Instructional Principles for Self-Regulation

Kathryn Ley
Dawn B. Young

The purpose of this article is to suggest principles for embedding support in instruction to facilitate self-regulation (SR) in less expert learners. The principles are based on an analysis of the growing body of research on the distinctive self-regulation differences between higher and lower achieving learners. The analysis revealed four instructional principles that designers should consider to provide support for self-regulation. Each principle is supported by research and instructional examples are included.

An individual's ability to self-regulate contributes to motivation and learning. *Self-regulation* (SR) may be broadly defined as the effort put forth by students to deepen, monitor, manipulate, and improve their own learning (Corno & Mandinach, 1983). SR includes factors such as resource management, goal setting, success expectations, and deep cognitive involvement (Trawick & Corno, 1995). During the SR process, expert learners "identify what the current task requires in terms of cognitive, motivational, and environmental strategies and determine if their personal resources are adequate to effectively accomplish the task" (Ertmer & Newby, 1996, p. 18). Self-awareness, self-monitoring, and self-evaluation are critical to effective SR and performance (McCombs, 1989). Some have suggested that SR is synonymous with metacognition (Brown, Hedberg, & Harper, 1994) or metacognitive adjustments by learners in response to feedback on errors (Brown, Bransford, Ferrra, & Campione, 1983).

According to Osman and Hannafin (1992), research has "provided concrete evidence that [self] regulation strategies may be embedded within instruction" (p. 88). McCombs (1989) has indicated that instructional interventions can help enhance or supplant existing capacities and skills for learners who have difficulties with SR.

Several recent approaches to embedding SR into instruction offer systematic principles and guidelines to facilitate their design. Design guidelines have been derived from a synthesis of research on SR components such as monitoring, self-efficacy, and metacognition (Shin, 1998). These guidelines suggest embedding SR training into instruction by modeling SR, using cognitive apprenticeships, and providing attributional feedback to identify appropriate strategies, among other strategies. More recently,

Corno and Randi (1999) presented a theory for classroom instruction to "foster self-regulated learning among students and teachers" (p. 294).

Several SR interventions classified as exemplary by Schunk and Zimmerman (1998) have been tailored to specific content, students, or media. SR interventions have been suggested for writing (Graham, Harris, & Troia, 1998), reading comprehension (Pressley, El-Dinary, Wharton-McDonald, & Brown, 1998), and mathematics (Schunk, 1998). Others have described SR interventions incorporated into college learning-to-learn courses (Hofer, Yu, & Pintrich, 1998; Weinstein, 1994) or in computer-mediated instruction (Winne & Stockley, 1998). Some approaches have been directed toward specific populations such as children (Biemiller, Shany, Inglis, & Michenbaum, 1998; Corno, 1995), adolescents (Belfiore & Hornyak, 1998), and learning disabled students (Butler, 1998).

INSTRUCTIONAL PRINCIPLES FOR SR

The purpose of the current article is to suggest principles for embedding SR support in instruction to facilitate regulation in less expert learners. Instruction that includes these principles may ameliorate learner SR deficiencies in varied instructional contexts. The principles suggested in this article can be embedded in instruction to support SR regardless of content, media, or a specific population. They can be systematically employed in diverse contexts such as print-based or instructor-led instruction as well as synchronous or asynchronous Web-based instruction.

The principles are based on research literature that supports SR and identifies SR components that may be deficient in some learners. Each principle meets two criteria: (a) It is supported by research results suggesting a positive influence on learning, and (b) it addresses a need—an SR gap associated with achievement. The principles are designed to address the components that research evidence suggests exert the greatest influence on achievement.

The four main principles described below are derived from research on six SR components—(a) goal-setting, (b) preparing a place to study, (c) organizing materials, (d) monitoring learning, (e) evaluating progress and effectiveness, and (f) reviewing tests. These four principles are an attempt to embody both effective and flexible guidance for embedding SR into instruction:

1. Guide learners to prepare and structure an effective learning environment.
2. Organize instruction and activities to facilitate cognitive and metacognitive processes.
3. Use instructional goals and feedback to present student monitoring opportunities.

Table 1 ☐ Instructional Principles to Support Self-regulation

Regulating activity	*Definition*	*Instructional support example*
Preparing and structuring learning environment	Select or arrange the physical setting to make learning easier	Advise students how to arrange physical environments and cope with distractions
Organizing and transforming instructional materials	Overt or covert rearrangement of instructional materials to improve learning	Give students partial outline that they complete
Keeping records & monitoring progress	Record events or results	Instruct student to keep a progress report recording completed activities
Evaluating performance against a standard	Evaluate completed work quality; reread tests to prepare for class or further testing	Review exam responses with student(s) item by item, why response correct or how to correct response

4. Provide learners with continuous evaluation information and occasions to self evaluate.

Principle 1: Guide learners to prepare and structure an effective learning environment

Instruction should encourage and guide learners to prepare appropriate learning environments. Successful learners make "efforts to determine or arrange where a task is to be completed" (Trawick & Corno, 1995, p. 62). Structuring the environment relates to a learner's ability to cope effectively with disturbances, a crucial part of SR (Corno, 1994). A confirmatory factor analysis on data from 100 college students validated *managing distractions* as a first-order factor contributing to SR (Orange, 1999).

Environmental structuring enables learners to eliminate or decrease distractions and to attend to learning, an essential first instructional event (Gagné, 1985). Before learners can pay attention they must have an environment that allows, if not encourages, them to focus attention on the learning task at hand. Expert learners have knowledge about the "optimal study conditions for meeting the demands of the task" (Ertmer & Newby, 1996, p. 8); expert learners ask themselves, "When and where do I study best? How supportive is the learning environment?" (p. 20). Self-regulated learners arrange elements in an instructional environment so that learning goals successfully compete with other goals for attention and other cognitive resources (Corno, 1994).

Although there have been few investigations of environmental structuring comparing its relative influence to other SR components, the strength of the evidence in these studies may warrant consideration. Evidence from studies in which learners have recalled their usual study practices suggests that academically stronger learners use environmental structuring more often than do academically weaker learners (Lan, 1998; Ley & Young, 1998). When environmental structuring has been analyzed simultaneously with other components to determine its relative contribution to SR, evidence supports the relative importance of environmental structuring in discriminating between higher and lower achievement. A discriminant function analysis with 14 SR activities indicated that arranging the physical setting was the second strongest predictor for scoring above or below the minimum score for college admission (Ley & Young, 1998). Furthermore, environmental structuring was the strongest difference between college students who used an instructional self-monitoring protocol and those who did not (Lan, 1996). In Lan's study, learners who recorded their study behaviors with a protocol reported significantly more environmental structuring and earned significantly higher exam scores than either those who recorded instructor behaviors or those who did no recording.

Effective instruction requires creating and maintaining motivating and engaging environments (Belfiore & Hornyak, 1998). Instruction to foster SR should embed suggestions for establishing a study area that is quiet, comfortable, and without distractions. Environmental structuring methods bring the learner's attention to environmental preparation and, to be more effective, require learner participation (Garner, 1990). The approaches vary in labor intensiveness for the learner.

One of the less labor-intensive techniques requires learners to complete an environmental structuring checklist that establishes the characteristics of an effective distraction-free study environment. Detailed strategies for teacher-led, synchronous environments (see Corno, 1994, p. 246) may be adaptable to asynchronous Web-based instruction. For example, Web learners might identify their potential distractions from a list and choose from among activities that eliminate the distraction. The instruction would offer effective methods for eliminating or decreasing the distraction impact.

Some activities to encourage environmental structuring require minimal but continuous learner effort. Recording study time on a form may increase the learner's attention to environmental structuring. Instruction could require learners to record time spent studying in an appropriately structured learning environment and submit the record (see Belfiore & Hornyak, 1998, p. 193). Encouraging learners to sustain a quiet, comfortable, and distraction-free study environment can require combining activities to

establish an appropriately structured environment with recording the time spent studying in it.

Other techniques could depend on the learner's developing an environmental structuring plan. Instruction might present learners with environmental structuring advice such as how to eliminate specific distractions. The advice could be integrated into text procedures or instructions for completing the initial assignment. Learners might first select or list the threats to structuring a supportive learning environment and then choose environmental structuring activities to develop a plan. To successfully complete a plan, some learners might require a catalog of distraction-coping strategies. More labor-intensive plans might require learners to analyze how and when to effectively control distractions (Corno, 1994). This strategy encourages learners to reflect on how prepared they are to study and might culminate in a written environmental structuring plan. However, learners who typically use ineffective strategies may be unable to suggest effective strategies without additional support.

To provide more support, instruction can prompt learners and offer them environmental structuring options. Prompting learners whose initial performance indicates that they may have difficulty structuring their environment may help those who have higher SR needs. For example, in a distance course, learners who do poorly on the first assignment could be asked to follow a series of procedures for structuring their learning environment. Providing a list of strategies will assist less self-regulating learners to plan effective strategies since they often use familiar but ineffective strategies (Garner, 1990).

Principle 2: Organize instruction and activities to facilitate cognitive and metacognitive processes

Organizing is an important study activity (Di Vesta & Moreno, 1993) and a key component of SR (Hagen & Weinstein, 1995; Zimmerman & Paulsen, 1995). Organizing materials may be broadly defined as transforming and "rearranging instructional materials to improve learning, for example, 'I make an outline before I write my paper'" (Zimmerman & Martinez-Pons, 1986, p. 618). Learner statements may best exemplify this self-regulated learning component that Corno (1986) referred to as encoding control: "Write it one way then another [and] write the parts of a problem and look at it" (p. 341).

Organizational strategies, such as outlining content or relating concepts within content, are among the cognitive learning strategies that individuals use to self-regulate and that usually result in a deeper understanding of the material (Hofer et al., 1998, p. 67). Strategies that organize content, such as concept mapping, schematizing, and structured overviewing have boosted achievement in several studies investigating the relationship between instruction and structural knowledge (Jonassen & Grabowski, 1993). Furthermore "comprehension has significantly improved with the use of visual organizers such as concept maps" (Simpson & Randall, 2000, p. 55).

Organizing was strongly associated with achievement in three studies that investigated the relative strength of SR strategies (Ley & Young, 1998; Zimmerman & Martinez-Pons, 1986; 1988). Research has indicated that organizing and transforming strategies are used by middle school students more than most other SR strategies (Zimmerman & Marinez-Pons, 1988) and are more strongly related to achievement than most SR strategies (Ley & Young, 1998; Zimmerman & Martinez-Pons, 1986). In addition, organizing and transforming strategies are strong contributors in explaining the difference between advanced track and lower track high school students (Zimmerman & Martinez-Pons, 1986) and in predicting regular admission and underprepared college student group classification (Ley & Young, 1998).

These studies credibly reinforce the notion that effort expended organizing learning materials influences achievement. All three studies collected data on the same 14 SR strategies. In the two studies with distinct achievement groups (Ley & Young, 1998; Zimmerman & Martinez-Pons, 1986), the academically stronger groups chose more organizing strategies and used them more frequently than did the academically weaker groups; both studies collected data and classified self-regulating behaviors with the same interview protocol and analysis technique,

lending further support to the relative importance of organizing strategies when compared to alternatives.

Different arrangements of the learning materials within the instruction may facilitate learning and the use of cognitive and metacognitive strategies. Metacognitive strategies may be defined as the "the ability to think about one's own thinking and to actively select appropriate strategies for various learning situations" (Zimmerman & Risemberg, 1994, p. 243). Proven organizing strategies suggested for instructors include advance or graphic organizers, concept mapping, and previews (Driscoll, 2000; Nist & Holschuh, 2000). Graphic organizers, a learner-generated version of advance organizers, are hierarchically arranged tree diagrams of a text's key terms and concepts (Driscoll). Previews are detailed narratives about a text that should be read in advance to activate knowledge and aid organization and reading comprehension (Nist & Holschuh). Concept maps are visual representations of information (Hadwin & Winne, 1996) that could introduce or summarize concept relationships within a module or chapter (see Driscoll). Some instructional software facilitates the learner by "structuring of a task . . . organization of information, or manipulation of data" without an instructor (Brown et al., 1994, p. 11).

Each of these techniques may be embedded in instruction to help learners self-regulate. Although learner-generated versions of graphic organizers have been more effective than instructionally provided ones, some students may not be able to create them if they lack time, knowledge, or willingness to do so. Examples of embedded strategies that support SR include headings, subheadings, chapter summaries, lesson overviews, and explicit orienting activities (Osman & Hannafin, 1992). An embedded strategy may include graphic organizers or concept mapping. Content previews may be combined with an organizing activity that engages learners and increases deeper processing (Nist & Holschuh, 2000). Learners may complete partial concept maps or fill in missing concepts on an outline. The content outlines, class outlines, or advance organizers structure the learning sequence and identify important concepts for learners.

Principle 3: Use instructional goals and feedback to present the learner with monitoring opportunities

"Monitoring is an important component of self-regulated learning" (Zimmerman & Paulsen, 1995, p. 13). Monitoring is the cognitive process that assesses the state of progress relative to goals and generates feedback that can guide further action; it is pivotal in self-regulated learning (Butler & Winne, 1995). A confirmatory factor analysis on an SR inventory completed by college students validated monitoring as a first-order factor (Orange, 1999).

Monitoring depends on two other critical self-regulating components: feedback and goal setting (Butler & Winne, 1995). Feedback and goal setting enable monitoring; the two components interact to promote SR. Self-regulators use external and internal feedback to monitor how well they are meeting learning goals, how effective their learning strategies and tactics are, and the quality of their learning outcomes (Butler & Winne). A meta-analysis of 131 feedback studies led researchers to conclude that goal setting augmented the effects of feedback interventions (Kluger & DeNisi, 1996). Conversely, feedback may also influence how learners set sequential goals (Butler & Winne). To monitor and control learning-goal attainment, learners must understand tasks and desired outcomes (Weinstein, 1994). They self-regulate by systematically activating and sustaining behaviors and cognitions to attain learning goals (Schunk, 1990).

Monitoring instructional interventions with and without explicit goal setting have improved performance. Girls who recorded their progress while learning to throw darts enhanced effects of both process and product goal setting and achievement when compared to girls who did not monitor (Zimmerman & Kitsantas, 1997). When prompted during instruction, they provided their own feedback by attending to and recording their progress. Learners who recorded their learning activities on a self-monitoring protocol scored higher on examinations than did learners who recorded teacher activities or who did no recording (Lan, 1996). The self-monitoring learners provided their own additional feedback over the other groups, which may have led to their improved learning outcomes. Successful

learners remember to monitor their progress and know how to correct their errors. First year veterinary students who reported using self-regulating behaviors more often than other students were able to identify goals, implement alternative strategies, and become aware of how learning occurred while completing case studies (Ertmer, Newby, & MacDougall, 1996). Learners who have received monitoring instruction or guidance or strategy advice about effective instructional choices learned more than when they did not (Kinzie, 1990).

Monitoring has been associated with achievement. Younger students and poor learners use very few monitoring strategies (Puntambekar, 1995). Extensive evidence indicates "that prompting students to keep records affects their learning, motivation, and self efficacy" (Zimmerman, 1989, p. 333). Keeping records and monitoring frequency was one of five significantly discriminating self-regulating differences between students who scored above and those who scored below the minimum standardized test score for college admission eligibility (Ley & Young, 1998). Keeping records and monitoring frequency was the second strongest predictor for discriminating self-regulating differences between eighth grade students from higher and lower achievement tracks (Zimmerman & Martinez-Pons, 1986).

Monitoring may be the cornerstone of self-regulated learning although "when learners do not need to act on instructions or descriptions, they are unlikely to monitor . . . rigorously" (Garner, 1990, p. 519). Therefore instruction that supports SR may prompt the learner to monitor. Self-monitoring may take the form of students (a) observing and recording whether or not they have done something, or (b) observing and recording behaviors so as to monitor if their performance has met a set criteria (Belfiore & Hornyak, 1998). In the latter case, specified criteria become goals when learners embrace them as attainable performance standards. Goals may enhance feelings of competence and interest if they can be attained in a short period of time and framed as specific actions (Meece, 1994). Furthermore, guiding learners to establish precise and attainable goals can enhance metacognitive monitoring (Winne & Stockley, 1998).

Instruction could prompt learners to observe and record whether or not they have completed interim activities required to produce a more complex assignment. Instruction could also include a form for monitoring learning activities and require the learner to record time spent on learning activities such as taking notes, reading the text, attending a lecture, working problems, and so forth (see Lan, 1998). In the process of completing an assignment, a learner might be required to track progress completing preparatory assignments that culminate in a product incorporating elements of the preparatory assignments. Instruction might also require explicit interim process and product assignments that are the occasion for feedback and that guide student efforts to attain desired learning goals.

An instructional process may also provide external (instructor or other instruction generated) frequent and systematic feedback. An instructor or facilitator might acknowledge or verify learner monitoring records or, in computer-mediated instruction, send a notice to the learner if an on-line monitoring form is not maintained. Some Web-based instructional shells such as WebCT™ provide feedback through computer-generated exams and scoring that do not require an instructor or facilitator to provide feedback.

External feedback on interim, process, or partial assignments may encourage monitoring. If the learning outcome is a technical report, instruction may require learners to submit and receive feedback on whether or not they have submitted notes for the report, then for a draft, and, finally for the report. SR support could incorporate feedback to learners on many, if not most, of the component activities that culminate in a more comprehensive, complex assignment. When learners begin or are prompted to compare their performance to a standard the process becomes self-evaluation, a related but separate SR process.

Principle 4: Provide learners with continuous evaluation information and occasions to self evaluate

Definitions of both monitoring and evaluation often include a comparison between the learner's own performance to a standard, but for

the purposes of this article, such comparisons are used to distinguish evaluation from monitoring. Self-evaluation "involves the comparative outcome between some component of performance and the set standard" (Belfiore & Hornyak, 1998, p. 190) or setting standards and using them for self-judgment (Zimmerman, 1998, p. 78). Monitoring is limited to tracking and recording one's own performance without comparing effort to outcomes. Setting evaluation standards and goals is a noted characteristic of self-regulated learners (Ertmer et al., 1996) and "comparing one's performance with standards informs one of goal progress" (Schunk, 1990, p. 73). The distinction between monitoring and evaluation may not be clear in practice but the distinction establishes a unique instructional purpose for each principle.

Evaluation judgments close an SR loop in which students monitor the effectiveness of their learning methods or strategies in reaching their goals and react to this feedback (Zimmerman & Kitsantas, 1997). Expert learners know how to evaluate their learning strategies and modify their learning strategies on a timely basis (Weinstein, 1994). Self-regulated learners evaluate their learning strategies to determine if the strategies are effectively advancing them toward their goals (Weinstein). They have an implicit if not explicit performance standard, evaluate their performance against the standard, identify strategy problems, and know how to correct strategies. Learners may not be able to accurately monitor and detect failure if they do not understand how to evaluate their learning (Garner, 1990). Some learners may need help with self-evaluation before they can develop skills for SR (McCombs, 1989).

Evaluating performance is a key SR component. Comparing current performance to goal performance to gauge progress was one of three items that loaded as a self-evaluation factor in the confirmatory factor analysis reported by Orange (1999). Only study strategy use exceeded self-evaluation in strength of its contribution to SR among seven first-order factors.

Self-evaluation processes have significantly differed between lower-achievement track high school students (Zimmerman & Martinez-Pons, 1990), lower-scoring college statistics students (Lan, 1996), college students who did not score at or above the minimum standardized test score required for college admission (Ley & Young, 1998) and their higher-achieving or scoring counterparts. Evidence suggests that higher-achieving students may use past performance to evaluate learning and identify deficits more frequently than do lower-achieving students. Higher-achieving college students in two studies reviewed previous tests significantly more than did lower-achieving college students (Lan; Ley & Young). Reviewing tests to identify correct and incorrect responses may enable evaluation. Self-regulated learners may compare past learning outcomes to desirable ones, identify their learning gaps, and renew efforts to repair specific performance gaps.

Monitoring may stimulate self-evaluation. College statistics students who recorded their study behaviors subsequently reported reviewing previous tests significantly more often than did those who did no recording or who recorded instructor behaviors (Lan, 1998). The instructor did not explicitly advise or teach learners how or what to study but only asked them to record weekly their study behaviors. Following learning goals had a positive influence on the SR of college men and women (Bouffard, Boisvert, Vezeau, & LaRouche, 1995). On the other hand, less self-regulating learners may be less able to evaluate and to select strategies than more self-regulating learners. Embedded appropriate learning strategies, (selection, sequence, viewing pace, and review of instructional events in computer-based instruction) closed a significant performance gap between self-identified lower self-regulators and higher self-regulators when both groups were allowed to control their strategies (Young, 1996).

Guiding students through tasks, delivering corrective feedback that helps a learner see where he has gone wrong, and providing hints about how to correct the problem "can be very helpful as students try to become self-regulated learners" (Pintrich, 1995, p.11). Embedded evaluation strategies may provide students with explicit feedback that relates effort to learning so that students can determine how well their strategy is working. Feedback may include observations about a learner's effort and, when

appropriate, improvement over time (Hagen & Weinstein, 1995). Feedback should indicate progress toward learning goals, that is, mastery and what the learner should know or be able to do; on the other hand, feedback on performance goals, that is, scores, grades, or relative standing may be counterproductive (Hagen & Weinstein). Therefore feedback that includes scores should reflect degree of mastery, not relative standing in a group of learners. When feedback encourages learners to compare their work to a standard or a goal and reflect on the quality of their performance compared to the standard or the goal, the learners engage the SR process of evaluating their learning outcomes.

SR "requires the development of both self-monitoring and self-evaluation processes" (McCombs, 1989, p. 72). Requiring "learners to interact with others, describe their learning processes, evaluate their performance, and provide feedback to each other" encourages metacognitive processes that accompany SR (Osman & Hannafin, 1992, p. 96). On the other hand, any instructional intervention incorporating peer evaluations should operate with the caveat that inaccurate or misleading peer evaluations are nonpunitively corrected quickly for both the evaluator and the evaluated.

Computer-based instruction that prompts students to use learning processes encourages SR (Winne & Stockley, 1998). Feedback may be provided through a display that automatically reports cumulative unit completion and mastery. Progress reports could indicate cumulative assignments with grades throughout instruction. Computer-based instruction that tests a learner frequently and provides the learner with explicit feedback on correct and incorrect responses supports self-evaluation and compels the learner to review the test items and responses.

Instruction may embed evaluation with test reviews or individual assignments. Learners may be required to follow frequent graded or ungraded tests with a review of the test and corrective feedback. Instruction could require learners to suggest how they might improve a test response or an assignment based on external evaluation. Another technique especially adaptable to distance learning might have learners use assignment evaluation criteria as a quality control checklist during assignment preparation and then receive their assignment evaluations based on the same criteria. The process encourages learners to compare their work to a set of standards during and after completion: (a) provide the learner with a set of measurable criteria for a product or process in a checklist format, (b) instruct the learner how to use the criteria as a quality control checklist when preparing the activity or completing the product, and (c) provide the learner with feedback on the quality of completed process or product using the same criteria checklist (Ley, 1999). Learners can compare their self-evaluations to an external evaluation conducted by the instructor or computer-mediated instruction and then determine their self-evaluation effectiveness.

DISCUSSION

Embedded SR support may be more important for some learners than others. According to Zimmerman (1989), "all learners try to self-regulate their academic learning and performance in some way, but there are dramatic differences in methods and self-beliefs among students" (p. 6). Evidence suggests that some learners may be less inclined or able to self-regulate than others (Zimmerman & Martinez-Pons, 1990). Several distinct activities and cognitive processes comprise SR but a select few apparently are associated with achievement levels. Less self-regulated learners may benefit from interventions that guide how, what, and where to study, (McCombs, 1989) and depend less on ineffective and inefficient learning approaches they know and use (Garner, 1990). Embedded SR support may be able to guide them through effective preparation, organization, monitoring and evaluation processes. Assuring that these few components are structured into the learning experience may help those who need it most.

Lower-achieving learners do far better when their instructional choices are limited by high structure (Kulik & Kulik, 1991). But how much structure is necessary? The answer depends on the learner's current SR skill. A complementary relationship between external and internal "reg-

ulation mechanisms . . . may provide a powerful balance among available alternatives" (Osman & Hannafin, 1992, p. 89). Since better learners probably employ strategies associated with SR to compensate for cognitive deficiencies (Di Vesta & Moreno, 1993), increased SR support might compensate for weak SR. Instruction may be embedded with information and activities to compensate for SR weaknesses in less self-regulated learners without adversely affecting more self-regulated learners. Including SR has not decreased achievement in more self-regulating students but has closed the achievement gap between more and less self-regulating students (Young, 1996).

Providing support for SR may have some advantages over teaching study skills or trying to teach the more specific SR strategies. First, the designer does not have to develop instruction to teach strategies, a time-consuming process that may not be needed by all learners and may have limited transferability (Hadwin & Winne, 1996). Second, instructional designers and instructors may be able to create instruction that supports more lower-achieving and often less self-regulating learners regardless of the media, content, or population for whom it is intended. Specific media or instructional format or population have been suggested as options, not requirements.

CONCLUSION

Although some educators advise against allowing learners to rely solely on external prompts (Brown et al., 1994) others advise the use of instructional interventions that support the learner's metacognitive activities (McCombs, 1989; Puntambekar, 1995). Most researchers agree that some students may only develop learning strategies that support SR when given explicit instruction (Ertmer & Newby, 1996). Some students require support to help them become masters of their own learning by acquiring the capability to self-regulate learning (Lebow, 1993).

This article has proposed four principles for embedding instructional SR to address deficiencies often associated with less self-regulated, lower-achieving learners—(a) guide learners to prepare and structure an effective learning environment, (b) organize instruction and activities to facilitate cognitive and metacognitive processes, (c) use instructional goals and feedback to present student monitoring opportunities, and (d) provide learners with continuous evaluation information and occasions to self-evaluate. These four principles should guide embedding SR support in a wide variety of instructional media and contexts. The principles guide but do not guarantee better learning. The true test of design principles is their usefulness, effectiveness, and efficiency. This test should be the next step in determining their value to instructional designers and learners. □

Kathryn Ley is with the Department of Instructional Technology, University of Houston Clear Lake. She can be reached at ley@cl.uh.edu.

Dawn B. Young is with the Department of Behavioral Sciences at Bossier Parish Community College.

The authors thank Peggy Ertmer, Gayle Davidson-Shivers, and Jim Klein for greatly improving the manuscript with their insightful recommendations.

REFERENCES

Belfiore, P.J., & Hornyak, R.S. (1998). Operant theory and application to self-monitoring in adolescents. In D.H. Schunk & B.J. Zimmerman, (Eds.) *Self-regulated learning; from teaching to self-reflective practice* (pp. 184–202). New York: The Guilford Press.

Biemiller, A., Shany, M., Inglis, A., & Michenbaum, D. (1998). Factors influencing children's acquisition and demonstration of self-regulation on academic tasks. In D.H. Schunk & B.J. Zimmerman, (Eds.) *Self-regulated learning; from teaching to self-reflective practice* (pp. 203–224). New York: The Guilford Press.

Bouffard, T., Boisvert, J., Vezeau, C., & LaRouche, C. (1995). The impact of goal orientation on self-regulation and performance among college students. *British Journal of Educational Psychology, 65,* 317–329.

Brown, A.L., Bransford, J.D., Ferrara, R.A., & Campione, J.C. (1983). Learning, remembering and understanding. In P.H. Mussen, (Ed.) *Handbook of psychology* (Vol. III, pp. 77–166). New York: Wiley.

Brown, C., Hedberg, J., & Harper, B. (1994). Metacognition as a basis for learning support software. *Performance Improvement Quarterly, 7*(2), 3–26.

Butler, D. (1998). A strategic content learning approach to promoting self-regulated learning by students

with learning disabilities. In D.H. Schunk & B.J. Zimmerman, (Eds.) *Self-regulated learning; from teaching to self-reflective practice* (pp. 160–183). New York: The Guilford Press.

Butler, D., & Winne, P.H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research, 65,* 245–282.

Corno, L. (1986). The metacognitive control components of self-regulated learning. *Contemporary Educational Psychology; 11*, 333–346.

Corno, L. (1994). Student volition and education: Outcomes, influences, and practices. In D.H. Schunk & B.J. Zimmerman (Eds.), *Self-regulation of learning and performance: Issues and educational applications* (pp. 229–254). Hillsdale NJ: Lawrence Erlbaum Associates, Publishers.

Corno, L. (1995). Comments on Winne: Analytic and systemic research are both needed. . *Educational Psychologist, 30,* 201–206.

Corno, L. & Mandinach, E.B. (1983). The role of cognitive engagement in classroom learning and motivation. *Educational Psychologist, 18*, 88–108.

Corno, L. & Randi, L. (1999). A design theory for classroom instruction. In C.R. Reigeluth (Ed.), *Instructional design theories and models: A new paradigm of instructional theory, Vol. II* (pp. 293–318). Hillsdale NJ: Lawrence Erlbaum Associates, Publishers.

Di Vesta, F.J., & Moreno, V. (1993). Cognitive control functions of study activities: A compensation model. *Contemporary Educational Psychology, 18,* 47–65.

Driscoll, M.P. (2000). *Psychology of learning for instruction.* Boston: Allyn and Bacon.

Ertmer, P.A. & Newby, T.J., (1996). The expert learner: Strategic, self-regulated, and reflective. *Instructional Science, 24,* 1–24.

Ertmer, P.A., Newby, T.J., & MacDougall, M. (1996). Students' responses and approaches to case-based instruction: The role of reflective self-regulation. *American Educational Research Journal, 33,* 719–752.

Gagné, R.M. (1985). *The conditions of learning* (4th ed.). New York: Holt, Rinehart & Winston.

Garner, R. (1990). When children and adults do not use learning strategies: Toward a theory of settings. *Review of Educational Research, 60,* 517–529.

Graham, S., Harris, K.R., & Troia, G.A. (1998). Writing and self-regulation: Cases from the self-regulated strategy development model. In D.H. Schunk & B.J. Zimmerman, (Eds.) *Self-regulated learning; from teaching to self-reflective practice* (pp. 20–41). New York: The Guilford Press.

Hadwin, A.F., & Winne, P.H. (1996). Study strategies have meager support; a review with recommendations for implementation. *Journal of Higher Education, 67,* 692–715.

Hagen, A.S., & Weinstein, C.E. (1995). Achievement goals, self-regulated learning and the role of classroom context. In P.R. Pintrich (Ed.), *Understanding self-regulated learning* (pp. 43–56). San Francisco: Jossey Bass.

Hofer, B.K., Yu, S.L., & Pintrich, P.R., (1998). In D.H. Schunk & B.J. Zimmerman, (Eds.) *Self-regulated learning; from teaching to self-reflective practice* (pp. 57–85). New York: The Guilford Press.

Jonassen, D.H., & Grabowski, B.L. (1993). *Handbook of individual differences, learning, and instruction.* New York: Lawrence Erlbaum Associates.

Kinzie, M. (1990). Requirements and benefits of effective interactive instruction: Learner control, self-regulation, and continuing motivation. *Educational Technology Research and Development 38,*(1), 5–21.

Kluger, A. & DeNisi, A. (1996). The effects of feedback interventions on performance: a historical review, a meta analysis, and a preliminary feedback intervention theory. *Psychological Bulletin, 119*(2) 254–284.

Kulik, J.A., & Kulik, C.C. (1991). *Developmental instruction; an analysis of the research.* Appalachian State University: National Center for Developmental Education.

Lan, W.Y. (1996). The effects of self-monitoring on students' course performance, use of learning strategies, attitude, self-judgment ability, and knowledge representation. *Journal of Experimental Education, 64,* 101–115.

Lan, W.Y. (1998). Teaching self-monitoring skills in statistics. In D.H. Schunk & B.J. Zimmerman, (Eds.) *Self-regulated learning; from teaching to self-reflective practice* (86–105). New York: The Guilford Press.

Lebow, D. (1993). Constructivist values for instructional systems design: Five principles toward a new mindset. *Educational Technology Research and Development, 41,* 4–16.

Ley, K.L. (1999). Providing feedback to distant students. *Campus Wide Information*

Systems, 16(2) 63–69.

Ley, K., & Young, D.B., (1998). Self-regulation behaviors in underprepared (developmental) and regular admission college students. *Contemporary Educational Psychology 23*, 42–64.

McCombs, B.L. (1989). Self-regulated learning and academic achievement: A phenomenological view. In B.J. Zimmerman & D.H. Schunk (Eds.), *Self regulated learning and academic achievement: Theory, research, and practice* (pp. 51–82). New York: Springer Verlag, Publishers.

Meece, J.L. (1994). The role of motivation in self-regulated learning. In D.H. Schunk and B.J. Zimmerman (Eds.), *Self regulation of learning and performance,* (pp. 25–44). Hillsdale, NJ: Lawrence Erlbaum.

Nist, S.L. & Holschuh, J.L.(2000). Comprehension strategies at the college level. In R.F. Flippo & D.C. Caverly (Eds.), *Handbook of college reading and study strategies* (pp. 75–104). Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Orange, C. (1999). Using peer modeling to teach self-regulation. *Journal of Experimental Education, 68* (1) 21–39.

Osman, M.E. & Hannafin, M.J. (1992). Metacogntiion research and theory: Analysis and implications for instructional design. *Educational Technology Research and Development, 40(2),* 83–99.

Pintrich, P.R. (1995). Understanding self-regulated learning. In P.R. Pintrich (Ed.), *Understanding self-regulated learning* (pp. 3–12). San Francisco: Jossey Bass.

Pressley, M., El-Dinary, P.B., Wharton-McDonald, R., & Brown, R.(1998). Transactional instruction of comprehension strategies in the elementary grades. In D.H. Schunk & B.J. Zimmerman, (Eds.) *Self-regulated learning; from teaching to self-reflective practice* (pp. 42–56). New York: The Guilford Press.

Puntambekar, S. (1995). Helping students learn 'how to learn' from texts: Towards an ITS for developing cognition. *Instructional Science 23,* 163–182.

Schunk, D. (1990). Goal setting and self-efficacy during self-regulated learning. *Educational Psychologist, 25,* 71–86.

Schunk, D. (1998). Teaching elementary students to self-regulate practice of mathematical skills with modeling. In D.H. Schunk & B.J. Zimmerman, (Eds.) *Self-regulated learning; from teaching to self-reflective practice* (pp. 137–159). New York: The Guilford Press.

Schunk, D., & Zimmerman, B. (Eds.). (1998). *Self-regulated learning; from teaching to self-reflective practice.* New York: Guilford Press.

Shin, M. (1998). Promoting students' self-regulation ability: Guidelines for instructional design. *Educational Technology, 38*(1), 38–44.

Simpson, M., & Randall, (2000). Vocabulary development at the college level. In R.F. Flippo & D.C. Caverly (Eds.), *Handbook of college reading and study strategies* (pp. 43–74). Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Trawick, L., & Corno, L. (1995). Expanding the volitional resources of urban community college students. *New Directions for Teaching and Learning, 63,* 57–70.

Weinstein, C.E. (1994). Strategic learning/strategic teaching: Flip sides of a coin. In P.R. Pintrich, D.R. Brown, & C.E. Weinstein, (Eds.), *Student motivation, cognition, and learning.* (257–274). Hillsdale, NJ: Lawrence Erlbaum.

Winne, P.H., & Stockley, D.B. (1998). Computing technologies as sites for developing self-regulated learning. In D.H. Schunk & B.J. Zimmerman, (Eds.) *Self-regulated learning; from teaching to self-reflective practice* (pp. 106–136). New York: The Guilford Press.

Young, J.D. (1996). The effect of self-regulated learning strategies on performance in learner controlled computer based instruction. *Educational Technology Research, and Development 44*(2), 17–28.

Zimmerman, B.J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology, 81,* 329–339.

Zimmerman, B.J. (1998). Academic studying and the development of personal skill: A self-regulatory perspective. *Educational Psychologist, 33* (203), 73–86.

Zimmerman, B.J., & Kitsantas, A. (1997). Developmental phases in self-regulation: Shifting from process goals to outcome goals. *Journal of Educational Psychology 89,* 29–36.

Zimmerman, B.J., & Martinez-Pons, M. (1986). Development of a structured interview for assessing student use of self-regulated learning strategies. *American Educational Research Journal, 23,* 614–628.

Zimmerman, B.J., & Martinez-Pons, M. (1988). Construct validation of a strategy model of student self-regulated learning. *Journal of Educational Psychology, 80,* 284–290.

Zimmerman, B.J., & Martinez-Pons, M. (1990). Student differences in self-regulated learning: Relating grade, sex and giftedness to self-efficacy and strategy use. *Journal of Educational Psychology, 82,* (1) 51–59.

Zimmerman, B.J., & Paulsen, A.S. (1995). Self-monitoring during collegiate studying: An invaluable tool for academic self-regulation. In P.R. Pintrich (Ed.), *Understanding self-regulated learning* (pp. 13–28). San Francisco: Jossey Bass.

Zimmerman, B.J., & Risemberg, R. (1994). Investigating self-regulatory processes and perceptions of self-efficacy in writing by college students. In P.R. Pintrich, D.R. Brown, & C.E. Weinstein, (Eds.), *Student motivation, cognition, and learning* (pp. 239–256). Hillsdale, NJ: Lawrence Erlbaum.