning to actual practice. Next, it applies evidence-based instructional strategies in discussing common management teaching practices including lecture, discussion, experiential exercises, cases and the case teaching method, and group projects. It addresses the appropriate use and potential misuse of evidence-based learning principles, as well as problems created by relying on teaching approaches that contradict the evidence. Finally, the chapter confronts the individual and institutional challenges that can impede implementation of evidence-based management teaching and learning and recommends responses to these challenges.

Our Thesis

We contend that instructional methods in management should be thoroughly grounded in scientific evidence about how people learn. Cognitive and instructional psychology and education theory and research should be used to develop evidence-based instructional methods. Evidence-based teaching fosters the intellectual skills required to engage in evidence-based management. These skills will enable our students to apply course content to the workplace and prepare them for the life-long learning that the practice of management requires.

Teaching strategies that support real learning demonstrate substantial transfer of knowledge and skills to various tasks and contexts. In contrast, many commonly used strategies (e.g., task simplification; specific, immediate, and frequent feedback; specific goals) have been found to result in increased training performance, *at the expense of transfer*. Common teaching practices, such as cases and experiential exercises, also can be (mis-) applied in ways that lead to lively discussion and interesting ideas, but do not support transfer. The confusion of means with ends common in management education reflects a lack of familiarity with the learning literatures. Widespread ignorance regarding the body of evidence on teaching and learning gets in the way of identifying and then using effective educational strategies. Consistent with the principle of rewarding A while hoping for B (Kerr, 1995), a good deal of management education focuses attention away from learning outcomes towards more general self-reports of learning and affective outcomes captured in the fundamentally flawed course evaluations (Armstrong, 1998) our institutions typically use.

Clear goals need to be specified for management education, particularly in terms of the learning outcomes that we seek to achieve. If we think of managerial performance on a continuum from novice to expert performance, the goal of our efforts should be to move our students further along this continuum and help prepare them for future learning, whether they are undergraduates or experienced executives. The management domain contains both well- and ill-defined problems, and no one can fully anticipate the problems our students will face as practitioners. It is imperative that management educators cultivate students' abilities to continue to learn and adapt to new, unexpected, and complex problems. This cultivation requires critical thinking, reflection and other meta-cognitive habits of mind, developed in the context of acquiring and applying concepts, models, and theories to management practice. Instruction needs to expand habits of mind to allow learners to disentangle personal beliefs from what the evidence actually says. Overall, we endeavor to have our students learn to identify problems, engage in evidence-based causal analysis, and develop analysis-based solutions, consistent with the practice of evidence-based management. These aspirations necessitate active and informed engagement in the learning process by both learners and instructors.

Cognitive Theories of Learning and Associated Instructional Strategies

The learning research in cognitive and instructional psychology and education varies in its depth and specificity. Research streams differ in their theoretical development, subjects' levels of expertise, task domains, attention to learning processes and strategies, relative emphasis on automatic and controlled cognitive processes, and assumptions made regarding working memory's scope and structure. Yet, all streams agree that learners must deploy active cognitive processes, such as meta-cognition, critical reasoning, and hypothesis generation and testing to truly learn, and that instructional conditions must be structured to support these cognitive activities.

Our detailed analysis starts with learning theories that address short and long-term memory and the processes of information encoding and schema construction in novices, experts, and advanced learners. We connect these to other relevant theories and perspectives to inform our discussion of specific management education practices.

Cognitive Load Theory

Cognitive load theory (CLT) builds on knowledge of human cognitive architecture to address the mental processes in which learners engage in response to information presented during instruction (Pollock, Chandler, & Sweller, 2002). CLT assumes that working memory holds only a small number of elements at one time, and that knowledge stored in unlimited long-term memory can overcome the limits of working memory (Pollock et al., 2002). Human cognitive architecture is hierarchically organized: Individual bits or elements of information are combined into organized cognitive structures or schemata, and less complex schemata are combined to form more complex schemata. Schemata are stored in long-term memory and called into short-term working memory when needed. These bigger chunks of information are treated as individual elements in working memory and therefore require less working memory capacity than the set of individual elements that comprise them (Pollock et al., 2002; Sweller, van Merrienboer, & Paas, 1998). With sufficient practice and memorization, schemata are processed automatically, further decreasing their demands on working memory and freeing up its capacity (Sweller et al., 1998).

Information received during instruction imposes cognitive load on the working memory of the learner. According to CLT, total cognitive load is the sum of intrinsic, extraneous, and germane load. Intrinsic load is imposed by task complexity, increasing with the number of information elements in the task and the extent to which these elements interact. For example, the task of memorizing the definitions of fairly isolated concepts has low element interactivity. Alternatively, the task of understanding a complex model or theory that contains a set of interrelated and causally connected concepts is high in element interactivity, and thus imposes higher intrinsic cognitive load. Extraneous and germane extrinsic cognitive load are imposed by the way instructional information is presented and the learning activities the instructional design requires. Germane load comes from information and activities that contribute to schema construction and automation, whereas the information and activities that produce extraneous load do not promote these processes. Following our example above, having students learn the theory in the context of applying it to an organizational problem increases germane cognitive load because this activity can support the construction of knowledge structures for understanding and using the theory. Extraneous cognitive load may be imposed, for example, by prematurely focusing students' attention on generating problem solutions, grades, or other outcomes that could detract from schema construction. The learner's current knowledge impacts both the intrinsic cognitive load experienced and whether learners experience instructional information and activities as extraneous or germane load

(Paas, Renkl, & Sweller, 2004).

CLT researchers have observed that novice problem-solvers tend to use goal-directed, means-end analysis (Sweller, 1988). This strategy involves working backward from a goal to try to bring the current state of the problem (e.g., a/b – c x d = e) progressively closer to the goal state (e.g., b = ?) by recognizing differences between the current and goal states and identifying and progressively implementing problem-solving operators (e.g., rules of algebra) to move closer to the goal (Sweller et al., 1998). As the problem-solver gets closer to the goal, previous actions and strategies can be ignored, as the focus is on reducing the distance between the goal and the most recent current state. This strategy can benefit performance (i.e., the problem is solved), but it increases extraneous cognitive load (Sweller et al., 1998), and thereby impedes learning by inhibiting the construction of appropriate schemata for the problem (Sweller, 1988). Alternatively, more experienced problem solvers tend to use history-cued strategies in which they work forward from previous moves and develop and test hypotheses to identify subsequent moves. Working forward through a problem supports schema construction, rule induction, and transfer (Sweller, Mawer, & Howe, 1982).

CLT suggests that learning is best facilitated when the conditions of learning are aligned with human cognitive architecture (Paas et al., 2004). Research in this area has resulted in a number of instructional methods designed to optimize cognitive load in order to facilitate the construction and automation of schemata. Methods such as introducing variability in worked examples and practice problems and requiring learners to provide self-explanations attempt to decrease extraneous and increase germane cognitive load (Pass et al., 2004; Renkl et al., 2004; Sweller, 2004; Sweller et al., 1998). The instructional methods have been examined with novice learners in primary and secondary school to train discrete problem-solving skills in mathematics and science domains (e.g., Gerjets, Scheiter, & Catrambone, 2004; Renkl & Atkinson, 2003; Renkl et al., 2004; Sweller, 1998, Schwonke, Renkl, Krieg, Wittwer, Aleven, Salden, 2009) and with college students and vocational and professional trainees on computer programming, troubleshooting and equipment testing, concept mapping, and simulated decision making tasks (Hilbert & Renkl, 2009; Moreno, 2004, Pollock et al., 2002; van Gog, Paas, & von Merrienboer, 2006; von Merrienboer, Schuurman, Crook, & Paas, 2002).

For instance, the "worked example effect" has received a great deal of research support (e.g., Hilbert & Renkl, 2009; Renkl et al., 2004; Schwonke et al., 2009). At the beginning of instruction, learners are provided and work through a complete model protocol showing the steps taken to complete a problem, along with the final solution. Critical features are annotated to show what the steps are intended to illustrate. Providing worked examples imposes less extraneous cognitive load than conventional problems, where students are presented with whole problems to solve and tend to use means-end strategies. Worked examples free cognitive resources for schema building around understanding and learning all of the procedural steps involved in a task.

After the complete worked example has been studied, the solved steps are sequentially removed or faded, either backward or forward, in subsequent worked examples to progressively give the learner additional responsibility for problem-solving. After all of the worked steps have been faded, learners are responsible for solving problems in their entirety. Fading out the worked examples as learning progresses helps students to experience impasses on those parts of the problem they work out themselves (Renkl, Atkinson, & Grobe, 2004); this approach is particularly effective when learners are prompted to engage in self-explanation (Hilbert & Renkl, 2009).

Providing non-specific goals is also a recommended strategy for decreasing the use of means-end strategies and promoting schema construction. For example, in a physics problem, instead of assigning the specific goal of solving for particular variables, such as velocity, students would be instructed to find as many variables as possible (Sweller, et al., 1998). In the context of management education, students could be given a case or simulation and instructed to identify problems and the causes of problems using relevant theories. They would not be told what the end state should be (e.g., sales or other performance goals), as this may limit their search for problems and causes.

Interestingly, general goals have been found to be more supportive of learning processes and transfer than specific goals (e.g., Burns & Vollmeyer, 2002; Vollmeyer & Burns, 2002; Vollmeyer, Burns, & Holyoak, 1996). General goals promote the systematic development and testing of hypotheses, which supports rule induction (Klahr & Dunbar, 1988; Simon & Lea, 1974). Alternatively, specific goals tend to focus learners' attention on the goal itself, which decreases systematic exploration (Burns & Vollmeyer, 2002; Vollmeyer & Burns, 2002). Management goal setting researchers also recognize the disadvantages of specific performance outcome goals in situations that require learning. They suggest that instructors assign or encourage learners to set learning goals for discovering the steps and strategies for effective task execution (Latham & Locke, 2007; Latham & Pinder, 2005). Setting or assigning learning goals or providing general goals may not be sufficient for grade-obsessed students, but combined with other evidence-based teaching strategies, these types of goals can support learning and transfer.

Expertise/Expert Performance

Cognitive load theory (CLT) and theories of expertise and expert performance are similarly based on memory processes, with some important differences. First, contrary to CLT, expertise scholars assume that working memory capacity can be expanded with the acquisition of long-term working memory. Experts develop cognitive schemata for knowledge and procedures by using a variety of elaborate encoding processes to store information in long-term memory. Long-term working memory is a mechanism that allows for the rapid and efficient retrieval and temporary storage of information encoded in long-term memory when such information is needed for task performance (Ericsson & Delaney, 1999; Ericsson & Kintsch, 1995). The shift in view from limited to unlimited working memory capacity has implications in the design of instruction for advanced learners who possess more of the necessary schemata (van Gog, Ericsson, Rikers, & Paas, 2005).

In addition, CLT places significant emphasis on schema automization, which is consistent with theories of skill acquisition (e.g., ACT-R, Anderson, Bothell, Byrne, Douglass, Lebiere, & Qin, 2004). Alternatively, while many knowledge and skill structures become automated, expertise researchers maintain that the essential aspects of expert performance remain under the control of the performer (van Gog et al., 2005). The flexible representation of information in long-term working memory supports explicit cognitive processes such as planning, reasoning, anticipating, and self-monitoring. In turn, these explicit processes facilitate current task performance, adaptation, and further performance improvement (Ericsson & Delaney, 1999; Ericsson & Lehmann, 1996).

Expert performance is characterized by "superior reproducible performances of representative tasks [that] capture the essence" of a performance domain (Ericsson, 2006, p. 3). The amount of accumulated experience is not sufficient to develop expertise. Rather, expertise is acquired through deliberate practice, over a period of at least ten years, which may seem like a lifetime to undergraduate and MBA students. Deliberate practice activities are those that are specifically designed with the intention of acquiring and improving particular skills. The types of activities will vary depending on the performance domain and the current knowledge and skills of the performer. However, across domains and skill levels, expertise researchers advocate highly structured deliberate practice activities that involve extensive, repetitive engagement with the same or similar tasks and immediate feedback on performance. Activities are designed to address specific weaknesses, and performance is closely monitored to provide cues for how to improve. Deliberate practice is typically scheduled for a limited time each day, because of the focused effort involved. It is also not inherently enjoyable or rewarding. Motivation must come from incremental performance improvements and the prospect of improved performance over time (Ericsson, Krampe, & Tesch-Romer, 1993).

Deliberate practice activities initially are designed and supervised by instructors and coaches, with additional rehearsal of the activities between instructional sessions (Ericsson et al., 1993). Effective instruction is designed to guide practice in self-monitoring, self-assessment, and the use of feedback (Glaser, 1996). As expertise develops over time, the responsibility for designing deliberate practice activities and the regulation of learning and performance transitions from external scaffolding (i.e., supports) to the learner. Instructors decrease the instructional scaffolding to promote self-regulatory activities such as planning, self-instruction, self-monitoring, generating feedback, self-evaluation, and seeking assistance when needed (Zimmerman, 2002; Glaser, 1996).

Teaching learners to use feedback and to become self-regulating are particularly important in light of research showing negative effects of immediate, frequent feedback on transfer (Bjork, 1994; Schmidt & Bjork, 1992) and of specific feedback on exploration (Goodman et al., 2004; Goodman & Wood, 2004), stimulus variability (Goodman & Wood, 2004; 2009), and explicit cognitive processes (Goodman, Wood, & Chen, in press) that support transfer. Left to their own devices, learners tend to passively follow the advice feedback provides, which interferes with learning processes. Most of the research examining the effects of feedback on transfer suggests that limiting feedback during training aids effective learning and the transfer of the skills required to deal with errors, crises, malfunctions, and other difficulties that may present themselves.

Despite evidence to the contrary, "the more feedback, the better the learning" has become conventional wisdom. Prescriptions for frequent, immediate, specific performance feedback are found in edited academic volumes, journal articles, and textbooks. Some recommendations are inappropriately derived from research showing the positive effects of feedback on performance, although, positive performance effects are by no means guaranteed (Kluger & DeNisi, 1996). Prescriptions typically lack detail on what immediate, frequent, and specific feedback look like in practice. Recommendations also are not qualified by conditions such as cognitive load or learners' processing capabilities and do not consider potential negative effects on transfer-appropriate information processing activities. In the expertise literature, the effects of the various components of deliberate practice have not been isolated, and therefore, recommendations for providing immediate feedback must be qualified. As a rule, when learning is involved, feedback interventions should be designed to promote the cognitive activities that are needed for transfer. Determining the precise content, timing, and frequency of feedback that will promote transfer-appropriate processing will require professional judgment on the part of the instructor. Alternatively, once a skill is acquired, immediate and continuous feedback is useful in fine-tuning expert performance or preparing for presentations, competitions, or other activities that require maximum performance (Bjork, 2009).

Returning to the topic of expertise in general, the research focuses on the cognitive and performance activities of adult experts, the acquisition of expertise through deliberate practice, and comparisons of novices and experts in well-defined domains such as chess, typing, specific sports, military tasks, and medical diagnosis in specific specialties (Ericsson, Charness, Feltovich, & Hoffman, 2006). The research has expanded recently into the more varied work domains of insurance agents (Sonnentag & Klein, 2000) and small business owners (Unger, Keith, Hilling, Gielnik & Frese, 2009).

The objectives of deliberate practice are the same across work settings and the well-defined domains expert research typically examines. Nonetheless, deliberate practice activities in work settings differ because of the nature of the work (Sonnentag & Klein, 2000; Unger et al., 2000). For example, small business management involves a diverse set of tasks, with little opportunity for repetition (Unger et al., 2009), which may not lend itself to the repeated practice of distinct tasks (Sonnentag & Klein, 2000). Deliberate practice in work settings has been found to involve activities such as preparing for task completion; seeking feedback and other information from clients, colleagues, and domain experts; attending formal training sessions; engaging in self-instruction through reading; and tracking data (e.g., sales, inventory), errors, and employee performance (Sonnentag & Klein, 2000; Unger et al., 2000). Knowledge of the types of deliberate practice activities that take place in organizations can help us to prepare our students for generating and engaging in those experiences themselves when they enter or reenter the work world.

Adaptive Expertise

Researchers specifically interested in adaptive expertise distinguish routine from adaptive expertise, based on the work of Hatano and colleagues (Hatano & Inagaki, 1986; Hatano & Ouro, 2003). Routine expertise is characterized by the fast, accurate, automatic, efficient application of highly developed knowledge and procedures to problem solving (Hatano & Ouro, 2003). People expert in routine situations are highly successful with standard problems, but run into difficulties with those that are non-routine. They dismiss or otherwise fail to take into account distinctive features of problems that do not fit their existing understanding, and apply existing knowledge and procedures to problems to which they do not apply (Crawford & Brophy, 2006). In other words, discriminant learning suffers, and people overgeneralize the application of their strategies (Anderson, 1982). For example, in a study of radiologists, Roufaste, Eyrolle, and Marine (1998), found that experts who used deliberate, explicit reasoning to make diagnoses from X-ray images performed better than experts who relied on automatic processes. The distinguishing feature between these two groups of expert radiologists was that the latter were full-time practicing radiologists, while the former were not only practicing radiologists but academic researchers and teachers as well, whose work regularly involved explicit cognitive processing.

The efficient use of highly developed schemata is necessary for expert performance. However, innovation is also essential, and adaptive expertise requires balancing efficiency and innovation (Schwartz, Bransford, & Sears, 2005). Adaptive experts rely on heuristics and routines when appropriate, but recognize when to let go of them, expand their knowledge, and develop and apply new approaches to novel or more complex problems and situations (Crawford & Brophy, 2006; Klein, 2009). Adaptive expertise entails continuous learning through the act of problem solving (Wineburg, 1998). Alternatively, in crisis situations, such as emergency medicine, adaptive experts make fast judgments in real-time based on routine expertise, then reflect on and learn from the experience later in meetings with colleagues (Patel, Kaufman, & Magder, 1996). This type of analysis is also a significant component of the US Army's After Action Reviews following unit-training exercises (Fletcher, 2009), a process that institutionalizes learning from experience. Adaptive experts use meta-cognition, self-regulation, and reasoning to recognize current knowledge limitations, detect important differences between problems, and develop and test hypotheses to identify when current knowledge does and does not apply and to adapt strategies as needed. Adaptive experts perform better than routine experts on complex tasks such as medical diagnosis, technical troubleshooting, and the avoidance of workplace errors and have been found to exhibit superior cognitive flexibility (Crawford & Brophy, 2006).

A number of instructional principles emerge from research in adaptive expertise. Still, research is needed to develop specific guidelines for the application of this body of knowledge (Crawford & Brophy, 2006). Preparing learners for future learning (Branford & Schwartz, 1999) entails embedding opportunities for learners to build and adapt their knowledge and skills throughout their learning experiences. Instruction should be structured so that domain knowledge and efficient routines are developed in conjunction with innovation skills. This can be done by providing opportunities for iterative problem solving, by which students work through assignments in which they engage a task, get or generate feedback, and try again (Crawford & Brophy, 2006). This strategy is consistent with dual space theories of problem solving, which emphasize the role of learners' coordinated efforts for generating and testing hypotheses in fostering rule induction (Klahr & Dunbar, 1988; Simon & Lea, 1974).

For assignments to be effective, learners need to engage in deliberate, explicit reasoning and meta-cognitive strategies. To this end, learners need training in how to effectively use feedback, to counteract the tendency to passively follow the feedback provided. Adaptive expertise research also supports introducing experiences with variability in tasks and conditions, including non-routine problems that require gaining new knowledge and developing and applying new solutions. The innovation skills required for adaptive expertise can also be fostered through interactions with others. For example, medical students accompanying physicians on rounds are asked a number of medical and diagnostic questions that require them to reason independently and listen to and learn from one another (Crawford & Brophy, 2006).

Expert performance tends to be domain-specific (Chi, 2006), although some experts are able to apply their knowledge and skills across domains (Kimball & Holyoak, 2000; Hatano & Ouro, 2003). For example, Barnett and Koslowski (2002) compared the performance of strategic business consultants and restaurant owners on novel problems related to restaurant management. The consultants outperformed the restaurant owners, despite their lack of restaurant experience. Analyses suggested that consultants engaged in more theoretical reasoning, which was enabled by the variety of experiences those consultants had in their work.

Meta-cognitive skills, abstract general reasoning, and critical reasoning are likely influences of within and cross-domain transfer of expertise (Billing, 2007; Kimball & Holyoak, 2000). Reviewing the cognitive psychology literature, Billing (2007) found considerable evidence that instructional design affects skill transfer in higher education. Billing provided a series of instructional strategies to support transfer that are too numerous to repeat here, but are easily accessible in his article and overlap substantially with the strategies we included in the Appendix.

Despite the primary focus on experts, adaptive expertise researchers emphasize that adaptability can be displayed at any stage of skill development, from novices, to advanced learners, to experts. Adaptability is not a matter of the quantity or quality of knowledge acquired, but rather how that knowledge is used to support high-level reasoning processes and problem solving strategies (Crawford & Brophy, 2006). Moving along the continuum toward adaptive expertise is an effortful process that can lead to increased errors and decreased performance during transitional periods occurring throughout learning processes. It is therefore important to foster an innovation mindset early on and adopt the view that errors are beneficial for learning (Bransford & Schwartz, 1999; Keith & Frese, 2008).

Advanced Learning

As noted earlier, cognitive load theory (CLT) research focuses on the early skill acquisition of novice learners, while the study of highly skilled expert performers is the focus of expertise research. A recent attempt to connect the CLT and expertise literatures (van Gog, Ericsson, Rikers, & Paas, 2005) was prompted by CLT findings that instructional methods suitable for novices can be less effective or even dysfunctional for advanced learners (expert reversal effect; Kalyuga, Ayres, Chandler, & Sweller, 2003). However, CLT methods can in some cases be appropriately modified for use with more advanced learners, for example, by instructing learners to engage in self-explanation and envision their next steps (van Gog et al., 2005).

Advanced learners, whose skills fall somewhere between novices and experts, are the subjects of instructional research with medical students (Feltovich, Spiro, & Coulson, 1993). The goals of advanced knowledge acquisition are the deep understanding of complex information and the ability to apply this knowledge to new situations. The flexible use of knowledge requires deep understanding, which is particularly important for applying knowledge in ill-structured domains (Feltovich et al., 1993), such as medicine and management. Educational methods commonly used with novices can impede later advanced learning, partially by reinforcing learners' misconceptions that come from their inclinations to oversimplify complex material. For example, Feltovich and colleagues (Feltovich et al., 1993) found that simplifying strategies such as teaching topics in isolation, presenting common scenarios but not exceptions, and testing for rote memory interfere with advanced learning. This conclusion is consistent with the body of learning research on cognitive and motor skills that has found that conditions of practice that present difficulties for learners can decrease performance during and immediately following training while benefiting retention and transfer. These "desirable difficulties" (Bjork, 2009, p. 314) include providing less specific (Goodman & Wood, 2004; 2009), delayed, infrequent, or summarized feedback; introducing variability by providing experience with a representative sample of tasks and task conditions; randomizing the order of tasks and topics instead of presenting them in a blocked fashion; and spacing over time rather than massing training sessions (Bjork, 1994; Schmidt & Bjork, 1992).

Scaffolding researchers also emphasize the importance of striking a balance between providing supportive structure and "problematizing," by guiding learners into complexities and difficulties that will benefit learning. Supportive structure should provide only enough guidance to avoid undue frustration and confusion and a total lack of progress. Scaffolding should be used to support performance processes that would not be possible without assistance (Reiser, 2004). However, many tutors and instructors do not necessarily provide scaffolding in a way that optimizes independent performance (Merrill, Reiser, Merrill, & Landes, 1995; VanLehn, Siler, Murray, Yamauchi, & Baggett, 2003).

Although most learning occurs when learners experience impasses, tutors often provide guidance and modeling that prevents impasses. When learners make errors, tutors tend to identify them right way and demonstrate how to correct errors, without giving learners the chance to try to correct the errors themselves (Merrill et al., 1995; VanLehn et al., 2003).

VanLehn et al. (2003) concluded that the most effective tutors create opportunities for learners to make errors. They identify errors if learners do not detect them themselves, but allow learners to figure out how to recover from and correct their errors. Effective tutors also prompt learners to explain their errors and identify corrections, and only provide explanations when learners are unable to do so (VanLehn et al., 2003). The conclusions from this research concur with error management training research demonstrating the positive effects of communicating the benefits of errors to learners and providing active exploration training on transfer (Keith & Frese, 2008). The scaffolding literature affirms an important point: instructors often have difficulty stopping themselves from correcting learners' errors.

Contrary to the scaffolding literature and research on advanced learners, the results of some CLT research suggests advantages to decreasing intrinsic cognitive load by beginning instruction with simplified tasks, and then increasing task complexity after isolated concepts have been acquired (isolated - interacting elements approach, Pollock et al., 2002; von Merrienboer, Kester, & Paas, &, 2006;). However, CLT researchers recognize the potential for compromised understanding that can result from task simplification (Pollock et al., 2002). The evidence in favor of integrated instruction (e.g., Feltovich et al., 1993) leads us to suspect that the results of studies of the isolated -- interacting elements approach may be limited to novice learners, and that early simplification could have delayed negative effects on subsequent advanced learning.

Feltovich et al. (1993) presented a series of strategies derived from learning theories and their research that are consistent with the integration of "desirable difficulties" (Bjork, 2009, p. 314) into instructional design. For example, they recommended providing direct challenges to students' misconceptions, clustering related concepts together rather than teaching each in isolation, helping students cope with complexity instead of simplifying material, and engaging students in active cognitive processing. They also provided a number of recommendations for the use of cases, which are particularly relevant for management education. According to Feltovich and colleagues (1993), cases should be used to integrate the learning of knowledge and its application to support the development of reasoning skills. Notably, this type of integrated instruction challenges conventional wisdom that acquiring declarative knowledge precedes procedural knowledge. Feltovich et al. (1993) also recommend using multiple cases and scenarios differing in their surface structure (cover story) and deep structure (applicable concepts, rules, procedures), where the relationships among the cases is emphasized.

Application to Management Education Practices

We now turn to the matter of applying the above evidence to commonly used practices in management education. Our goal is to provide a model for evidence-based teaching practice. In doing so, we hope to inspire the management education community to bring its practice into closer alignment with learning theory and research.

Many commonly used instructional methods in management and business schools were developed and implemented for practical reasons, like efficient delivery of instruction to large groups. Others may have appeared to promote learning but may have drifted away from this focus over time as attention shifted to teaching ratings and school rankings (Khurana, 2007). Others were driven by an objective to promote the active engagement of students in the learning process. This is an admirable objective that is supported by evidence, but whether active engagement moves students along the path to adaptive expertise and supports transfer depends on the design and implementation of specific teaching practices. Unfortunately, common practices appear to have been designed around fragmented, casual knowledge of how people learn, promoted by teaching lore with a hint of evidence built in.

We would like to emphasize at the outset that teaching methods are not inherently evidence-based (or evidence-deficient), *per se*. Rather, whether the practices are consistent with the evidence depends on how instructors design and implement them. For example, the case teaching method can be applied either in an evidence-based fashion that promotes learning and transfer or in a way that is merely engaging and interesting, but does not develop valuable or enduring capabilities. We wholeheartedly agree that, "a challenge facing educational researchers is to discover instructional methods that promote appropriate processing in learners rather than methods that promote hands-on activity or group discussion as ends in themselves" (Mayer, 2004, p. 14). With this goal of promoting transfer-appropriate cognitive processing firmly in mind, we now turn to consideration of widely used management education practices.

Lecture

Lecturing is a customary and enduring form of instructional delivery in higher education. Perhaps the major problem with the lecture is consigning the learner to a fairly passive role as a member of an audience. This method has the added deficiency of providing little feedback to the instructor about students' understanding. Bligh (2000, p.1) cites evidence to argue that the lecture is, "as effective as other methods for transmitting information," but that "changing attitudes should not normally be the major objective of lecture" and that "lectures are relatively ineffective for teaching behavioral skills."

In addition, the exclusive use of lecturing or the sequencing of lectures followed by more engaging activities contradicts evidence that an integrated approach to instruction early on supports more advanced, later learning and fosters transfer (Crawford & Brophy, 2006; Feltovich et al., 1993). We therefore recommend that lectures be combined with other teaching methods in a way that integrates content learning with its application. Short, mini-lectures can be interspersed with cases or other activities. Impromptu mini-lectures also may be prompted by students' direct questions about course material they read or otherwise encountered, as well as by students' misconceptions identified during activities and discussions. This type of lecturing can provide an opportunity to model problem solving processes, akin to a verbal worked example (Renkl et al., 2004) or walk-through, and consistent with social learning theory (Bandura, 1986). We tend to view lecturing as a type of scaffolding that should be used when students have tried and are unable to understand or apply material on their own (Reiser, 2004).

The cognitive load imposed by the content of lectures is a concern. Consistent with cognitive load theory, carefully designed verbal or written worked examples increase germane cognitive load, however, digressions or excessive detail often distract learners and increase extraneous load. In general, we tend to convey too much detail in lectures. This particular error echoes Rousseau's admonition (2009, personal communication) that in the management classroom we perhaps ought to seek to teach less material in better, more skillful ways.

Class Discussion

Discussion is a useful complement to lecture, as it can promote increased engagement among learners while providing feedback on class and individual learning to instructors. It also represents a potentially more open, democratic approach to learning than the lecture, which harnesses the social context of the class to help meet learning goals. Managing discussion can be challenging, as learners may be reluctant to contribute, or may engage in hard-to-integrate digressions. There is a body of literature on techniques for leading discussion, asking questions in ways that promote deeper discussions, and increasing student contribution (e.g., Hill, 1977). For some instructors, it may be difficult to give up apparent control of the learning environment (Tompkins, 1990), out of fear that anarchy will ensue or that learning objectives will be missed.

The value of skillfully facilitated class discussions rests in its encouragement of errors and acceptance of misapprehensions as opportunities for learning and development. This calls for courage on the part of learners, in the face of anxiety about performance and perceived loss of face that many assume accompanies “being wrong.” In management education, neutralizing the fear of contributing to class discussion is an important objective. This allows discussion to serve as an opportunity for risk-taking and the testing of new ideas in a critical but supportive environment.

From an evidence-informed perspective, management educators should ask questions that will allow misconceptions to emerge in discussion and confront them directly and non-punitively, in a way that encourages learning from errors (Crawford & Brophy, 2006; Feltovich, et al., 1993). Further, discussion leaders can contribute to the development of reasoning skills typical of good social science practice by modeling these skills during discussions. They can probe unclear or incomplete responses or contributions, ask for summarizing and integrative comments, provide or prompt for alternative explanations, and expose and address logical flaws and errors. This kind of active, reflective responding in class can be valuable for creating self-directed learning strategies. These in turn may endure and support future learning, consistent with the principles of developing adaptive expertise (Branford & Schwartz, 1999; Hatano & Ouro, 2003). Over time, it is probably also appropriate to fade the scaffolding that instructors provide to class discussions, to transition the responsibility to students (Riser, 2004; Sherin, Reiser, & Edelson, 2004) for initiating the elaboration of points and the productive critique of peer comments.

Thus far, our treatment of discussion practice has focused on matters of form for class discussion. Next we turn to the activities that provide the context and substance for discussion, as discussion is integral to the administration of experiential exercises and case teaching.

Experiential Exercises

Experiential exercises are popular management education activities that involve role-playing, problem solving, or other hands-on activities (e.g., puzzles, building towers). They are readily available commercially (e.g., Dispute Resolution Research Center (DRRC), Kellogg School of Management), featured to varying degrees in textbooks, and published in peer-reviewed sources like the *Journal of Management Education*.

Experiential exercises vary in the degree to which they are grounded in management theory and research. For example, the exercises published by the DRRC tend to be based on negotiation and decision making research, which facilitates the integrative application of theory and research findings in the execution and debriefing of the exercises. However, like anything else, it comes down to how individual instructors use the exercises. For example, the Carter Racing exercise (Brittain & Sitkin, 1986) was designed to expose a number of common decision making process errors (e.g., sampling on the dependent variable, framing decisions as a choice between two losses, escalation of commitment). It was also developed as a context in which learners can practice and develop skills such as effective decision framing, accurate computation of expected values, and prediction using historical data. However, some instructors simplify the exercise to address only one or a small number of the issues (e.g., groupthink) that are represented in this exercise. We see this oversimplification as a missed opportunity to help students learn to deal with the realistic complexity afforded by the Carter Racing exercise. Other exercises and role-plays similarly can be oversimplified, decreasing their value for learning and transfer.

Simplicity is a deliberate feature of other popular exercises, including survival exercises (e.g., Desert Survival) and those involving puzzles or building with children's toys. These types of exercises typically are designed to highlight just one or a small number of points about difficulties coordinating group activities or biases that may occur in team decision making. Although these exercises may address validated concepts, they do not conform to many of the evidence-based teaching principles listed in the Appendix. They present concepts in an isolated manner and often require no more than cursory application of content knowledge to complete the exercise. In addition, the application often comes after the exercise, and is not integrated into the activity itself. These types of activities may be fun and engaging for (some) students. They may also help students to encode a small number of fairly isolated concepts. However, given the class time and effort they require, it is unlikely that they do enough to support complex schema development and to help prepare students for the complex problems they are likely to encounter in later learning or during their organizational lives.

Some popular self-assessment exercises, like the MBTI, color-coded teamwork styles, and learning styles assessments have received conflicting or no support from the research literature (McCrae & Costa, 1989; Pittenger, 1993; Pashler, McDaniel, Rohrer, & Bjork, 2009). Instructors may justify using these self-assessments because of students' immediate, positive affective responses to them or because they believe they facilitate growth in self-awareness. This may be true, but it is not at all clear to us how such an unsubstantiated approach could support the instructional goals we have laid out in this chapter.

We recommend that more complex exercises be used and that their complexity be preserved, as in our Carter Racing example above. In addition, using a series of exercises or an exercise with multiple phases can further promote learning and transfer of domain and meta-cognitive skills. For example, a series of negotiation role-play exercises could be used that require students to iteratively apply overlapping sets of evidence-based negotiation concepts and practices. Between exercises, students should be coached to engage in self-reflection and self-evaluation of their role-play performance, including how well they applied negotiation concepts and practices and what they need to learn and do to improve their application in future role-plays. They should also be required to do an evidence-based analysis of the causes of the conflicts written into the exercise instructions and experienced during the role-plays. These activities can help to maximize the impact of the exercise on learner meta-cognition, setting the stage for future learning and practice.

If properly designed and implemented, exercises also afford the opportunity to explicitly teach learners how to collect and interpret feedback from multiple sources, including observations of themselves and peers during the exercise itself and after-action feedback from peers and instructors. To promote schema development, exercises should be set-up and debriefed to capture and contextualize learning and identify problems and unresolved issues. Instructors should also seek to collect and analyze data to validate what was learned and support evidence-based refinement of exercises over successive administrations. These supporting structures for exercises promote deeper, more mindful engagement with the exercises on the part of both learners and instructors.

Our recommendations are consistent with deliberate practice activities (Ericsson et al., 1993) in that they are structured, monitored, and involve repeated engagement with similar tasks. However, the limited time and other resources typical of educational settings often restrict the ability to provide the individualized design and guidance, intensity of practice, and amount of repetition recommended by Ericsson and colleagues (1993).

<u>Cases and the Case Teaching Method</u>

Cases typically describe a real or realistic organizational situation, from the point of view of a particular manager, other employee, or set of actors. The business cases typically used in management education usually include problems that need to be solved and decisions that need to be made. Cases can take several forms including written accounts, video depictions, computerized interactive simulations, and multi-media formats. We typically think of written cases as being fairly long, like those published by Harvard, Ivey, Darden, and others. However, broadly conceived, cases also include short scenarios that are readily available in textbooks or may be written by instructors for specific purposes.

The appeal of cases for management education may rest in part on their narrative structure, as well as the knowledge that cases often are drawn from actual managerial practice "in the wild," frequently including recognizable companies and products. Yet from an evidence-based management perspective, cases may also be exemplary platforms for the discussion of the judgment and expertise of practicing managers and the integrative application of management theories and concepts.

The case teaching method is an overarching strategy for management education originally based on practice at Northwestern University's Kellogg School of Management and the Harvard Business School. This method of instruction relies on the use of cases in class settings in which learners discuss the elements of the case to develop a recommended course of action for the decision-makers depicted in the case. In the Harvard Business School construal of the case method, instructor intervention is minimized and limited to discussion facilitation. There are a number of sources that address strategies for teaching written cases along these lines (Mauffette-Leenders, Erskine, & Leenders, 2003), as well as materials for students on how to learn from cases under this approach (Ellet, 2007). The authors have experience with this approach from the perspective of having attended the case discussion leadership workshop at Harvard Business School and the case teaching workshop at the Ivey School of Business.

The traditional case teaching method has both advocates (Christensen & Carlile, 2009) and critics (Shugan, 2006; Chipman, 2009). Shugan (2006) asserts that "… the traditional case method of teaching often ignores important research findings…. Students lose the benefit of important research findings while leaving the classroom with false confidence about what they know" (p. 109). In contrast, Erskine, Leenders, and Maufette-Leenders (2003) are fairly adamant about the central role of relevant theories and concepts to the case method of teaching. To this end, case teaching notes often contain relevant references, and students may be assigned supplementary readings in parallel with cases. In practice, this may be a matter of execution, as instructors vary in the emphasis they place on theory. Although neglect of theory is a potential pitfall of the case teaching method, it is not necessarily a property of the method *per se*. In addition, Shugan (2006) cites Argyris (1980) in arguing that it may be more accurate to describe case teaching methods, rather than method, because there is variance in case-teaching practice across and even within individual instructors and universities.

Like experiential exercises, cases vary in the extent to which their design supports the application of management theory and research to practical problems. We regularly have to read through dozens of commercially available cases before finding one that is consistent with this criterion. In addition, cases tend to be written in a way that encourages a bias toward action, which may support learners' tendencies to engage in superficial causal analysis in favor of reaching the specific goal of quickly choosing a solution. Also, few cases implicitly favor a solution that defers action, argues for more time for the situation to develop, or requires more or better data, despite the consideration that these responses may be legitimate under particular circumstances.

Using Cases to Integrate Theory and Practice

Some cases lend themselves very well to integrating the acquisition of evidence-based knowledge and its application to practice. For example, Vista-Sci Healthcare Inc. (Gandz, 2004) provides the opportunity to apply evidence regarding person-job fit, in terms of personality, values, and competencies, in the context of a personnel promotion decision. The *Rogers Cable: First Time Right Program* (Martens, 2007) case lends itself to evidence-based causal analysis about performance problems, as well as the development of evidence-based solutions for job design and reward systems. The *Overhead Reduction Taskforce* (Wageman & Hackman, 1999) case combines written background information with a video case that depicts a team running into a number of difficulties as they work on a two-week project. The case was designed around recommendations for the effective design and leadership of teams derived primarily from Hackman and colleagues' program of research. During class, the video is stopped at various critical points in the team's work, and analysis centers on evaluating the team processes and performance, diagnosing the causes of the problems experienced, and developing recommendations for solving and preventing problems. The case has many evidence-based practical lessons for learners to use in their course project teams and other current and future teams, such as agreeing to ground-rules early in the team's development and engaging in team reflection and self-assessment during and following teamwork. The case is also useful for creating an appreciation for the need for team contracts, which student project teams can prepare after the case.

Using Cases o Promote Evidence-Based Causal Analyis

The use of cases can be enhanced further by designing instructions and case preparation questions that focus on evidence-based causal analysis prior to solution generation and leading case discussion and simulation execution along these lines. This approach is consistent with the recommendation to provide non-specific goals (i.e., figure out the causes), which promotes working forward through the case, instead of backward from a specific goal (i.e., identifying a solution), in support of schema construction and transfer (Sweller, Mawer, & Howe, 1982).

For example, *The Managers Workshop* (Dunham, 2004) is an interactive computer simulation that provides the opportunity to increase understanding of motivation (e.g., expectancy, equity) and attribution theories in the context of managing five poorly performing sales representatives. On the surface, the five employees have similar performance problems, but the underlying causes are different. Students have a tendency to make their management decisions based on “common sense” or trial and error and then working backward to figure out what went wrong. To counteract this tendency and support schema construction and transfer, instructors should assign the non-specific goal of determining the causes of the performance problems and basing managerial actions on those causes, while steering students away from outcome goals (e.g., to reach sales goals, to solve the problem by firing or otherwise punishing an employee) they may set for themselves. In addition, monitoring and guidance are needed to prompt students to choose managerial actions on the basis of the relevant theories as they interact with the simulation. This will help students learn to correctly interpret the reactions of the sales representatives (i.e., feedback) to their management decisions. This is consistent with guided-exploration strategies advocated in the organizational literature (e.g., Debowski, Wood, & Bandura, 2001). The guidance should be faded as learners begin to monitor and manage their own performance strategies (Reiser, 2004) by keeping track of their own performance processes, engaging in self-evaluation, carefully interpreting the feedback from the simulation, and planning and responding in more mindful, evidence-informed ways. Through the repeated use of this simulation, we have observed that students have an easier time managing the employees when they do the extensive cognitive work involved in engaging in evidence-based causal analysis in the process of working through the simulation. This may decrease the extraneous cognitive load associated with the trial and error approach and increase the germane load associated with using productive strategies (Sweller et al., 1998). It is also represents the coordinated efforts between hypothesis development and testing that supports rule induction (Klahr & Dunbar, 1988; Simon & Lea, 1974).

Using Short or Miminal Cases

Transfer-appropriate processes also can be supported with short case scenarios that depict problem situations. For example, textbooks and other sources often include a series of conflict scenarios (as well as scenarios on decision making, leadership, and other topics) that vary in length from a few sentences to a couple of paragraphs. All of the scenarios incorporate some sort of organizational conflict, but they differ in terms of the circumstances and parties involved and the underlying causes of the conflict. Using an assortment of brief scenarios that vary in their surface features and deep structures can be useful for learning to distinguish important from irrelevant features of problems. This sort of stimulus variability supports discriminant learning of the circumstances under which different responses apply and do not apply (Anderson, 1982) and the development of “more elaborate and flexible mental representations” (Ghodsian, Bjork, & Benjamin, 1997, p. 83) characteristic of adaptive expertise (Crawford & Brophy, 2006; Feltovich et al., 1993). It is also consistent with recommendations for engaging in deliberate practice to support the development of expertise (Ericsson et al., 1993). Explicit discussion and acknowledgment of similarities and differences in surface and deep structures of problems would further support the learning process.

No matter what case formats we choose, we ought to use cases that illustrate exceptions as well as those that are prototypical, in the interests of promoting deeper reasoning and less reliance on superficial or commonsensical strategies for problem solving. We should also emphasize relations across cases, as well as other examples that were given by the instructor and students over the course of the semester, to promote connections across course topics, the development of more-elaborated schemata, and deep learning (Feltovich et al, 1993).

Call for Additional Cases

Overall, we recommend that case writers, course developers, and instructors explore ways to better integrate theory and practice in the cases they construct and adopt. In addition, it would be valuable to have some exemplary cases that depict managers using the same analytic processes we seek to instill in our students. These could serve as worked examples or models of expert practice. For example, the *Gary Loveman and Harrah's Entertainment* (Chang & Pfeffer, 2003) case provides a model of a manager using data to make decisions, which is consistent with the principles of evidence-based management. These types of cases can be further enhanced by depicting managers applying and integrating relevant organizational research into their decision making processes.

The development of such cases would facilitate the fading of worked examples, with each successive case requiring more analysis on the part of the student. For example, a complete exemplar could be provided with the first case, including problem identification and representation, causal analysis, and analysis-based solutions. The second case would provide a model for problem identification and causal analysis, but leave the analysis-based solution identification to the students. The third case would provide a partial model of the causal analysis, and so forth.

Projects

Projects, especially team projects, are commonly assigned in management courses. The same types of instructional practices we have been describing all along can be applied in the design of projects. Students can be assigned to choose a company to work with or a situation presented in the business press, identify and define problems, engage in evidence-based analysis of the causes of problems, and develop analysis-based, practical solutions. As with formal cases, the causal analysis would rely on evidence from organizational theory and research. This could be supplemented with data collection, when students are working with companies on current problems. Instruction, feedback, and other guidance provided to learners over the course of their projects should be designed to encourage deep cognitive processing relative to the company's problems and self-monitoring, self-evaluation, and self-instruction on the part of the learners. Projects can also be used to support iterative problem solving, by which students perform part of the project, receive appropriate feedback, and make revisions before moving on to the next part of the project. Instructor-provided feedback should require reflective action on the part of the learner, and students should be required to use the feedback for continuous learning and project development.

Consecutive projects or the use of cases followed by projects can be used to fade scaffolding. For example, in the *Manager's Workshop* simulation, students could be told which theories and concepts apply to the management of the sales representatives. In a subsequent project, students could be required to identify applicable theories and concepts on their own, with appropriate guidance only when necessary.

Group projects also present an opportunity for students to learn to work in and manage teams. In organizational behavior courses, students can directly integrate what they are learning about research on team processes with the application of this research to their current project teams. For example, the

Overhead Reduction Taskforce (Wageman & Hackman, 1999) case, discussed earlier, along with relevant assigned readings (e.g., Hackman & Wageman, 2008; Wageman, Fisher, & Hackman, 2009) are useful for introducing teams research, demonstrating the importance of effective team design and management, and encouraging students to manage their teams in accordance with lessons from teams research. In future courses, instructors can remind students of the lessons learned from teams' research and reinforce application of these lessons in new project teams.

Challenges Associated with Evidence-Based Teaching

The challenges associated with the successful implementation of evidence-based teaching come from the nature of our subject matter, the institutions and systems in which we work, our students and colleagues, and finally ourselves. Misconceptions and partial understandings about learning processes and effective teaching practices present significant challenges. They may be the result of inadequate teaching training available for doctoral students and faculty and may be reinforced by the resources commonly used for information on teaching strategies and classroom activities. "Teaching tips" of dubious value may be handed down through generations of faculty, published in newsletters or online, or presented by well-meaning colleagues whose teaching is highly rated by students or who have authored popular textbooks. The tendency to rely on such sources is exacerbated by those who see teaching activity as a trade-off against time that could be spent engaged in research. Unfortunately, some of these erroneous beliefs are reinforced in the academic and practitioner literatures. For example, the provision of performance feedback (Goodman & Wood, 2004; 2009) and setting of performance goals (Burns & Vollmeyer, 2002; Vollmeyer & Burns, 2002) are two significant areas of common misconception that can lead to ineffective teaching strategies.

Even armed with accurate information, faculty members may be unwilling to incorporate "desirable difficulties" and other lessons from the learning literatures because of direct and indirect, real and perceived pressures from their universities and students. It is common practice to use student course evaluations as the sole measure of teaching effectiveness and for these assessments to be used for raise, promotion, and tenure decisions. Unreasonable demands from students for limiting ambiguity, decreasing their workload, making assignments and exams easier, and giving them high grades are often hard to resist, even for those of us who know better. The situation is further complicated by evidence that some instructional strategies that support transfer are likely to have a negative impact on proximal performance (Bjork, 1994; Schmidt & Bjork, 1992), and instructors are likely to encounter resistance from students whose grades suffer. These and other pressures likely contribute to too much "hand holding" in the form of overly structured assignments and providing detailed PowerPoint slides, notes, and study guides that decrease the cognitive burden on students, while simultaneously limiting their learning and preparation for future learning. Even without student pressures, it is difficult to withhold immediate responses to errors and consistently promote students' deep cognitive processing, as the scaffolding literature has demonstrated (Merrill et al., 1995; Van Lehn et al., 2003).

Many of these pressures could be alleviated with cross-curriculum coordination. Ideally this would involve all university courses, within and outside of management, adopting evidence-based teaching strategies and focusing efforts on building general cognitive capabilities, such as meta-cognitive and critical reasoning skills, in the contexts of their domains. It would also require professors from various disciplines to learn about other disciplines and emphasize to their students the similar problem solving skills and processes across disciplines. There is precedent for this in the communications field, where "writing across the curriculum," an approach that considers the importance of writing across disciplines, has informed thinking and practice in undergraduate education and curriculum development (Cosgrove & Barta-Smith, 2004).

Another challenge stems from a belief among some management researchers that they do not have much to contribute to practice. The consequence of this mistaken belief is that instructors may elevate applied experiences and the views of executives above research-based knowledge, rather than taking advantage of the benefits of careful integration of knowledge from these sources. Instructors may treat theories and their associated research results as information students need to "know," rather than something they ought to understand deeply and learn to apply. We believe these approaches undervalue the applicability of management theories and research, oversimplify complex information and processes, and reinforce the instructional separation of more complex domain knowledge from practical skills. Management academics should be heartened by findings like those of Roufaste et al. (1998) that demonstrate that the deliberate, explicit reasoning that academics commonly use in their work is beneficial when applied to organizational practice.

Textbooks that include discrete "theory" chapters and "practice" chapters also exacerbate this separation between research and practice. For example, the topic of motivation is often presented in two separate chapters, with one chapter including expectancy, equity, and other theories of motivation, and another chapter covering options for reward systems, job design, and other techniques. The latter are typically based on research, but an artificial distinction is made between foundational theories and applied research and practice. This disjunction does little to facilitate the skilled application of theories and gives the false impression that theory-based research and practice are distinct concerns for distinct constituencies. Also, questions identified as "application" items in test banks often have little to do with the application of theory. Instead, they tend to assess rote memorization of terms associated with particular techniques and questions about the effectiveness of the techniques as drivers of performance, motivation, and job attitudes. This supports the partial and rather superficial integration of the acquisition of domain knowledge and its application. In keeping with the learning literatures, a comprehensive and deeper integration is called for.

The content and structure of textbooks, especially for survey courses, may contribute to an apparent tendency to cover a large number of topics and a large number of concepts, theories, and practices, within each topic. In addition to a sizable amount of evidence-based information, textbooks also typically include popular, but unsupported theories (e.g., Maslow's needs hierarchy, Situational leadership theory), concepts (e.g., Goleman's version of Emotional Intelligence), and assessment instruments (e.g., MBTI). (See Pearce, this volume.) These are occasionally treated as though they are evidence-based or presented as useful despite the acknowledged lack of evidentiary support. In other cases, the lack of research support is pointed out to students, but students often miss the point. Reaching our instructional goals may require paring down the number of topics, concepts, theories, and practical applications to better balance depth of learning and breath of coverage, manage cognitive load, and ultimately support transfer.

Our goals of preparing students for future learning and promoting the transfer of skills to their future work environments are likely impeded by common instructor and course assessment practices. The assessment of educational achievement tends to occur during and immediately following a course, which can confound transient effects of instruction with more permanent learning effects (Schmidt & Bjork, 1992; Wulf & Schmidt, 1994). Transient effects are sustained by the supports provided during instruction. They do not persist with the removal of supports and do not transfer across time or changing task and contextual conditions. True learning effects are more enduring and resistant to the removal of supports and changes in context and task characteristics (Christina & Bjork, 1991; Schmidt & Bjork, 1992).

Assessing former students' use of course material in their jobs presents obvious practical difficulties in terms of assigning grades upon course completion, accessing job performance data, and validly assessing relevant job performance. Nonetheless, our assessments of student learning need to be improved to better support our educational goals. First, instead of separate tests or test items that assess the retention of declarative knowledge, we can give assessments (i.e., exams, case write-ups, simulations, projects) that evaluate the ability to apply knowledge to real or realistic organizational problems. Correct responses would be indicative of a combination of knowledge acquisition and the ability to apply the knowledge, which is consistent with recommendations for integrated instruction (Crawford & Brophy, 1993; Feltovich et al, 1993; Reiser, 2004; Simon & Lea, 1974). For example, students could be given scenarios and asked to make evidence-based judgments about the causes of problems, and then to identify suitable solutions given those causes. The scenarios would be designed to differ from one another and from those presented during instruction in terms of both surface and deep structures. Learning would be assessed on tasks that differ from those encountered during formal instruction, with minimal guidance, and, if possible, separated in time from initial instruction (e.g., later in the semester, during finals week). However, the time between instruction and assessment may be more important for retention tests than for assessments of transfer to modified tasks (Ghodsian, Bjork, & Benjamin, 1997).

A shift in focus from summative (i.e., grades) to formative assessment with purely developmental purposes would also support reaching our instructional goals. This shift could facilitate refocusing students from outcome goals (e.g., "I want to get an A.") to the processes of learning (e.g., "I want to understand and develop adaptive skills."), which could benefit transfer. Of course, the prospect of eliminating formal grades is unrealistic at most universities. Nevertheless, simulations and projects that allow for experimentation and revision, with suitable levels of guidance and developmental feedback, could be incorporated into the design of courses. However, there are continuing concerns for the time required to evaluate and reevaluate students' work, a lack of help from qualified (or any) teaching assistants, and the possibility that many students will persist in their focus on grades.

An additional challenge is the fact that the management domain is not clearly defined. This may be due to the domain's permeable and fuzzy boundaries. Much of the expertise research is done in complex, but well-defined domains, with clear boundaries, such as chess and sports. In addition, management is not a profession in the same sense as medicine or accounting. There is no formal set of professional standards or comprehensive set of identifiable responsibilities. At this point, we do not know what a true management expert looks like, and there are currently no objective ways of identifying management experts. The field would benefit from identifying management experts and using knowledge elicitation methods (Ericsson, 2006; Hoffman, Crandall, & Shadbolt, 1998) to study their knowledge and skills. The processes involved in the development of management expertise also should be examined, including the deliberate practice and other instructional strategies used as learners progress from novices to advanced learners to experts. Information about the domain knowledge needed by management experts and effective (and ineffective) developmental methods and processes would be valuable input for instructional design.

Finally, it is unrealistic to expect business students to search through, read, understand, and figure out how to apply the academic management literature at the same level as academics who regularly consume and perform research. (See Werner, this volume.) In addition, many universities withdraw library privileges upon graduation, so even if graduates had the skill and motivation to search and use the literature, access would be an issue. Having a large body of systematic reviews, available free of charge in accessible on-line locations would certainly be advantageous (Briner, Denyer & Rousseau, 2009). In the meantime, we can use evidence-based teaching principles to help our students gain content knowledge from imperfect textbooks and other sources, to evaluate the merits of this knowledge, and to develop their problem-solving, critical reasoning, and meta-cognitive skills in the context of applying the knowledge to management problems. Along the way, we can help them to gain an appreciation for systematic thinking regarding management problems and for the applicability of management research to management practice. We can require students to use some academic research articles in their practical research projects, providing guidance as needed. We can also encourage them to practice their skills in their work, school, and volunteer activities; show them how to distinguish between resources that are largely opinion-based and those that are primarily evidence-based (e.g., academically-oriented books, journals, and annual review journals; the more evidence-based practitioner journals), and point them to some evidence-informed resources that may be helpful to them in the future.

Conclusion

Theory and research findings from cognitive and instructional psychology and education can help us develop evidenced-based instructional strategies for management education. We refer readers to the Appendix for descriptions of a number of instructional strategies derived from these theories.

Evidence-based teaching has the potential to promote processing in learners that leads to better transfer of skills and knowledge to the workplace and contributes to the emergence of adaptive expertise. We also anticipate possible supplemental effects, along the following lines. When future and current managers observe and experience the consistent modeling of evidence-based teaching practices in their professional education, they will be well-positioned to adopt and adapt those practices in support of the learning and development of others. In this way, the evidence-based teaching practices we use may have indirect benefits for other organizational members, above and beyond the principal benefits for instructors and learners that we address in this chapter.

If you seek to adopt evidence-based teaching strategies in your own practice, the chapter and Appendix suggest a myriad of things you can do, right now. Foremost among these may be recognizing that this path will likely be difficult, because of various current institutional arrangements, as well as the fact that much of what we suggest here calls for a trade-off of short-term advantages for the benefits of deeper learning, improved transfer of training, better preparation for practice (including future learning), and improvements in skills related to meta-cognition and critical thinking.

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Appendix

Overview of Evidence-Based Instructional Strategies

Instructional strategy	**Description**	**Mechanisms**	**Literature sources & implementation issues**
1.Fading worked examples	• Model protocol shows the steps taken to complete a problem. • Critical features are annotated to show what the steps are intended to illustrate. • Start with complete worked example (including the final solution), then sequentially remove solved steps (backward or forward) in subsequent	• Decreases extraneous cognitive load compared to conventional problems (where students start out solving whole problems, and use means-end strategies) to free resources for schema building around understanding and learning procedural steps, in the context of the whole task. • Fading helps students to experience impasses on parts of problem they work	• Literature source • CLT (worked example and completion effects) • Issues and proposals • Possible issues with generalizability from the task domains examined (e.g., algebra, statistics, computer programming). • Calls for a library of

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
	worked examples to progressively give the learner responsibility for problem-solving. • Later problems are solved by learners in their entirety.	out themselves, and prompts self-explanations. • Additional prompting or instruction on self-explanation may be needed to ensure that freed cognitive resources are being used to promote understanding. Fading helps this, but also need to make sure the worked parts of the example are being properly studied.	examples, annotations and protocols. • Takes time to administer this approach. • Instructors need to ensure that freed-up cognitive resources are applied to understanding. • Can give students a scenario and model (verbal, written, demonstration) how it should be solved (where and how to

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
			gather information for causal analysis, how to draw conclusions, how to develop cause-based recommendations). With successive scenarios, give students responsibility for performing more and more steps.
2.Non-specific goals	• Provide a general goal for a problem (e.g., identify causes of problem; find as many variables as	• Novices use means-end analysis to solve problems because they do not have the schemata needed to work forward.	• <u>Literature sources</u> • CLT (goal-free effect) Dual process theory for rule

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
	possible) instead of describing the desired end state/specific goal (e.g., reach a specific performance level; solve for X).	• Specific outcome goals increase the use of means-end strategies. Means-end is an efficient strategy for reaching a solution, but it does not promote schema construction. • Providing a general goal decreases the cognitive load associated with means-end strategy, freeing resources for schema construction as learners focus on the problem states and the processes that move them forward. • Less specific goals also support	induction Educational psychology • Issues and proposals • As in (1) above, generalizability from task domains studied may be an issue. • In management education, can ask open-ended questions; avoid setting page limits; use ambiguity strategically to promote exploration of problem space, consideration of

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
		systematic exploration, but some learners also need direct instruction for how to systematically test hypotheses.	assumptions, and creative responding. • Students may become anxious about performance when expectations are not directly and unambiguously described. • It may be helpful to adopt a managerial frame of reference, telling students that managers proactively identify and solve problems

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
			without explicit direction or supervision.
3.Interacting elements	• When concepts are interdependent, teach them together. • Emphasize their connections, interdependence, and variance in how they interact across contexts. • Instead of simplifying material, help learners to cope with complexity.	• Focusing on concepts in isolation gives the false impression that they are independent and facilitates learners' tendency toward oversimplification. • Integrated instruction promotes understanding of individual concepts and how they interact. • Task simplification that benefits novices' learning initially can hurt them later, during more advanced learning.	• Literature sources • Advanced knowledge acquisition • Adaptive expertise • Issues and proposals • This strategy imposes high cognitive load. Novices and possibly advanced learners will likely need support for coping with the

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
			complexity. Strategies such as providing written and modeled worked examples may provide the support needed for schema development for complex tasks. • Further research may be required in the management domain, where multivariate interactions are a likely domain property.

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
4.Deliberate practice	• Design tasks for practicing the essential skills needed in performance domains that address the specific weaknesses of the learner. • Activities are highly structured and closely monitored and involve extensive, repetitive engagement with the same or similar tasks, and immediate feedback on performance.	• Increases LT-WM capacity, supports the acquisition of structures for domain knowledge and procedures, promotes flexible performance within a domain, and supports the meta-cognition and self-regulation needed for independent performance. • Expertise research does not address feedback's mechanisms, possible negative effects on transfer, differential effects of various sources (coach v. naturally occurring	• Literature source • Expertise/expert performance • Issues and proposals • The issue of immediacy of feedback is important. There is a distinction to be made between preparing for a situation requiring maximal performance or refining existing skills vs. acquiring a skill in the first

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
	• Promote meta-cognition and self-regulation by guiding practice in self-monitoring, self-assessment, the use of feedback, the self-generation of feedback for self-evaluation, planning, self-instruction, and seeking assistance when needed. • Instructional scaffolding is decreased over time.	feedback), or different needs for different levels of expertise. The immediate feedback recommendation needs to be qualified.	place. • Expertise requires skill in interpreting one's own performance and integrating feedback from multiple sources. • Expert performance is a long-range objective, and management education typically does not have the resources to implement this approach fully. • However, some

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
			elements can be applied, particularly the purposeful development of activities to promote learning and independent performance and guidance for developing self-regulatory skills.
5.Performance feedback	• Provide less specific, delayed, infrequent, and/or summarized feedback.	• Limited feedback tends to decrease performance during and following training, but promotes long-term retention and transfer. • Prepares learners for	• Literature sources • Cognitive and motor skills learning • Organizational behavior • Issues and

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
		independent performance, without the aid of instructional supports. • Provides opportunities to make errors and to learn to recover from and to prevent errors. • Less specific feedback promotes exploration, explicit cognitive processes, and stimulus variability.	<u>proposals</u> • This is a substantive issue in management education, where much of learner performance on reports and exams is evaluated and detailed feedback may be provided, without the opportunity for learners to revise their work and demonstrate that they have

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
			reacted appropriately to feedback. • There are motivational overtones here, including the problem of feedback-seekers' expectations for uniformly positive feedback and reinforcement. • There is a need to make sure learners can handle the "desirable difficulties" from feedback

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
			or other sources, or this strategy may backfire.
6.Training scheduling	• Space practice sessions out instead of having massed, bunched training sessions. •	• Provides more opportunities for elaboration and schema construction.	• <u>Literature sources</u> • Cognitive and motor skills learning • <u>Issues and proposals</u> • Suggests that class preparation might be best done earlier than immediately before the relevant class. • Instructors can use “forcing devices” like

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
			required submission of intermediate products and peer review to prevent cramming and last-minute work.
7.Stimulus variability	• Design training tasks to provide experience with a representative sample of tasks, task conditions, and analogies. • Introduce variability in problem/task dimensions by varying the features of the	• Assists with schema construction because it gives learners opportunities to identify similar features and distinguish relevant from irrelevant features. • Increases germane cognitive load, and has positive effects on transfer to novel	• Literature sources • CLT • Associative and discriminant learning • Cognitive and motor skills learning literatures • Organizational behavior • Advanced

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
	task itself (e.g., complexity, underlying rules/structure, surface features, routine and non-routine problems), how the task is presented, and the context in which the task is performed.	problems not encountered before. • If extraneous load is high, it should be decreased because variability adds to the total load. • Tends to decrease performance during and following training, but promotes long-term retention and transfer. • Prepares learners for independent performance, without the aid of instructional supports. • Promotes elaboration, explicit cognitive processes, and discriminant learning.	knowledge acquisition • <u>Issues and proposals</u> • Addresses problem of students anchoring on single, vivid examples, or seizing on the surface features of an example. • This approach might seem repetitive, but it likely will deepen understanding. • Supports consideration of exceptions and

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
		• Provides opportunities to: ○ make errors and to learn to recover from and prevent future errors. ○ experience and distinguish problems that differ in terms of their surface and deep structures. ○ experience various aspects of a concept to limit misconception	atypical circumstances as well, which may reflect deep principles (e.g., Manager's workshop discussion in the text).

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
		s.	
8.Task sequencing	• Randomize the order of various tasks and topics instead of presenting them in a blocked fashion where one skill or topic is presented before moving onto the next.	• Tends to decrease performance during and following training, but promotes long-term retention and transfer. • Prepares learners for independent performance, without the aid of instructional supports. • Provides opportunities to make errors and to learn to recover from and prevent future errors. • Promotes elaboration, explicit cognitive processes, and discriminant learning.	• Literature sources • Cognitive and motor skills learning • Advanced knowledge acquisition • Issues and proposals • On the surface, this would be challenging to implement, as normative expectations for task learning are linear over time, and disrupting sequences is

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
			"heavy lifting," cognitively speaking. Worked examples, scenarios, and cases that begin in the middle of a process and require learners to proceed iteratively can take advantage of the principle.
9. Address learners' misconceptions	• Determine what misconceptions learners have or typically have in the domain (diagnostic component) and directly challenge	• Directly addresses incorrect mental models that are often implicit, including private theories about how the world works. • Makes mental models explicit and	• <u>Literature sources</u> • Advanced knowledge acquisition • Educational psychology • <u>Issues and</u>

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
	them (prescriptive component). • Also, have students provide self-explanation and focus on trying to reconcile conflicting information.	encourages students to think about their knowledge and what they may have to unlearn.	proposals • Test pre-existing beliefs about counterintuitive management issues using instruments designed for this purpose in the management/OB domain (e.g., McShane & Von Glinow, 2010; Rynes, Colbert & Brown, 2002) • Expose implicit theories and invite learners to test them in light of

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
			observed facts. • Consider how faulty or deficient theories emerge and are propagated, and the perils of commonsensical approaches to management analysis and social scientific reasoning (Stanovich, 2007).
10. Integrate the acquisition of content (declarative) and procedural	• Design instruction to engage learners in acquiring declarative knowledge (the what)	• Integration promotes the development of reasoning skills and deeper understanding. • It also provides opportunities to	• <u>Literature sources</u> • Advanced knowledge acquisition • Adaptive

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
knowledge (application)	simultaneously with procedural knowledge (the how) by integrating instruction on concepts with their applications. • Provide examples that couple abstract principles with applications.	actively engage learners earlier in the learning process. Integration supports rule induction by promoting the coordinated movement back and forth between generating and testing hypotheses about concepts, processes, and cause-effect relationships. Separating skill acquisition into declarative and procedural stages can limit more advanced learning.	expertise. • Dual space theories of rule induction • Scaffolding • Issues and proposals • This principle is applicable to various case formats and projects. Students would be required to identify and define problems, engage in evidence-based causal analysis (using evidence from

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
			organizational theory and research), and develop analysis-based, practical solutions. • Media sources could be used to demonstrate abstract principles in organizational contexts. • Systematic rule induction and reasoning principles may impose less cognitive load for management students when

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
			embedded in work and organizational problems.
11. Articulation and reflection	• Design activities that require students to reflect on and articulate how they performed a task, what they learned, opportunities for future learning, and strategies for correcting errors. • Have students articulate their misunderstandings and engage in self-explanation.	• Promotes meta-cognitive processing, self-monitoring (e.g., of misconceptions, comprehension), self-evaluation, and planning.	• Literature sources • Adaptive expertise • Scaffolding • Issues and proposals • Articulation and reflection may be naturally difficult for students, and they may need to be taught how do perform these tasks in productive ways.

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
			• One way to do this might be to have the students interview each other about an activity or experience, using probes to elicit more elaborated, reflective responding. There is some skill-based discussion of this in Whetten and Cameron (2007).
12. Interactions with others	• Design activities that require learners to work	• Promotes reasoning and adaptation of knowledge and skills.	• Literature source • Adaptive

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
	with one another on interdependent tasks or assist one another on individual tasks. • However, just putting people together does not guarantee learning. Activities need to be structured, for example, by assigning discussion questions and requiring students to share their products with the class. • Students can easily get off track		expertise • Issues and proposals • This principle is a good fit for organizational behavior courses that cover team processes. • Explicit discussion and cases that demonstrate the common pitfalls of teamwork (e.g., free-riding, conflict) can be used. Student project teams can be required

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
	and discuss unrelated things. • Students also need instruction and other guidance for managing team processes and coordinating teamwork.		develop of preventive measures (e.g., team contracts, enabling team structures) and remedies (e.g., social accountability, rules for norm enforcement). • Instructors can model appropriate behaviors and help set appropriate norms for the class.
13. Scaffolding and fading scaffolding	• Decrease the support provided to learners as they	• The initial scaffolding supports performance processes that would	• Literature source • Scaffolding

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
	develop the capability to perform various aspects of the task on their own.	not be possible without assistance. • Scaffolding can be used for actual task performance and to provide an organizing structure for planning and monitoring, which can be difficult for students. • Fading promotes gradual independence, based on the readiness of the learner.	• Issues and proposals • Fading is important, because learners may become dependent on the scaffolding. • This may be most applicable to one-on-one instruction, or during meetings with individual students or teams, because it requires diagnosis of current knowledge and skills, which would be

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
			difficult in the classroom in real-time. • Fading can be used with a sequence of cases or projects in which students are given increasing responsibility for each case or project in the sequence. • In addition, structured formats can be provided for early assignments, which incorporate

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
			planning and self-monitoring tasks. This scaffolding can be decreased on subsequent assignments, so that students are expected to plan on their own and self-monitor. • The risk here is that some students will not be ready for or will resist taking on the additional responsibility.

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
14. Guided exploration/ discovery	• Systematic guidance is provided to support constructive cognitive activity, with enough freedom for the learner to actively engage in the sense-making process. • There are many different options that are often combined in studies, so it is not possible to isolate their effects. E.g., Provide an organizing structure for the	• Pure discovery, with no guidance, can lead to impasses that novice learners cannot get past. • Also, learners may not gain experience with important concepts and rules, because what learners come into contact with depends on how they explore. • Alternatively, providing too much instruction can hurt adaptive transfer. • Limited guidance helps to focus cognition and task behaviors and develop meta-cognitive skills.	• Literature sources • Educational psychology • Organizational behavior • Issues and proposals • This approach requires students to assume responsibility for their learning, which among novice learners, may call for some persuasion or "selling" on the part of the instructor.

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
	task, a general task strategy (leaving learner to figure out specific actions), hints, direction, coaching, modeling, and reminders to keep the learner on track. • Provide meta-cognitive instructions that prompt learners to articulate goals, generate and elaborate on ideas, and strive for mastery and deep understanding.		• Students who are naturally or have been conditioned to be intolerant of ambiguity will likely struggle. • These manifestations of resistance may be useful in themselves, in that they provide opportunities to link this instructional practice with managerial work. There is actually quite good alignment

Instructional strategy	Description	Mechanisms	Literature sources & implementation issues
			between this instructional practice and management work, as it occurs naturally.