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The expert learner: Strategic, self-regulated, and reflective

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Abstract. Reflection on the process of learning is believed to be an essential ingredient in the development of expert learners. By employing reflective thinking skills to evaluate the results of one's own learning efforts, awareness of effective learning strategies can be increased and ways to use these strategies in other learning situations can be understood. This article describes how expert learners use the knowledge they have gained of themselves as learners, of task requirements, and of specific strategy use to deliberately select, control, and monitor strategies needed to achieve desired learning goals. We present a model of expert learning which illustrates how learners' metacognitive knowledge of cognitive, motivational, and environmental strategies is translated into regulatory control of the learning process through ongoing reflective thinking. Finally, we discuss the implications that the concept of expert learning has for instructional practices.

We have all probably met, at one time or another, 'expert' learners: those successful individuals who approach academic tasks with confidence, diligence, and resourcefulness. It's not merely the *amount* of knowledge or *number* of skills possessed that distinguishes these learners from their less successful peers, but rather their ability to implement appropriate regulatory strategies when they become aware that certain facts or skills are missing from their learning repertoires that are necessary for reaching desired academic goals. Expert learners display planfulness, control, and reflection; they are aware of the knowledge and skills they possess, or are lacking, and use appropriate strategies to actively implement or acquire them. This type of learner is self-directed and goal oriented, purposefully seeking out needed information, 'incorporating and applying a variety of strategic behaviors to optimize academic performance' (Lindner & Harris 1992).

To illustrate the concepts discussed in this paper, we would like you to consider the studying behaviors of the following two high school students, Emilie and Monica, upon hearing that they will be taking an essay test on a textbook chapter that discusses the effects of environmental pollution on the ecosystem. Assume, for the sake of comparison, that neither learner has any prior experience in this subject area.

When Emilie is told about the upcoming test she is slightly worried, not only because the test is scheduled for the morning after the basketball playoff game, but also because she is aware that essay tests are difficult for her. Although she sees herself as a competent hard-working student, she acknowledges this weakness in herself and knows that she will have to be more selective about the way she prepares for this test. She realizes that she must set aside ample time and that she should probably not study at home as she is likely to be distracted by the telephone and other family members. A few days before the test, Emilie takes her text and a notebook to her favorite study carrel at the public library. She likes to study there because the desks and chairs are comfortable, the lighting is good, and there is a minimal amount of noise. Emilie recalls that when she studies for a multiple-choice test she usually begins by writing definitions for all the bold-faced words. However, she knows that studying for an essay test requires different strategies. Although it will take her a little longer, Emilie decides to prepare for the test by outlining the information in the chapter and reorganizing it so that it can be more readily recalled. This strategy has been helpful in the past and Emilie is willing to take the extra time needed.

While skimming the chapter, Emilie notices that the authors have presented the information by linking causes and effects. She divides a piece of paper into two columns, 'causes' and 'effects', and proceeds to fill in the information. As she works through her outline, Emilie stops periodically to assess the progress she is making. Is her plan working the way she had anticipated? Is she maintaining her concentration? Is she understanding the content? Emilie judges that her understanding has been enhanced by visually representing the relationships among the concepts being discussed. After completing the outline, Emilie self-tests by drawing a diagram of the chapter to illustrate the relationships between events and outcomes in the ecosystem. During the next few days, Emilie reviews her outline and informally discusses her understanding of the concepts with her classmates. When opposing viewpoints arise, Emilie checks back with the text and, if necessary, consults with the teacher about her confusions. The evening before the test, Emilie completes a final self-check before heading to the big basketball game; she wouldn't pass up a chance to cheer for her favorite team!

Monica is also anxious about the test format because she is aware that she usually does better on multiple-choice tests. She's not really sure why that is, but judges that if she just studies harder she will be successful. She thinks if she spends a little more time reading and rereading the chapter and memorizing the vocabulary words she'll be prepared. Monica doesn't make a conscious decision about when or how to study; she automatically plans to study the night before the test so she has a greater chance of recalling the memorized information. She does notice that the test is scheduled for the day after the big basketball game and thinks that is unfortunate, if not a little unfair. She is nervous about not getting started until after the game but she really can't think of any other alternatives; missing the big game is not an option; the idea of starting to study a day or two earlier, or studying a different way, never crosses her mind.

It is essential for Emilie and Monica to utilize their knowledge about ecosystems in a flexible manner when they finally take the test. Because Emilie's approach has increased her understanding of the workings of an ecosystem, she is able to access her knowledge from a variety of vantage points, and thus performs in a confident and competent manner. Although Monica has increased her knowledge of the specific terminology related to environmental ecosystems, she finds it difficult to utilize this information to answer the essay questions. She leaves the test feeling anxious about her grade; did she do well enough to pass the test? (Based, in part, on an example from Palinscar & Brown 1989.)

For many years educators have defined an expert as 'any individual who is highly skilled or knowledgeable in a given domain' (Bruer 1993: 8), suggesting that expertise depends on well-organized, domain-specific knowledge that arises only after extensive experience has been gained in a particular area. However, it is easy to see that the difference between Emilie and Monica is not due so much to the amount of content knowledge each possesses (both are novices in this domain), as to the approach each takes for learning new information. Although both students spend time studying, Emilie's awareness of herself as a learner and her knowledge of cognitive strategies (using text structure to outline the chapter) enables her to implement a strategic study plan. By comparing task demands with personal constraints and resources, Emilie is able to take charge of her learning activity. In contrast, Monica has little, if any, awareness of these critical factors: she isn't sure why she is better at one task than another; she seems unaware of the available personal resources she might garner to accomplish the studying task; she doesn't know how to adapt her study plan to meet the specific task demands. The difference between Emilie and Monica is not a simple quantitative difference in the amount of content knowledge possessed; what are illustrated here are the qualitative differences that exist between a more expert learner and a less strategic peer.

This article explains and illustrates this concept of an expert learner as a strategic, self-regulated, and reflective learner. We describe how expert learners approach novel learning tasks; how metacognition (knowledge and regulation of one's own learning) facilitates the strategic performance of expert learners; and how reflection provides the critical link between the knowledge and control of the learning process. Although these concepts of expertise, metacognitive knowledge and regulation, and reflection are mentioned quite frequently in the literature, the relationship among them has not been well established. Weinstein & Van Mater Stone (1993) have taken the first step by linking the notions of expert and self-regulated learners yet we are convinced that, without the additional element of reflection, expert learning cannot occur. Our conception of expert learning focuses on reflection as the key to the process. To facilitate our discussion of these concepts, we present a model of the metacognitive knowledge and regulatory processes that underlie and support expert learning. The major components of knowledge and self-regulation are discussed first, followed by an explanation of how the process of reflection provides a critical link between them.

The expert learner – a description

The topic of expertise first appeared in major textbooks in cognitive psychology in 1985, in Anderson's second edition of *Cognitive Psychology and Its Implications* (noted in Chi, Glaser & Farr 1988). Since that time, many studies have examined the differences between experts and novices in a variety of fields including chess, physics, architecture, electronics, teaching, etc. (cf., Chi, Glaser & Farr 1988; Swanson, O'Connor & Cooney 1990). For many years educators' conception of an expert was 'simply someone who knew more about something than most other people knew' (Weinstein & Van Mater Stone 1993: 31). Although most people tend to think that it is the presence of large stores of knowledge that 'make an expert', current research indicates that there are both quantitative and qualitative differences between experts and novices (Alexander & Judy 1988; Bruer 1993; Paris, Lipson & Wixcon 1983). While the amount of experience one accumulates is an important part of expertise, experience alone is not considered sufficient to guarantee its development (Berliner 1994; Bruer 1993).

In 1988, Glaser and Chi listed and described seven key characteristics of expert performance that previous research had uncovered. Weinstein & Van Mater Stone (1993) have summarized these characteristics succinctly: 'experts know more; their knowledge is better organized and integrated; they have better strategies and methods for getting to their knowledge, using it, applying it, and integrating it; and they have different motivations. Moreover, they tend to do things in a more self-regulated manner' (p. 32). Experts are described as being more aware of themselves as learners; their learning is 'reflected upon more than is the learning in which others engage' (Berliner 1994: 162). In addition, experts are thought to be more sensitive to the task demands of specific problems, as well as more opportunistic and flexible in their planning and their actions (Berliner 1994). As a result, experts are more aware than novices of *when* they need to check for errors, *why* they fail to comprehend, and *how* they need to redirect their efforts (Brown & DeLoache 1978, italics added).

To some extent, the self-knowledge and superior monitoring skills of experts simply reflect the accumulation of greater domain knowledge and a different representation of that knowledge from novices. Yet expertise depends on more than just knowing facts and procedures (Schunk 1991a). It is the monitoring and self-regulatory skills that enable experts to know not only *what* is important (declarative knowledge) but also *how* (procedural knowledge), *when, where*, and *why* (conditional knowledge) to apply the right knowledge and actions. Expert learners are *strategic* strategy users. By using the knowledge they have gained of themselves as learners, of task requirements, and of specific strategy use, they can deliberately select, control, and monitor strategies to achieve desired goals and objectives. Learning activities are monitored while in progress to make on-line decisions regarding whether the strategy(ies) in use should be continued, modified, or terminated.

Bransford & Vye (1989) extended Glaser and Chi's (1988) summary by describing some of the regulatory strategies that experts employ. Citing the work of a number of researchers, Bransford and Vye described experts as monitoring their own thinking and problem solving better than novices; judging the difficulty of problems more successfully; allocating their time and assessing their progress more effectively; and predicting the outcomes of their performance more accurately. The description of Emilie's studying behavior, provided earlier, depicts these qualities in action. Emilie's success was not due simply to her ability to apply an appropriate cognitive strategy, i.e., outlining based on text structure. What was more critical was her ability to effectively match the demands of the studying task with her own personal resources and constraints. By reflecting on previous learning experiences, Emilie effectively combined knowledge of task requirements (the particular demands of studying for essay tests), her own learning habits (preference for multiple-choice tests, willingness to work hard to master the content), and effective regulatory strategies (planning a time and place for studying, monitoring progress through self-testing and self-questioning, assessing understanding through peer conversations, while continually adjusting and revising chosen strategies to meet changing task demands) to create and implement a strategic study plan.

Less successful learners are not as likely to monitor their own learning and, as illustrated by Monica, often do not have a very good idea about whether they have comprehended and mastered the information presented. It is generally acknowledged that many students are not adept at cognitive self-appraisal (Paris & Winograd 1990). Candy, Harri-Augstein & Thomas (1985) state that 'most students are almost totally unaware of how they attribute meaning to the things they encounter in lectures, laboratories, libraries, seminars, work placements and elsewhere' (p. 101). Furthermore, novice learners are unlikely to use self-tests and self-questioning as sources of feedback to correct misconceptions and/or to redirect the use of learning strategies (Brown, Bransford, Ferrara & Campione 1983; Stein, Bransford, Franks, Vye & Perfetto 1982; Rafoth, Leal & DeFabo 1993).

These differences point to a meaningful distinction between expert and novice learners: expert learners notice when they are not learning and thus are likely to seek a strategic remedy when faced with learning difficulties. By being consciously aware of themselves as problem solvers and by monitoring and controlling their thought processes, these learners are able to perform at a more expert level, regardless of the amount of specific domain knowledge possessed. Novice learners, on the other hand, rarely reflect on their own performances and seldom evaluate or adjust their cognitive functioning to meet changing task demands or to correct unsuccessful performances (Paris & Newman 1990). When an expert learner is faced with a cognitive failure (lack of understanding), the failure is detected and learning strategies are altered so as to 'fix' the problem. Poorer learners are unlikely to even detect the cognitive failure. For example, Baker (1984) demonstrated that poor readers often rely on a single criterion for textual understanding: comprehension of single words. As long as the individual words make sense, these students continue 'reading' despite their poor degree of text-level comprehension.

Figure 1 illustrates the two basic components of metacognition which are believed to facilitate expert learning. Although knowledge (of cognitive states and learning processes) and control (management and regulation of learning) are represented in our model as separate entities, we believe that these constructs interact in a dynamic way to bring about expert learning. Neither one alone can facilitate the entire process: knowledge includes an understanding of the task demands, of oneself as a learner, and the comparative relationship between the two; control (which we will refer to as self-regulation) is the application and evaluation of that knowledge in action. These processes do not take place in a linear fashion but occur in a more cyclic, interactive manner. Students' knowledge of academic tasks and their perceptions of themselves as learners influence their judgments and beliefs about their personal learning which, in turn, affect the strategies they choose and the effort they expend in school. Metacognitive knowledge provides learners with the personal insights needed to regulate their learning process in relationship to changing task demands. Together, this knowledge of, and ability to regulate, one's cognition are thought to facilitate expert learning (Paris & Winograd 1990).

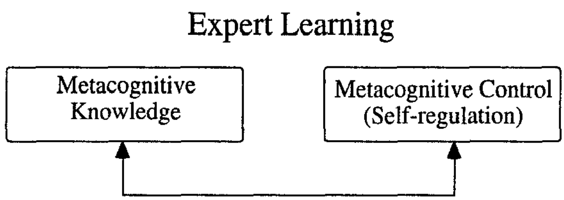

Figure 1. Major components of expert learning.

The expert learner as a strategic knowledge user

Most of the work in the area of expert/novice differences has been done in very specific content areas such as physics, chess, computer programming, etc. While it is important to consider how experts approach novel problems in their own domains of expertise, it is also useful to consider how experts think and solve problems in unfamiliar domains. Differences in how successful and unsuccessful learners approach new information can inform our conception of expert learners. When faced with a new type of problem, everyone is a novice to a certain extent since even general problem solving skills are thought to differ across domains (Bransford & Vye 1989; Pressley, Borkowski & Schneider 1987). Thus, when we are asked to deal with novel situations, the specific cognitive skills and learning strategies we have available become more critical than the limited content knowledge we may possess.

Weinstein & Van Mater Stone (1993) indicate that expert learners strategically utilize four different types of knowledge to bring about successful learning: knowledge about selves as learners (e.g., What are my strengths? What time of day is best for me? What are my current study habits?); knowledge about learning tasks (e.g., What does this task require for successful completion? How will performance on this task be evaluated?); knowledge about a wide variety of strategies (e.g., What cognitive strategies would facilitate the recall of this information? What can I do to keep my motivation high? What obstacles in the environment must be removed or sidestepped?); and knowledge about content (What do I know about this topic?). In addition, an expert learner has the 'skill, will, and a systematic approach to studying and learning' (Weinstein & Van Mater Stone 1993: 35) which make strategic learning not only possible, but probable as well.

Figure 2 illustrates the different kinds of knowledge which interact to bring about expert learning. On the one side, knowledge of task requirements includes information about: a) the type of task to be accomplished (e.g., memorizing, rule-finding, problem-solving, etc.), and b) the types of strategies and resources that are most effective for accomplishing given tasks. This information may be of a cognitive (e.g., specific comprehension,

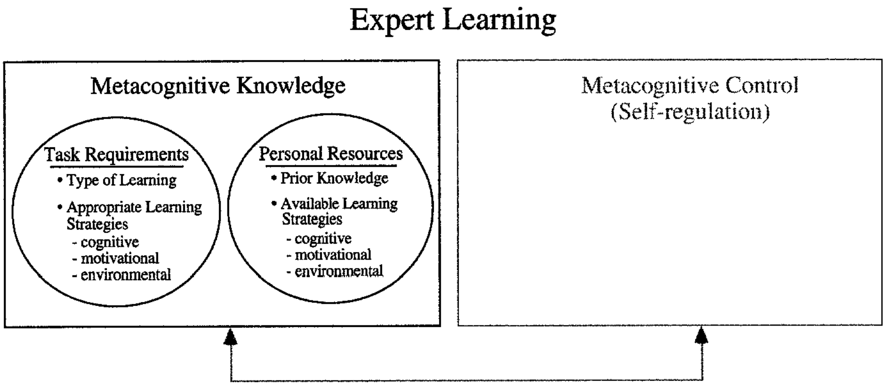

Figure 2. Types of metacognitive knowledge involved in expert learning.

organizational, and/or elaboration strategies which are effective with this task), motivational (e.g., the amount of effort required to complete the task; the relevance of the topic to the learner), and/or environmental nature (e.g., optimal study conditions for meeting the demands of the task). For example, tasks requiring a low degree of processing (e.g., matching common French and English vocabulary words) have different requirements than tasks demanding high levels of processing (e.g., translating a French passage into proper English).

The second category of metacognitive knowledge depicted in Figure 2, knowledge of personal resources, includes: a) an awareness of one's prior knowledge and previous experiences with the content to be learned, and b) information regarding one's skill at employing the various types of learning strategies suggested by the task. As before, these learning strategies may be of a cognitive (e.g., mnemonics, outlining, elaboration, etc.), motivational (e.g., setting goals, providing self-reinforcement, using positive self-talk), and/or environmental nature (e.g., arranging study space, scheduling adequate time, utilizing outside resources).

One might think of this body of metacognitive knowledge as a type of warehouse where the learner stores information that has been gained from previous learning experiences regarding task requirements and personal learning resources. Knowledge about learning situations, as well as rules about when and how to apply various learning strategies, is stored in, and accessed from, this warehouse. As suggested by Weinstein & Van Mater Stone (1993), expert learners would be distinguished from their less strategic peers by both the size and the accessibility of the stores of knowledge in their metacognitive warehouses.

For example, even though Emilie was a novice in the specific domain of ecosystems, she was aware of a variety of cognitive, motivational, and environmental strategies that could be employed in accomplishing the assigned task. This included knowledge of general learning strategies (e.g., paying attention, expending effort), as well as specific strategies (e.g., locating a quiet study environment, using outlining techniques) that had been successful with similar tasks in the past. Emilie's ability to recall the specific task requirements of studying for an essay test (effective cognitive strategies, required levels of concentration and effort, and appropriate studying environments), as well as her previous knowledge of, and skill in, meeting such requirements, indicates that she had access to an organized and well-stocked knowledge warehouse.

The expert learner as self-regulated

When do learners utilize these stores of metacognitive knowledge regarding task requirements and personal resources? How does this knowledge affect the way learners manage the learning process itself? Although many of us can recognize ourselves or someone we know in the previous description of an expert learner, researchers have neither pinpointed, nor agreed upon, a precise definition of the component processes by which students regulate their learning. Numerous definitions and various descriptions of self-regulation exist, varying somewhat in accordance with each researcher's theoretical orientation. However, Zimmerman (1990) has examined the similarities among definitions of self-regulated learning and has listed the following features as common to most: students' selective use of learning strategies; responsiveness to feedback regarding learning effectiveness; and self-initiated efforts to seek out opportunities to learn.

Zimmerman's definition of self-regulated learners, commonly cited in the literature, describes such learners as 'metacognitively, motivationally, or behaviorally active promoters of their academic achievement' (1986: 308). This definition suggests that self-regulated learners utilize three types of strategies to orchestrate their learning: metacognitive, motivational, and behavioral. Although we use a slightly different classification scheme, our model of the expert learner includes these same components, as well as an additional piece: knowledge and use of effective cognitive strategies.

Metacognitive strategies described by Zimmerman (1990) include: setting goals, organizing, self-monitoring, and self-evaluating. These strategies correspond well to those which we have incorporated within the regulatory component of expert learning and will be described in more detail in the next few pages. Zimmerman's motivational and behavioral strategies are almost identical to the motivational and environmental strategies described in the previous section. We have, however, expanded Zimmerman's list of strategies to include those of a cognitive nature (e.g., rehearsal, mnemonics, analogies, imagery, etc.). To successfully orchestrate the learning process, an expert learner must effectively select and manage strategies in each of these categories. However it should be noted that although we categorize a learner's awareness of motivational, environmental, and cognitive strategies as part of the knowledge component of metacognition, we agree with Zimmerman that this knowledge is actually utilized by an expert learner during the regulation process.

Our model suggests that *during* the learning process, learners *use* their metacognitive knowledge of cognitive, motivational, and/or environmental strategies to *choose* those strategies which are most appropriate for a given learning task. This metacognitive *knowledge* of the mental processes and strategies required for the performance of any cognitive task then becomes manifested in the strategic *control* of the processes necessary for successful performance (Schmitt & Newby 1986). Metacognition, then, is manifested in self-regulated learning that reflects 'the systematic application of declarative, procedural, and conditional knowledge to tasks' (Schunk 1991b: 183). Furthermore, as the learner reflects on the learning process, additional metacognitive knowledge about task and self characteristics is gathered, which is then available when planning for, monitoring, and evaluating future learning tasks. Evaluations and reactions to one's performance can both inform and motivate, setting the stage for additional observations of the same or other strategic behaviors (Schunk 1991b).

The process of self-regulation

How do expert learners actually go about managing their own learning? What are the individual steps in the process of self-regulation? Figure 3 extends our original model of the expert learner to illustrate how the various components of self-regulation – planning, monitoring, and evaluating – interact to bring about successful learning. Although presented in a manner that suggests that each step occurs only once within a single learning activity, in reality they interact and dynamically impact each other in a recursive fashion.

Before beginning a specific learning task, expert learners tend to consider a variety of ways to approach the task. They access their knowledge warehouses to recall past experiences with similar tasks and select an approach which matches task requirements and personal resources in such a way that the desired results can be obtained. Effective learners have a plan (either in their minds or on paper) that details how they expect to accomplish their goals. While executing the task, they constantly reflect on this plan to assess

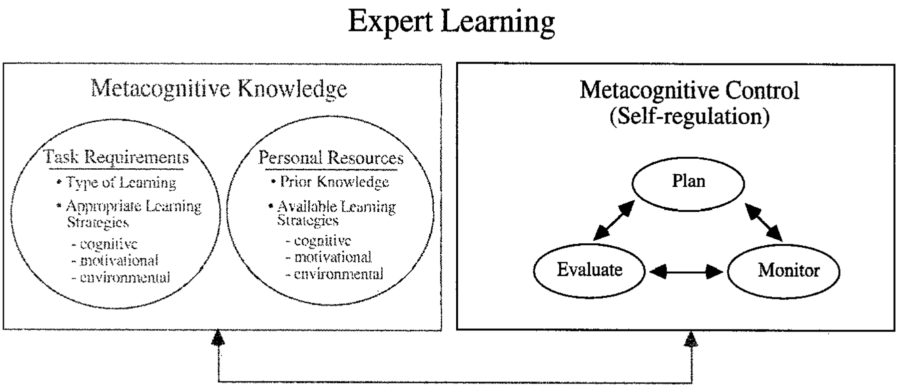

Figure 3. Self-regulation components involved in expert learning.

the extent to which it is working and then revise or modify it as necessary. As a result of this continuing reflection, expert learners make constant on-line adjustments, eliminating extraneous steps, implementing alternative strategies, and/or performing unplanned actions whenever necessary. In the next section we discuss how an expert learner activates each of these operations during a learning task. Following that, we discuss how the individual processes are all linked through reflection.

Planning

Before beginning a task, expert learners must consider three things: 1) the task demands (e.g., type and length of the material to be learned); 2) their own personal resources (e.g., knowledge of and skill at using various strategies); and 3) potential matches between the two (e.g., mnemonics vs rehearsal vs outlining strategies for remembering the names of the Great Lakes). For example, if learners think that note taking and underlining are good strategies for identifying the main points of a technical article (task) and know that they are good at underlining but poor at taking notes (personal resources), the most effective match would call for underlining.

According to Beyer (1987), anticipatory planning serves three purposes: it eases the actual execution of the task, it increases the likelihood of successfully accomplishing the task, and it tends to produce a product (e.g., effective match, solution, decision) of quality. The activities involved in this step tend to resolve around three major tasks: setting a clear goal, selecting and sequencing a series of strategies and/or procedures for achieving the goal, and identifying potential obstacles to the successful attainment of the goal. It is important to note that the strategies/procedures selected must include not only the appropriate cognitive strategies (e.g., outlining, memorizing, analogizing, etc.) but also the motivational (e.g., recalling previous successful performances, determining task relevance) and environmental strategies (e.g., removing distractions, forming work groups) which would be instrumental in completing the learning task.

In our earlier example, Emilie set a clear goal for mastering the textbook content for the upcoming essay exam. Based on her knowledge of both the demands of the task and her available personal resources, she carefully decided on a study plan which was designed to create a match between the two. She selected a special time and place to study and consciously chose to use different cognitive strategies than those used to prepare for multiple-choice tests. She considered potential obstacles in terms of time, motivation, and personal understanding and subsequently adjusted her plan to reflect ways to overcome these; she allowed enough time to study and self-test and availed herself of the opportunity to clarify her ideas with her teachers and peers. By simultaneously utilizing her personal strengths (e.g., skill in employing a variety of cognitive strategies, will to succeed, ability to optimize her studying environment), while adjusting for her weaknesses (e.g., preference for multiple choice tests, need for extra time and effort in comprehending the material, competing demands for her attention), Emilie was able to create a strategic study plan; i.e., one which carefully matched task requirements with her own available resources.

Monitoring

Monitoring a learning act is a complex process which involves: an awareness of what one is doing, an understanding of where it fits into the established sequence of steps, and an anticipation and planning for what ought to be done next. Furthermore, this is all accomplished while one is engaged in the learning act itself!

Throughout the execution of a learning plan, expert learners mentally check what they are doing to ensure that they are making progress toward the specified goal. Here the focus is on actually implementing the steps in the plan, while monitoring the effects of selected cognitive, motivational, and environmental strategies. This involves looking backward at the plan to determine if the necessary steps are being performed in the correct order, looking forward to the steps still to be performed, while carefully attending to what is going on at the moment (Beyer 1987). As expert learners complete each step in the plan they must consider how accurately and effectively it was accomplished and decide whether or not it is appropriate to move on to the next step. They need to pay attention to feedback regarding the effectiveness of their selected cognitive, motivational, and environmental strategies and make on-going revisions. If an obstacle is encountered, adjustments must be made, not only to remove the block but to decrease the possibility of it reoccurring at some later point.

As Emilie was studying, she periodically checked to see if her strategies were moving her towards her goal of comprehension. Sometimes Emilie stopped and considered how things were going by visualizing her performance and its effects. Other times she asked herself questions that helped her to determine the current status of her approach. Was she maintaining her concentration and effort? Was the library setting as conducive to studying as she had anticipated? Did her outline of causes and effects help her link her knowledge about the various components of the ecosystem? Was she able to remember the content immediately, as well as some time after, having studied? How did her understanding compare to that of her peers? Although most of Emilie's monitoring skills were covert, others, such as her use of self-testing and peer/teaching checking, were more overt. On the other hand, Monica seemed to have no system for determining when, or if, she had mastered the given material. Although she was motivated to pass the test, her main technique for judging the progress she was making appeared to be in terms of how much time she had spent 'reading and rereading, and memorizing vocabulary words.'

Evaluating

After completing the entire task, expert learners assess both the process employed and the product achieved. According to Berliner (1994), experts appear to be more evaluative than novices. Beyer (1987) suggests that this involves attending to a number of different things: the reasonableness and accuracy of any product that resulted from the learning task (e.g., a classification scheme, a written report, a technical outline) to determine the extent to which the goal was achieved; the overall process, as well as its supporting steps, to determine how effective they were in achieving the goal; the obstacles encountered to determine how well they were anticipated, avoided, and/or managed; and the overall plan to determine its relative effectiveness and efficiency so that it can be modified, if necessary, prior to use with similar tasks in the future.

Had we carried our example of Emilie and Monica a little further, we would have seen a contrast in how the two learners executed this step of the learning process. After taking the test, it is likely that both students would have used their test scores for evaluative purposes: Monica to judge whether or not she had passed the test; Emilie to consider the effectiveness of her approach. Because Monica did not have a strategic plan for studying and focused more on time rather than strategies available, she would have been more likely to attribute her grade to external causes: the total time devoted to the task, good (or bad) luck, teacher bias, level of test difficulty, etc. Emilie, on the other hand, would have been more inclined to attribute her test results to the effectiveness of her plan. If she had been successful, her awareness of the potential benefits of the specific strategies invoked (e.g., scheduling time and resources, using text-based outlining, self-testing, peer checking, continual comprehension monitoring) would have increased. Had she not been successful, modifications in the overall plan and its supporting strategies would have been made prior to further use. Monica's evaluation of her efforts focused on only one aspect of the learning process – the resulting outcome; Emilie's evaluation considered outcomes (product) as well as strategies (process). The types of information gained from Emilie's evaluation would help to increase her cognitive skills (use of an outlining strategy), as well as her metacognitive knowledge (the perceived benefits of this strategy for this type of task).

The expert learner as reflective

How do expert learners coordinate their metacognitive knowledge and regulatory actions to successfully orchestrate their learning? How do they translate what they *know* about learning (metacognitive knowledge) into what they *do* about learning (self-regulation)? Specifically, how do they manage to oversee their learning even as they are learning? We believe that reflection serves as the link between metacognitive knowledge and self-regulation (see Figure 4) and agree with Simons (1993) who states that a learner's reflection on the process of learning can lead to changes in future processing and increased metacognitive knowledge about learning. Driscoll (1994: 349) suggests that 'reflection may well be essential to cognitive strategy learning.' As a powerful link between thought and action, reflection can supply information about outcomes and the effectiveness of selected strategies, thus making it possible for a learner to gain *strategy* knowledge from specific learning activities.

Reflection makes it possible for learners to utilize their metacognitive knowledge about task, self, and strategies during each stage of the regulatory process: planning, monitoring, and evaluating (see Figure 4). In an actual learning situation, reflection allows learners to consider plans made prior to engaging in a task, the assessments and adjustments made while they work, and the revisions made afterwards. Whereas metacognitive knowledge might be regarded as the 'static' knowledge one has accumulated regarding task, self, and strategy variables (Garcia & Pintrich 1994), reflection is believed to be a more 'active process of exploration and discovering' (Boud, Keogh & Walker 1985: 7).

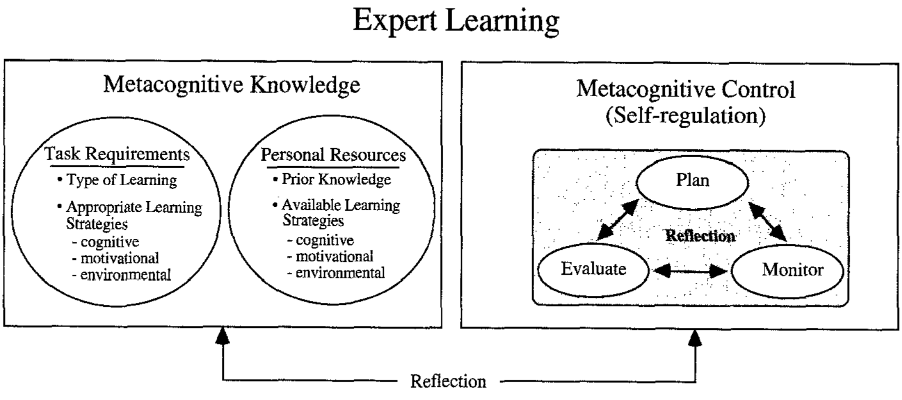

Figure 4. Reflection as a linking component in expert learning.

Reflection facilitated Emilie's recall of past experiences with essay tests, her consideration of how previous outcomes related to specific strategy use, and her design of a study plan which carefully matched new task requirements with available personal resources. In addition, Emilie's reflections allowed her to predict how her plan might affect her upcoming test performance, to keep track of the progress she made as she studied, to look back over what she had done, and to prepare herself for coming steps.

This is not to suggest that all of this mental activity must go on at a conscious level each time the learner is involved in some type of learning situation. Research suggests that when mental processes are used often, they become automated and more efficient (Chi, Glaser & Farr 1988). Expert learners, as competent performers, are able to respond quickly, consistently, and effectively to internalized strategies for thinking and problem solving. Unless learners hit a cognitive snag (lack of comprehension), they are able to proceed with most of the mental work being done at a subconscious level (Schmitt & Newby 1986).

The idea that reflection may be at the center of learning endeavors is not new. Although Locke is credited with first having used the term 'reflection' (noted in Brown, Campione, Webber & McGilly 1992), early philosophers, including Plato and Aristotle, are noted to have emphasized the power of this process. In more modern times, Dewey (1933) characterized reflection as a special form of thinking and argued that we learn more from reflecting on our experiences than we do from the actual experiences. According to Dewey, reflection is the 'hallmark of intelligent action' (p. 17), enabling effective problem solving to take place and improving the effectiveness of learning. Smith (1991) concurs when he writes that 'we learn to learn as we become more aware of ourselves as learners . . . and more active in examining what happens as we learn' (p. 12).

Even though many educators agree that reflection is an important part of the learning process, there is little shared understanding of how exactly it might operate to facilitate learning (Grimmett 1988; Houston, Clift & Pugach 1990). To adequately address this issue, it is necessary to first establish a common definition of reflection, as well as to clarify the relationships among reflection, metacognition, and self-regulated learning.

Perhaps some of the confusion in the literature regarding a single definition of reflection can be attributed to the fact that reflection may be viewed from either the past or present tense: reflection *on* action and reflection *in* action (Schon 1983, 1987). The distinction between these two aspects of reflection is useful in delineating the specific type of reflection that occurs at different stages in the learning process. Our model of expert learning includes both types of reflection to indicate that expert learners' reflections continually alternate between previous, ongoing, and future learning activities.

Reflection *on* action is represented in our model by the double arrow linking learners' metacognitive knowledge with the regulatory control of the learning process (see Figure 4) and is defined as the active process of making sense of past experiences for the purpose of orienting oneself for current and/or future thought and action. This type of reflection allows us to extract meaning from our experiences. Dewey's (1933) original definition of reflection captures this concept of reflection *on* action: 'that reconstruction or reorganization of experience which adds to the meaning of experience and which increases ability to direct the course of subsequent experience' (p. 76).

Reflection *in* action is illustrated in our model by the shaded area which encompasses each of the three steps in the regulatory learning process: planning, monitoring, and evaluating. Reflection *in* action is defined by Jones & Idol (1990) as 'managing the progress of learning on-line while it is taking place, and constantly adjusting and changing as new information is assimilated – sometimes thinking backwards to previous experiences and acquired information, sometimes thinking forward to anticipate and estimate' (p. 524). A number of authors capture this view of reflection when they refer to a reflective learner as a type of researcher – rigorously testing inferences by mental elaboration and overt action (Grimmett 1988). According to Schon (1988), a practitioner forms mental experiments to see what would happen if the problem were solved as defined. Reflection might be conceived of as a strategy or skill that operates on other strategies (Borkowski, Carr, Rellinger & Pressley 1990); a form of personal experiment which is conducted to compare strategies with one another. In conducting these mental experiments, the practitioner envisions the consequences of a proposed solution, and then judges these consequences against his/her definition of the problem and also against the ability to satisfy competing or parallel criteria that derive from other goals (Kennedy 1987).

Reflection and metacognitive knowledge

A learner's ability to use reflection as a metacognitive skill depends on an existing body of metacognitive knowledge (Schmitt & Newby 1986). Referring back to our earlier analogy of the knowledge warehouse, reflection can be thought of as the vehicle which transports knowledge between warehouse and learner. As the learner begins a new learning activity, the 'stored' knowledge is loaded into the reflection vehicle and delivered to the planning dock so that a strategic approach, which matches task and learner variables, can be created. Then, as the learning process continues, additional information regarding requirements and resources is obtained as needed. Finally, as the learner reflects on information acquired from the current situation, awareness of new and/or revised learning strategies is shipped to, and deposited in, the knowledge warehouse.

Students who possess a large store of knowledge about learning strategies and their uses are better prepared to cope with a wide variety of learning situations (Derry 1990). However, reflection is not merely the acquisition and storing of information (i.e., remembering) but the ability to draw inferences from one's past experiences to create possible action plans for the future (i.e., reflexivity). 'It is through the quality of our reflection that we gain the insights essential to improved learning performances' (Smith 1991: 13).

Reflection enables learners to see themselves as actors with different alternatives. As one learns to anticipate chains of events, strategy corrections are made in advance of overt action and become part of one's action plan (von Wright 1992). These processes of inference-drawing, hypotheses-testing, and sense-making enable 'reflection to stretch the mind beyond mere information towards the accumulation of wisdom' (Grimmett 1988: 7). By providing a link between past and future action, reflection is thought to make possible the transfer of metacognitive knowledge to new situations (von Wright 1992).

Wilson & Cole (1991) indicate that the strategies of reflection and articulation (i.e., talking about one's own knowledge, reasoning, or problem-solving processes) help to bring meaning to activities that might otherwise be more 'rote' and procedural. Without reflection, learners may not learn to discriminate in applying procedures, may fail to recognize conditions when strategies may be appropriate for use, and may fail to transfer knowledge and strategies to different tasks. As Emilie reflected on her own strategy performance, she increased her understanding of how to use different strategies as well as the benefits to be gained from their use. Monica, on the other hand, was unable to connect her test performance with the use/misuse of specific learning strategies. Given another essay test in the future, it is unlikely that Monica could locate useful information in her knowledge warehouse that would enable her to create a more effective plan.

Reflection and self-regulation

As a metacognitive skill which leads to, uses, and subsequently increases metacognitive knowledge, reflection plays a key role in the process of self-regulation (Vermunt 1989). Reflection is critical for transforming the knowledge gained *in* and *on* action into knowledge available *for* action. By employing reflective thinking skills to evaluate the results of one's own learning efforts, awareness of effective learning strategies can be increased and ways to use these strategies in other learning situations can be understood.

Reflection uses previous knowledge to gain new knowledge. At each stage in the self-regulation process, expert learners utilize the metacognitive knowledge they have gained from previous learning experiences to identify what the current task requires in terms of cognitive, motivational, and environmental strategies and to determine if their personal resources are adequate to effectively accomplish the task. If they find, as Emilie did, that their typical approach doesn't quite match with what is needed, then the plan must be modified or abandoned. During the planning stage, Emilie recalled that she could ease the difficult task of studying for an essay test by using an outlining strategy, yet realized that this approach demanded a greater amount of time, concentration, and effort than usual. Cognizant of these task demands, Emilie considered the cognitive, motivational, and environmental resources she had available as well as the potential obstacles to be overcome in utilizing them (e.g., not being very proficient at outlining, not being willing to miss the basketball game in order to study, not having an optimal study environment at home).

Because of the number of factors that can affect learning, it is unlikely that Emilie's original learning plan would have been carried out exactly as envisioned. Thus, as Emilie implemented her plan she would have had to continually compare its effectiveness to the changing task demands. What if Emilie had found the library closed when she went to study or discovered that outlining took an exorbitant amount of time and that her concentration and effort waned after only two hours of studying? If Emilie encountered any of these, or similar kinds of obstacles, she would have had to consider alternative resources and strategies available and adjust her plan accordingly. When the learning activity was over, Emilie's reflection would take the form of a final comparison between the strategies and resources utilized and the strategies and resources required by the task. Had there been a good match?

How successful had her approach been? What had she learned about the problems and/or benefits of the strategies used for this specific task? Had she discovered a new match?

Although Emilie's reflections do not have to take the form of questions, self-questioning can facilitate the reflective process. To clarify the process of how a learner utilizes reflective thinking throughout an entire learning task, we have included a list of possible questions that might occur at each step in the self-regulation process. Although it is unlikely that each question would be explicitly addressed by expert learners, Table 1 includes samples of the types of questions learners may ask as they plan, monitor, and evaluate their approach to a particular learning task. To facilitate understanding, questions in Table 1 are grouped according to steps in the self regulation process, and subgrouped by the three types of personal strategies and task requirements (cognitive, motivational, environmental) that would be considered during each step.

Facilitating the growth of reflection – Developing expert learners

How does a learner acquire this ability to question and/or reflect? How can teachers promote and support the development of reflective thinking in their students? Today's educators are becoming convinced of the importance of reflection and teachers from many diverse disciplines are beginning to consider ways to incorporate some form of reflection into their courses (Boud et al. 1985). In fact, whole programs and curricula are currently being crafted around the concept of reflection (Grimmett 1988). Still, there is very little understanding (and even less empirical evidence) of how this skill develops and how it can be influenced and improved.

Houston & Clift (1990: 218) state that 'reflective inquiry is not learned by listening to a lecture or reading a book. Rather it becomes a habit through use and further reflection on such use.' Researchers today would agree that most students do not develop learning strategies unless they receive explicit instruction in their use: 'learning how to learn cannot be left to students. It must be taught' (Gall, Gall, Jacobsen & Bullock 1990: v). Walters, Seidel & Gardner (1994: 301) indicate that 'to facilitate genuine reflection, the teacher must make time for it and then guide students' efforts until they become comfortable with the process and its benefits.'

It is hypothesized by some researchers (e.g., Derry & Murphy 1986; Gagne 1984) that metacognitive skills (a category which includes reflection) are learned in much the same way that other skills are learned, i.e., through periods of extensive practice followed by feedback. Experts are known to spend a substantial portion of their lives practicing their specialties in order to achieve a performance style characterized by 'smooth, rapid, and automatic

Table 1. Sample questions a learner might ask during the three stages of the learning process.

Plan

Cognitive
- What is the goal of this lesson/task? (Task)
- What strategies are most effective with this type of task? (Task)
- What do I know about this topic/task? What useful skills do I have? (Personal)

Motivational
- Does this task require a great deal of concentration and effort? (Task)
- How do I feel about this kind of task? Do I like this kind of work? (Personal)

Environmental
- What kind of study conditions are best for meeting the requirements of this task? (Task)
- When and where do I study best? Is that time and place available for this task? (Personal)

Monitor

Cognitive
- Are the strategies I've chosen working with this task? Have the task demands changed in any way? (Task)
- Do I understand what I am doing? Am I making progress toward the goal? (Personal)

Motivational
- Is this task holding my attention? Is this an interesting lesson/topic to me? (Task)
- How am I feeling as I work on this task? What is my level of confidence? (Personal)

Environmental
- How supportive is the learning environment? Do I need to find a new place to work? (Task)
- What outside materials or resources should be added? (Task)
- Am I giving myself the time I need? (Personal)

Evaluate

Cognitive
- How well did my approach work with this task? What did I do when strategies didn't work? (Task)
- When else could I use this approach? How could I improve this approach? (Task)
- Did I achieve the goal? What did I learn about this topic/task? (Personal)
- What new goals do I have now? (Personal)

Motivational
- How much effort was required to complete this task? How did I stay motivated? (Task)
- How do I feel about the outcome? Did I enjoy this work? (Personal)

Environmental
- Did I encounter any unexpected obstacles in completing the task? How did I remedy the problem(s)? (Task)
- How well did I arrange my study environment? Did I choose a good time and place to study? (Personal)

processing' (Derry 1990: 370). It is not sufficient to simply tell students what expert learners know or even to demonstrate the procedures that expert learners use since much of what they know and do is not directly observable nor readily available to the student. Even if a student completely understands the expert learning process in a declarative sense, there is still the need for extensive practice if it is to be automatically and effectively implemented. Gagne (1984) points out that metacognitive skills (which he terms 'executive skills') have much in common with procedural skills, suggesting that practice is essential for developing expertise in the metacognitive domain. It is believed that students can gain competence and confidence utilizing metacognitive knowledge and skills if they are given opportunities to use them in a variety of learning environments and to receive informative, corrective feedback concerning their use. For this reason, extensive long-term practice and feedback are considered critical for the development of expert learning. Expertise in learning, as in other domains, can only be expected to develop from many years of actually performing the necessary metacognitive and regulatory skills in the context of meaningful learning activities.

Conclusion

In this paper we described the characteristics of an expert learner and presented a model to illustrate how metacognitive knowledge, regulatory control processes, and reflective thinking are integrated within the expert learning process. In our example, Emilie utilized the knowledge she had gained of task requirements, of herself as a learner, and of specific strategy use to select, monitor, and evaluate learning strategies needed to reach a desired goal. Although it is possible that Emilie did not receive an 'A' on the essay test she took, most of us would feel comfortable in inferring a high probability of success. It is clear that Emilie has the tools she needs to direct her own learning; she has learned how to learn.

But what of Monica? What chance is there that she, too, will acquire the capacity and tools needed to identify her own learning needs, to capitalize on her own experiences and thus manage her own learning activities? Winograd & Paris (1989) state that 'thoughtful, strategic teachers are the essential element in promoting thoughtful, self-regulated learning by students' (p. 32). For students, like Monica, who are metacognitively unaware or not yet capable of being self-regulated, research suggests that all of the tasks underlying expert learning (e.g., preparing for one's own learning by considering personal resources and task requirements, taking the necessary steps to learn, reflecting on and monitoring learning, providing one's own feedback, and keeping concentration and motivation high) can be executed by teachers or instructional systems, thereby fulfilling these learning functions for their students (Bruer 1994; Simons 1993). The instructional goal then becomes one of gradually transferring the initiation and regulation of the learning process from the external control of the teacher to the internal control of the learner him/herself.

It is hoped that the understanding we have gained of the knowledge and skills involved in expert learning will influence not only our idea of what it means to learn, but also our conception of what it means to teach. If schools are going to help all students become expert learners, the metacognitive capabilities of learners must be acknowledged, cultivated, and exploited. Students must be actively engaged in their own learning and knowledge building; they must be able to effectively direct their personal quest for knowledge and skills, to judge for themselves whether they understand, and to know what to do when they need more information. A major function of all schooling must be to help create learners who know how to learn. By fostering the development of strategic, self-regulated, and reflective learners, it is hypothesized that this goal can be achieved.

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