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PROMISING PRINCIPLES FOR TRANSLATING PSYCHOLOGICAL SCIENCE INTO TEACHING AND LEARNING

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> Psychology is a science, teaching is an art, and sciences never generate arts directly out of themselves. An intermediary, inventive mind must make the application.
>
> —James, *Talks to Teachers on Psychology, and to Students on Some of Life's Ideals* (pp. 7–8)

Where do effective teaching and learning come from? Possible sources include trial and error, word of mouth, the research literature, and even dumb luck. Our predecessors who took on the improvement of teaching and learning at the St. Mary's conference in 1991 (Mathie et al., 1993) advocated the use of active learning, which promised to be sufficiently flexible and rigorous to produce better teaching and learning across a variety of contexts. In light of the present variegated educational landscape, however, we sought an answer that is more sensitive to local terrains. Thus, our view from the University of Puget Sound (UPS) takes a novel approach. We focus on a dynamic model (see Figure 8.1) that can be used to frame teaching and learning practices across content domains and contexts. A foundational premise of the model is that teaching and learning are forms of work and doing either effectively will require much effort. But the focus is not simply on doing more

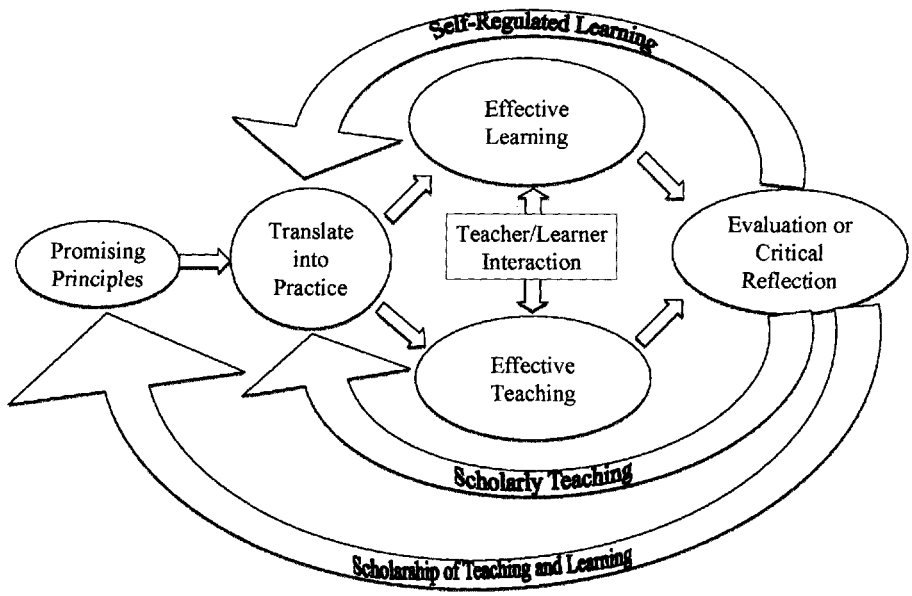

Figure 8.1. A dynamic process model of teaching and learning.

work. Instead, we suggest a process that will make the work of teaching and learning more effective, a process that will have important and desirable outcomes for teachers and learners.

Any form of work is principled. In other words, we can identify some principle or set of principles that explain why the work produces specific outcomes. As psychological scientists, we seek principles that are useful for the work of teaching and learning. Rather than claim that there are best practices, we more modestly identify several *promising principles* from the extant literature—principles that are promising candidates to be translated into more effective practices of teaching and learning. We consider them promising because they have passed at least one of two crucial empirical tests. The first (and often the easier) is that they have survived laboratory experiments designed to disprove them. The second is that they have survived experiments conducted in real-world classroom settings.

Although there are many promising principles that meet our criteria, we highlight only a few of them. In the pages that follow, we describe the structure and dynamic nature of the model in some detail. We then offer examples of how promising principles may be translated into learning and teaching practices that produce outcomes suitable for evaluation and critical reflection. There are at least two important implications of the model. The first is to recognize that the world is not divided into teachers and learners. Each person, within the same skin, is both. Sometimes we teach and sometimes we learn. What this implies is that the practices of learning and teach-

ing that the model includes apply to everyone. For this reason, people who are lauded as fine teachers often disclose that they are avid learners or admit to having learned something new from a class or a particularly curious student. The other implication is ethical. The model attempts to capture a process that teachers and learners should engage in if they care about teaching and learning. Thus, the model is meant to be lived early and until the last breath is drawn.

A DYNAMIC MODEL OF TEACHING AND LEARNING

The model in Figure 8.1 presents participants at every level of analysis as active and interactive. For example, learners must work to develop and use new strategies and evaluate their relative effectiveness, as must teachers. Laboratory researchers must consider issues specific to learners and teachers with an eye to real-world generalization when developing appropriate research methodologies. Similarly, those who conduct research studies in real-life contexts must necessarily attend to learner and teacher variables and their interactions.

The model can be viewed from the perspective of the learner, the teacher, and others interested in pursuing related inquiry and practice. The promising principles described in a subsequent section and in Table 8.1 are the starting points for the model. Part of their promise is that they can be approached from different levels of analysis. As previously noted, we do not mean to imply that effective teaching and learning cannot arise from other sources (e.g., mentoring, trial and error, direct observation). But we believe strongly that the greatest likelihood of improving teaching and learning lies in practices grounded in empirically derived principles.

However, principles alone are not sufficient to guarantee effective teaching and learning. The principles must be *translated into practice* through the interaction of teacher, learner, context, and content. Thus, translational research is at the heart of our model at all levels. In order for promising principles to have utility in practical contexts, teachers, learners, and researchers must adapt them to their particular goals and resources. Teachers must be creative when making the leap from the laboratory-based literature to their classrooms, just as researchers must be creative when approximating the complexity of the teaching and learning environment. Successfully translating principles into practice leads to effective learning for students and effective teaching for teachers.

For students, *effective learning* includes increased domain-specific knowledge and metacognition (i.e., the ability to articulate what one does when one learns). As students reflect critically on their learning, a feedback loop (labeled self-regulated learning in Figure 8.1) is created. Reflection changes what learners contribute to future learning environments, in essence modify-

TABLE 8.1
Promising Principles Translated Into Classroom Techniques

Translation into practice	Example
Desirable difficulties	
Generate answers based on scaffolding, rather than the teacher providing all answers.	To learn the names of famous psychologists, students generate the names from one- to two-sentence descriptions of the psychologists, with their initials provided by the instructor.
Interleave learning by alternating content presented, types of problems solved, or skills practiced by students rather than focusing on one topic or skill at a time.	Present 12 short descriptions of experiments, and ask students to identify the hypothesis for Experiment 1, the independent variable for Experiment 2, the dependent variable of Experiment 3, and so on.
Induce cognitive equilibrium/dissonance by providing information likely to be unfamiliar to most students, then helping them to incorporate this new information into their previous knowledge.	Ask students to write down how the sex of a baby is determined, then describe how the sex of a fetus is determined by both the sperm's X- or Y-carrying chromosome transmitted at conception, as well as testosterone production and absorption in the first weeks of embryonic development. Relate all of this to what students already knew.
Deep explanatory processing	
Ask questions that elicit explanations rather than simply explaining every concept. Develop questions that elicit complex answers, not easy, shallow answers.	Rather than asking what percentage of adolescents smoke cigarettes, ask why adolescent girls have surpassed adolescent boys in their cigarette-smoking rates.
Connect new information to prior knowledge when presenting new material in class or in the readings.	Have students write a list of four methods for improving their memory of textbook material, and then share their methods with the rest of the class. Based on their answers, expand on and add to their current knowledge of how to improve their memory.
Organization effects	
Outline important points from the assigned reading.	Provide a scientific article on a topic to be discussed in class, and require students to read it and bring a typed outline with main headings and subheadings to class.
Develop concept maps to visually represent important concepts and their relationships to one another.	Have students draw a concept map for a particular concept in which they integrate materials from class and text.

Spacing or distributed learning	
Space learning over time rather than lumping all learning into one study session.	Ask students to prepare for a quiz by spending 20 minutes in the morning, 20 minutes at midday, and 20 minutes in the evening studying. Specifically ask them not to study for the allotted 60 minutes all at one time.
Testing as a teaching device	
Quiz to promote reading by giving quizzes after assigned reading should have been completed.	At the beginning of class, give a 1–5 question short quiz on the reading that students should have completed before class.
Metacognition	
Teach students to delay judgment of their own learning until after a meaningful delay. This prevents them from confusing comprehending at the moment with remembering and understanding later.	Ask students to use the quizzes at the end of each chapter. Ask them to read, then after at least a 1-hour delay, to answer the questions.
Provide feedback to students on the efficacy of their learning efforts.	Ask students to use the quizzes at the end of each chapter. Ask them to read, take the quiz, then go back to the text to read about any question they missed and determine why their answer was incorrect.
Transfer appropriate processing to new contexts	
Teach students metacognitive skills that they can transfer to new learning situations.	Let students know that an upcoming essay exam will require them to learn and apply the assigned reading to a specific case study. Explain that they will be required to discuss the material at the level of Application, according to Bloom's (1956) taxonomy. If they are able to prepare more effectively for the essay exam, they should be able to prepare more effectively for essay exams requiring application in other courses as well.
Teacher and learner as holistic agents	
Motivate students to complete and study the reading.	Provide students with a 10-point contingency for completing online prelecture quizzes.
Build rapport with students by letting them know the teacher is attempting to learn about them as individuals.	Learn students' names as early in the semester as possible.

ing their status as learners. Thus, students develop self-pedagogy as they learn to self-regulate their learning. For teachers, *effective teaching* includes improved metacognition about teaching, a wealth of domain-specific knowledge, and awareness of research and theoretical developments in pedagogy. As teachers evaluate and critically reflect on their teaching, a similar feedback loop develops, labeled *scholarly teaching* (Buskist & Davis, 2006).

The *teacher–learner interaction* is an essential component of the model. The teacher's role includes providing the learner with opportunities for translation through direct instruction on strategies, initial contingencies for engaging in new strategies, and opportunities for feedback to enable learners to refine the use of specific strategies and assess their effectiveness. Not all learners will benefit in the same way from each strategy in every context or with all subject matter. The learner, however, must be motivated to faithfully engage the process and expend the effort essential for success. The teacher thus serves as a bridge between the learner and successful strategies found in the research literature.

Finally, the model urges teachers at all levels to contribute their evaluations, critical reflections, and data to the *Scholarship of Teaching and Learning* (SOTL). Thus, SOTL creates a translational feedback loop with the promising principles (reciprocally translating between science and practice). In this way, teachers communicate their findings to learners, other teachers, and researchers. In turn, researchers, both basic and applied, should realize that high-quality practices are not only an outcome of the use of promising principles but also a wonderful source of new principles. Teachers who are not directly involved in SOTL can develop partnerships with researchers who are so that the data generated by teachers' efforts through scholarly teaching eventually contribute to the promising principles.

TRANSLATION INTO PRACTICE

At all levels of teaching and learning, the translation process is best understood as a process involving ineluctable interactions among several important factors, including characteristics of teachers and learners, context, and content.

Teacher Characteristics

Critical to whether and how a principle translates successfully into practice are characteristics of the teacher, such as familiarity with the principle, past experience, teaching philosophy, domain knowledge, and confidence. Teachers also need to consider their willingness to take risks and to devote discretionary time as well as their abilities and preferences. In translating principles into practice, teachers become learners and, as such, may benefit

from workshops and conferences, advice from more experienced colleagues, and from organizations such as the Society for the Teaching of Psychology.

Student Characteristics

The diversity of learners, including their levels of preparedness, past experience, academic motivation, and personal interests, is a crucial consideration (see chap. 4, this volume). Students may need explicit instruction about the time they are likely to need for reading and other learning activities and perhaps even how to read and learn effectively. The teacher may find it useful to explain the logical bases and empirical support for practices that are being recommended. Students have already developed their own strategies for successful learning in some classroom contexts (Ross, Green, Salisbury-Glennon, & Tollefson, 2006), but some of these strategies may be detrimental to their success in other contexts. Informing students about criteria for identifying successful practices may help them revise or abandon counterproductive strategies.

Context and Content Characteristics

Translation also must consider local conditions that might be barriers to effective and efficient practices. For example, an overcrowded classroom or one with fixed seating may be a serious barrier to the successful use of some principles. Aspects of the course content, including unfamiliar terminology, directness of application, and connections to existing knowledge, are also relevant considerations. Moreover, teachers should ensure that their objectives are congruent with the subject matter being taught.

The interactive nature of the translation process means that one size will certainly not fit all. The translation of principles into techniques necessarily implies unique combinations of the characteristics already described as well as their interactions (Daniel & Poole, 2009). Successful translation may require precise prescriptions that take into account the variety and fluidity of teaching styles, learners, motives, goals, and resources that may potentially interact in a particular context. We view teaching, learning, and their interaction as personally empirical: Each teacher and learner must discover what works for the task at hand and then, perhaps spontaneously, adapt to be successful (Ross et al., 2006). Failure to take these characteristics into account may result in practice that does not meet its objectives and leaves learners and teachers frustrated by the wasted time and effort.

IDENTIFYING PROMISING PRINCIPLES

Literally hundreds of findings across domains of psychology may be applicable to classroom practice and learning. From the cognitive psychology

literature alone, several research groups have derived lists of recommendations for educational practice (e.g., Halpern & Hakel, 2003; Lifelong Learning at Work and at Home, n.d.; Pashler et al., 2007). However, the process of translating laboratory findings into teaching and learning in a classroom context has not been as rigorously pursued, making it difficult to identify principles that may apply to a variety of teaching and learning contexts. Principles extracted from the extensive, predominantly laboratory-based literature may be promising, but learners and teachers need to translate them in terms of their particular goals, contexts, and resources. Translations into practice should include a critical evaluation of the implementation and its resulting impact to provide suggestions for modification and further refinement of practices and principles, as indicated in Figure 8.1.

As previously noted, good teaching and meaningful learning both require effort, feedback, and critical reflection. Rather than attempting to identify translations that are effortless, we point to principles that, when translated, reward the work of teaching and learning by helping teachers and learners target their efforts toward desired outcomes. Indeed, the popular quest for a method of teaching that results in effortless learning violates our claim that individuals must actively work at learning. Often, students expend effort using strategies that, at best, waste time or, at worst, have a negative impact on learning (Gurung, 2003, 2004; Gurung & Daniel, 2005). Unfortunately, teachers may do the same. Our goal is to encourage the emergence of a clearinghouse of effective, empirically grounded principles to serve as a base on which to structure demonstrably effective practices. Following is a brief description of sample principles that have solid grounding in the basic experimental research literature. Table 8.1 includes these principles and suggestions for how they might be translated into effective teaching and learning.

SOME PROMISING PRINCIPLES

The principles that follow are not intended to be exhaustive. These principles were chosen because they have a well-established empirical base.

Desirable Difficulties

Learning, retention, and transfer can be enhanced by introducing desirable difficulties into the instructional process (e.g., presenting two topics in interleaved fashion or asking students to generate information that integrates concepts across two or more topics; see also Table 8.1). Though interleaving and integration across concepts make the initial acquisition of the target information more challenging, these difficulties enhance performance on criterial questions several days after the lesson (Richland, Linn, & R. A.

Bjork, 2007). Generally, desirable difficulties stimulate active engagement that would not ordinarily occur, and this supports retention, transfer, or both (R. A. Bjork, 1994; R. A. Bjork & E. L. Bjork, 2006; McDaniel & Einstein, 2005). We recognize that the learner ultimately must be able to meet the difficulty that is posed (otherwise learning could be stymied) and that the difficulty may slow the pace at which students produce correct answers. However, gains typically appear in long-term retention.

Spacing

Reviewing key content with delays between repetitions produces positive benefits for long-term retention as opposed to massing repetition or relying on a single presentation (for a review, see Cepeda, Pashler, Vul, Wixted, & Rohrer, 2006). For example, material on the action potential of a neuron might be revisited some days after its initial presentation (for a classroom example, see Reynolds & Glaser, 1964).

Organization

Organizing content can be extremely effective for promoting retention and recall. Organization involves relating and structuring individual facts and concepts into integrated and coherent representations that can be viewed as schemata, mental models, or situation models that allow learners to draw on previously learned information (Dean & Kulhavy, 1981; Moore, Hauck, & Furman, 1975).

Deep Explanatory Processing

Deep explanations foster development of a complex understanding of the topic (Pashler et al., 2007). Deep explanations reflect well-reasoned arguments, logic, use of causal mechanisms, and persuasive assembly of evidence. For example, when introducing students to the limitations of correlational evidence, it is useful to discuss the research conditions necessary for drawing causal inferences (even from correlations), rather than simply stating the oft-repeated phrase *correlation does not imply causation.*

Transfer-Appropriate Processing

Maximizing performance on summative assessments in an academic course requires that study and learning strategies are appropriate for transfer to the type of assessment selected for the course. Although this principle is straightforward, its consequences often are underappreciated. For example, study that involves elaborative processing of individual facts will enhance performance on tests that focus on individual facts but penalize metacognitive

awareness and performance on tests that focus on conceptual relations. Conversely, elaborative processing of conceptual relations will enhance performance on tests that focus on such relations but may penalize performance on tests that focus on the retention of individual facts (Metcalfe, Kornell, & Son, 2007; Thomas & McDaniel, 2007).

Testing as a Learning Tool

Testing is not a neutral event. Requiring retrieval of information from memory in the form of a test is a potent memory modifier that produces robust long-term retention relative to repeatedly studying the information (Karpicke & Roediger, 2008; Roediger & Karpicke, 2006b). Thus, quizzes (even low- or no-stakes quizzes) enhance learning and retention of course material (McDaniel, Anderson, Derbish, & Morrisette, 2007).

Metacognitive Monitoring

Metacognitive monitoring refers to learners' assessments of their knowledge levels and ability to remember information on criterial assessments. Promoting accurate metacognitive monitoring results in learners being able to more effectively assess what they know and do not know, leading to the development of more efficacious study habits (Schunk & Zimmerman, 1998).

A CAUTIONARY NOTE

Translating research-based principles into the practice of teaching and learning is not straightforward. The perils associated with translations of research-based principles into teaching and learning practices are illustrated by a problem that lurks in many psychology textbooks. Typically, these textbooks contain a variety of so-called pedagogical tools for students that take the form of signaling devices such as headings, bolded terms, and marginal inserts. The value of signaling devices is convincing in laboratory studies (e.g., R. F. Lorch & E. P. Lorch, 1996; Mautone & Mayer, 2001), especially for readers who do not spontaneously organize their reading or who cannot easily discern the most important information. However, the utility of signaling devices may not generalize to use in the classroom. For example, when used in the college classroom, self-reported usage of text-embedded signaling devices was neutrally or negatively associated with exam performance (Gurung & Daniel, 2005).

EFFECTIVE TEACHING

Several efforts have sought to identify the qualities of effective teachers (e.g., Bain, 2004; Buskist, 2002; McKeachie & Svinicki, 2006) and the prac-

tices they use (see chap. 6, this volume). We contend that effective teachers approach their teaching the way scientists approach their research (i.e., they use the scientific method by proposing and testing hypotheses). Effective teachers strive to be scholarly in their approach, basing their practices on empirically tested principles. They engage in self-reflection and critical evaluation of their practice. In other words, scholarly teachers examine their teaching goals and methods in great depth, experiment with new approaches, and assess the effectiveness of each approach with effective learning as the desired outcome.

Thus, effective teaching is a continual, lifelong process, and teachers at all levels have an ethical imperative to examine and improve their teaching practices. As previously stated, the process may begin with identifying promising principles from the research literature on how students learn (Figure 8.1). The teacher then develops learning activities and other teaching approaches that instantiate one or more of the promising principles. The application of principles to practices is not a one-size-fits-all process. When developing lesson plans, effective teachers must consider the contextual factors that potentially impinge on their practice, including, for example, the characteristics of their students (see chap. 4, this volume), educational institution (see chap. 5, this volume), classroom configuration, learning objectives for the specific course, and desired curricular outcomes (see chap. 9, this volume).

Teachers' assessment of their own teaching is as crucial to maintaining the flow of our dynamic model as is assessment of student learning. Without evaluation of teaching practices, neither teachers nor researchers can distinguish what works from what does not work in reaching learning outcomes. The model includes two potential feedback loops or paths that the results of teaching assessment might follow, both of which are vital to continuously improving teaching and learning.

One path focuses more narrowly on using evaluation and critical reflection to improve a teacher's own practice, that is, to adopt scholarly teaching. Faculty members' assessment of their own teaching requires them to reflect on how their own experiences, willingness to take risks, abilities, and preferences affected their choices in the classroom. After a teacher tries a new method, the teacher's metacognitive task is to determine whether the practice worked. Did the teacher accomplish the predetermined goals for student achievement? How might he or she improve the technique next time? Do the data support trying the technique in other sections of the same course or even in other courses? Was the class time intellectually stimulating and enjoyable for the teacher's students and for the teacher? Were all groups of students engaged?

A second path involves teachers using their evaluations of practice to build the empirical literature on applying promising principles to classroom settings. Regrettably, scientists often do not apply science when studying

teaching and learning. For example, researchers have observed that too few submissions on SOTL include pretests, baseline data, or control or comparison groups (e.g., Richlin, 2001, 2006), thereby limiting their potential for satisfying peer review and contributing to promising principles. We propose that educators interested in SOTL assure that these types of measures are included whether they intend to use the assessment results for improving their own teaching or for wider dissemination.

TRANSLATING PROMISING PRINCIPLES INTO EFFECTIVE TEACHING

To make the model concrete, consider how a teacher at a small liberal arts college (let's name her Bettina) would use our proposed model to improve her teaching. To identify promising principles, Bettina scans the literature on evidence-based principles for improving student learning. She notices that *testing as a learning tool* is a promising principle and one that might suit the context in which she teaches. For example, trying risky new methods is not supported in her college, and she does not want to dramatically alter her present curriculum and support materials. She recognizes, however, that using quizzes to improve learning could be translated into her current classroom practices.

At this point, Bettina is confronted with a host of decisions about translating this promising principle into her teaching. She must decide about quiz format (multiple-choice, short answer), timing (before class, during class, outside of class), frequency (every class, once a week), delivery system (paper and pencil, online, interactive response systems such as clickers), and so on. Her particular translation will depend on a combination of her intuitions, the constraints of her teaching context, and perhaps even additional perusal of the research literature.

Bettina decides to use prequizzing when introducing new topics. It shows promise for helping students to identify material they do not know and to activate any relevant prior knowledge. She also decides to use postlecture short-answer quizzes to reexpose students to key content and promote retrieval practice. After implementing this new technique for a semester, Bettina finds that her students are performing better on exams than in past semesters, and she decides to integrate the quizzing methods into her courses. After a couple of semesters, Bettina might engage in SOTL by publishing a brief report of her data and reflections on the successful use of quizzing (e.g., Leeming, 2002).

Suppose, however, that with continued use of pre- and postlecture quizzing, certain aspects of Bettina's translation become increasingly problematic. Students resist so much quizzing, and Bettina finds that prequizzing is taking up more class time than she envisioned. Accordingly, she decides to

drop prequizzes but retain postlecture quizzes. In later classes, she observes that eliminating the prequizzes has not had a negative impact on her students' learning. Bettina discusses this issue with her colleague David, an instructor at a nearby state university. Like Bettina, David introduced pre- and postlecture quizzes. However, when he removed prelecture quizzing, his students' exam scores went down, and he reinstituted them. For David's students, prelecture quizzes provided motivation for reading the text each week, which resulted in higher exam scores (see Brothen & Wambach, 2004; Daniel & Broida, 2004).

Bettina's and David's unique translations of a promising principle resulted in more effective teaching. Their evaluations produced iterative improvements that were particularly effective for their respective pedagogical contexts. At this point, if so inclined, Bettina and David might conduct a study in their classes to evaluate more objectively whether quizzes are an effective translation of the basic principle. Individually or in collaboration, their research could then inform the larger scholarly community of their results (e.g., McDaniel, McDermott, Agarwal, & Roediger, 2008).

TRANSLATING PROMISING PRINCIPLES INTO EFFECTIVE LEARNING

Our model assumes that fostering the development of sound principle-based learning strategies by students and promoting sound principle-based pedagogies by teachers are equally important. A growing literature supports the use of training in metacognition to improve classroom learning. How might such training increase the effectiveness of student learning? The literature on metacognitive strategies (sometimes referred to as *self-regulated learning*) may be traced back to Dewey (1933) and has increased substantially in the past 30 years (e.g., Montalvo & Torres, 2004; Ross et al., 2006; Schunk & Zimmerman, 1998).

For example, a teacher might initially assess the metacognitive abilities of students in her classes using scales developed for this purpose (e.g., Niemivirta, 1998; Pintrich & DeGroot, 1990; Wolters, Pintrich, & Karabenick, 2005). After the teacher conducts the preassessment, results are shared with students to enhance their awareness of the strategies they are already using. The teacher then engages the students in questioning whether their strategies are the most effective and efficient ones to use. The teacher then encourages students to develop hypotheses for improving their metacognition, citing some of the promising principles and helping students to focus their hypotheses on one or more of these. The teacher could go further by introducing *concept mapping* as an example of how to integrate, test, and review material from the lectures, the textbook, and any additional readings or video sources (Hilbert & Renkl, 2008; Nesbit & Adesope, 2006; Novak, 1990).

Students are shown examples of concept maps and then instructed to construct their own for a specific topic in the class. Each student can proceed by identifying and selecting relevant material and organizing it in a meaningful way for him or her, using verbal, spatial, and visual means to enhance its construction. At this stage, the maps are submitted to the teacher or to merged collaborative groups to identify inaccuracies or omissions. Later, students reconstruct their maps from memory and have the opportunity to fill in omissions and correct misconceptions. The maps may be valuable to the teacher as the means for identifying what students deem important and also assessing their understanding of relationships among concepts. Of critical importance, however, is the students' acquisition of a new practice (or the opportunity to refine an already existing practice) by which to increase the effectiveness of their learning.

RECOMMENDATIONS AND CONCLUSION

Our model of learning and teaching is applicable to a complex terrain. It does not specify conditions for optimal implementation, nor does it require preconditions other than some familiarity with one or more of the promising principles and a willingness to translate them into practice as a learner or teacher or both. We recognize that effective teaching and learning have long occurred, but we think that anyone, even those already effective in teaching or learning or both, may use the model with positive results. We also recognize that engaging in the process proposed in the model is time consuming and may be more difficult to implement by early career teachers and scholars working in contexts in which SOTL is not valued or rewarded. However, we enthusiastically encourage those teachers who are not hampered by organizational structures to apply the model in order to directly contribute to SOTL, and thus to enlarge and refine the base of promising principles. Ideally, as the number of researchers actively engaged in SOTL increases, the reward structures for faculty and institutional definitions of scholarship will change (Edgerton, O'Meara, & Rice, 2005).

Our examples of the model's application should not be viewed as prescribing a particular translation of a specific promising principle. Instead, they are intended to inspire individual teachers and learners, who will ultimately shape the practices that make teaching and learning more effective. Similarly, the following recommendations are meant for various stakeholders.

For teachers and learners:

1. Use the proposed dynamic process model (Figure 8.1) to guide teaching and learning practices.
2. Collect baseline and control or comparison data to enhance reflection and scholarly teaching and to facilitate contributions to SOTL literature.

3. Encourage students to invest efforts in developing metacognitive strategies and using all classes in becoming more independent and self-regulated learners.

For educational institutions and professional organizations:

1. Provide formal training in teaching and ongoing professional development for all teachers in higher or tertiary education settings on content and process knowledge.
2. Make scholarly teaching the standard practice in tertiary education settings.
3. Provide support for the pursuit of high-quality scholarship on teaching and learning, with an emphasis on translational research.
4. Create more outlets for translational research on teaching (e.g., increase the publication frequency of existing teaching journals and begin a new journal, tentatively titled *Psychology of Teaching*).
5. Create reward structures that support translational research as much as non-teaching-related research.
6. Facilitate and reward collaborations between scholarly teachers and researchers to build the knowledge base in SOTL with an emphasis on applying laboratory findings in real classrooms.
7. Publish casebooks on translating promising principles into effective teaching and learning.
8. Initiate a Promising Principle of the Year award and featured session at teaching conferences.
9. Produce an entertaining TV or DVD series for students on self-regulated learning. Emulate popular TV programs such as *Pimp My Ride* by transforming an unsuccessful student into to a successful learner through implementing evidenced-based strategies.
10. Form a committee dedicated to undergraduate education with teaching as a major charge.

For policy makers and grant-making institutions:

1. Provide funding for formal teacher training and ongoing professional development.
2. Provide funding for institutional and translational research in SOTL.

We hope the recommendations, taken collectively, will produce climates—family, local, state, regional, national, and international—that are more favorable to effective teaching and learning by means of the model we offer here. Nothing would please us more than to meet the model in altered

form as it is changed and adapted according to specific contexts and thereby see it take on a life of its own. Indeed, we would consider that happy development to be further evidence of effective teaching and learning.