Pathways to success: learning strategy instruction in content curriculum

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One powerful force reshaping our understanding of learning is conceptions of learning which challenge the separating of what is learned from how it is learned and used. It is argued that the learning task in which knowledge and skills are developed and used is not separable from nor ancillary to learning (Brown, Collins, & Duguid, 1989). Nor is it neutral. Rather, the task is an integral part of what is learned. However, despite the availability of and apparent enthusiasm for learning strategy research and theory by the education community, evidence suggests that while learning strategy instruction has been incorporated into the curriculum it has not been on a large scale (e.g.,Chamot & O'Malley, 1987; King, 1994). It is generally assumed that learners have developed strategies for learning and are applying them in the tertiary learning context. This however, may be an erroneous assumption. It appears that increasing numbers of learners come to university with limited academic experience or with experience they are unable to apply in the learning context. In response to this situation, curriculums which include instruction in learning strategy use can support learning by encouraging learners to apply learning strategies they already have and to develop new ones.

Within the context of higher education, what we most value must include learning and the active role learners play in the learning process. Amongst the range of qualities we value, and indeed expect of the student, learner independence is paramount. Research has shown that learner independence is supported through a range of learning strategies and that these strategies provide learners with the necessary framework for independent efforts (Salomon & Perkins, 1989). Furthermore, that well established general learning strategies are applicable across content areas, for example, maths, science, reading, writing, and language learning (cf., Vanderstoep, Pintrich, & Fagerlin, 1996).

Because learner independence is not only valued but essential to student success in higher education, the development of appropriate learning strategies must be addressed through curriculum. One fact that emerges from recent research is that "knowing about knowing" plays a vital role in the development of successful independent learners. "Knowing about knowing" involves the learners in understanding the processes at work in their learning (Bjork & Jacobs, 1985; Bransford, Sherwood, Vye, & Reiser, 1986; Brown, Bransford, Ferrara, & Campione, 1983; Gagne, Yekovich, & Yekovich, 1993; Gagne, 1984; Garner & Alexander, 1989; Kuhl, 1985; Pressley & Levin, 1983; Pressley & McCormick, 1995; Salomon & Perkins, 1989): for example, understanding strategy use, how strategies effect performance, as well as how learners use these strategies.

Describing strategies

Metacognitive strategy use by learners helps to organise and give meaning to facts related to "knowing about knowing", cognitive monitoring and strategy utility (Garner & Alexander, 1989). Another fact that emerges from this research is the combined role that cognitive strategies and metacognitive strategies play in successful strategy instruction. Cognitive strategies include a variety of rehearsal, elaboration and organisational strategies that facilitate the encoding, recall and comprehension of information and are used to make cognitive progress. Metacognitive strategies include planing, monitoring and evaluating and are those activities invoked to regulate progress. Understanding the dual role of cognitive strategies and metacognitive strategies in strategy instruction is

essential as it provides a critical perspective on the active role of the learner, and an understanding of how addressing both in curriculum can facilitate learner independence.

Learner independence is closely interwoven with the issue of self-regulated learning. Self-regulated learning is the process in which learners themselves activate and maintain cognitions and behaviours systematically oriented toward the achievement of learning goals, usually academic (Flavell, 1985). Self-regulated learning includes both cognitive and behavioural aspects of the learning process. For example, cognitive aspects include both cognitive strategy use involving the use of learning strategies such as notetaking, and metacognitive strategy use which includes knowledge about strategy utility, as well as beliefs about self-efficacy, outcome expectation, and the value of learning. On the other hand, Flavell (1985) describes behavioural aspects of self-regulated learning as those which focus on issues such as self-monitoring, self-instruction and self-reinforcement.

Self-regulated learning and metacognitive awareness share common features in that both include knowledge of the task – what is to be learned and when and how it is to be learned – as well as self-knowledge of personal capabilities, interests and attitudes (Flavell, 1985). However, the relationship between the two is not parallel, rather, self-regulated learning is dependent on metacognitive knowledge. Metacognitive knowledge is used by learners to formulate and apply learning strategies and content information. For example, learners analyse the situation as well as their personal characteristics, devise a plan to accomplish the learning goal, implement the plan, monitor progress, and modify the plan as necessary. It is metacognitive knowledge that guides the operation of these steps. As a result, metacognitive strategies produce self-regulated learning because they give learners better control over the learning situation and their learning processes.

However, activation of metacognitive strategies in order to produce self-regulated learning is not a spontaneous process. It requires priming of conditional knowledge on strategy utility. Strategy utility draws on specific strategy knowledge (Garner & Alexander, 1989) such as understanding the conditions for strategy use and on the basis of this, implementing the strategy effectively (Pressley, Borkowski, & Schneider, 1987). To this extent, strategy utility plays a key role in the learning and maintenance of cognitive strategy instruction and in the transfer of these learning strategies.

Strategies used by successful learners

To appreciate the role that learning strategies play in the learning process it is useful to consider the strategies used by successful learners and how they apply them. Successful learners posses an array of techniques, or cognitive strategies, for accomplishing goals; metacognitive knowledge about when and how to use these strategies; and an extensive non-strategic knowledge base (content or declarative knowledge) that can be used in conjunction with strategic and metacognitive processes (Pressley, Borkowski, & O'Sullivan, 1984; Pressley, Goodchild, Fleet, Zajchowski, & Evans, 1989).

The strategies that successful learners possess can be divided into three general groups (Cook & Mayer, 1983). The first of these is task-limited strategies which are used for very specific goals in particular domains such as science, mathematics, reading, writing, and language learning. Examples of language specific task-limited strategies used by successful language learners include maximising opportunities to practice and obtain feedback, willing and accurate guessing, and monitoring one's speech (Naiman, Frohlich,

Stern, & Todesco, 1978; Stern, 1983). Task-limited strategies also include tricks for aiding performance on particular tasks. For example, in a science class, a mnemonic device such as the phrase "RoY G BIV" can be used to remember the colours in the rainbow (i.e., red, yellow, green, blue, indigo, violet). Often these task-limited strategies are specific uses of more broadly applicable strategies.

Goal-limited strategies on the other hand are used to accomplish particular goals that are common across domains utilising general skills such as remembering, comprehending, and problem-solving. For example, a phrase such as "LCWC" (i.e., look, cover, write, check) can be used to memorise information, to learn the spelling of a word, or to memorise a formula.

Finally, there are general strategies which regulate the task-specific and goal-specific strategies. While these general strategies, sometimes referred to as master strategies or higher order strategies, tend to be less powerful they are none-the-less important. General strategies include monitoring performance, allocating attention to tasks and searching for relationships between the present task and previously accomplished tasks. For example, "REAP" (Eanet &Manzo, 1976) involves four strategies executed in a fixed order: reading, encoding, annotating, pondering. The integrated relationship between levels of strategies can be seen in the learning processes of successful learners.

Not only are successful learners good strategy users but they are able to transfer strategies readily and appropriately to new settings (Pressley, Borkowski, & Schneider, 1987; Pressley, Goodchild, et al., 1989). Good strategy users have many strategies, some of them specific to domains or subjects in which they are an expert. Although expertise involves acquiring a lot of declarative knowledge about a subject area, it also requires mastery of domain-particular strategies.

For example, we would expect a proficient reader to possess a host of task-specific strategies that lead to comprehension which is a goal-specific strategy. Proficient readers selectively take notes, underline, summarise, elaborate text and answer questions that occur to them about the material they are reading (Cook & Mayer, 1983). These strategies for comprehension are often combined into higher order strategies that are summarised into catchy anacronyms – for example, the "SQ3R" is a reading comprehension strategy (Robinson, 1962): survey, question, read, recite, review. When learners implement the SQ3R method, they first survey the text after which they pose questions. Learners then read the text while keeping the questions in mind, Following the reading, learners close the book and recall what they have read. After completing the previous steps, the learners can then open the book and review the material.

Reasons for strategy instruction

In order to develop both cognitive and metacognitive strategies in learners that will be used and applied in new contexts, judicious instruction is essential. In fact, one powerful force reshaping our understanding of learning in higher education is a more recent conception of learning which challenges the separating of what is learned from how it is learned and used. It is argued that the learning task in which knowledge and skills are developed and used is not separable from nor ancillary to learning (Brown, Collins, & Duguid, 1989). Nor is it neutral. Rather, the task is an integral part of what is learned. According to Brown et al. (1989) it is possible therefore to argue that learning is "fundamentally situated" (p. 32). This point is similarly maintained in the transfer of

learning literature in reference to both problem-solving and learning strategy use. Learners are active participants in the learning and transfer process and their ability to apply learned material to novel tasks is directly affected by the quality of the instructional program and aspects of the learning task.

The view of learning and transfer as being "fundamentally situated" (Brown et al., 1989) is one which has been acknowledged to varying degrees by the education community, including curriculum designers. For example, professional English subjects which are required in various courses, integrated approaches to teaching strategies such as components within subjects, as well as problem solving approaches in which strategies are developed through the study of genres such as case studies.

However, while there is some recognition of the role of learning strategies in academic success in higher education, it is seldom addressed by curriculums in a dedicated way. The teaching of learning strategies is subjugated to content demands. More frequently, it is assumed that learners have already developed strategies for learning and are applying these strategies in the learning context. This however may be an erroneous assumption on at least three counts.

Firstly, it appears that increasing numbers of learners come to university with limited academic experience or with experience they are unable to apply in the learning context. This situation is not unique to Australia. It is estimated that one third of the students entering colleges and universities in the USA are underprepared or lack the skills necessary to be successful (Burd, 1996). In response to this situation, curriculums which include dedicated instruction in learning strategy use can provide learners with bridges by encouraging them to apply the learning strategies they already have and in addition, to develop new appropriate ones.

Secondly, linguistic and sociocultural factors have a major impact on the use and transfer of learning strategies from the first language (L1) to the second language (L2). For example, learners who read and comprehend effectively in their L1 may not be able to transfer comprehension strategies which have not been mastered to their L2 (Grabe, 1986). O'Malley and Chamot (1990) agree that the academic setting poses real challenges for learners whose first language is not English. Academic skills such as listening and reading for new information as well as speaking and writing about new knowledge, may or may not have been developed in the learners first language. Congruent with the observations by Grabe (1986) on the learning context, O'Malley and Chamot (1990) note that learners whose first language is not English either need explicit instruction on how to transfer previously learned skills to English, or may need to learn academic skills for the first time.

Thirdly, research (Belmont and Butterfield, 1977; Bialystok, 1990; Brown et al., 1989; Gagne, Yekovich, & Yekovich, 1993; Garner, 1990; Gick and Holyoak, 1983) indicates that learners often rely on inappropriate strategies when more effective ones are available. In summary then, we can say that learners need to be taught how to learn effectively in academic contexts and this includes instruction in strategies that facilitate learning. To do this, curriculums must include academic strategy instruction thereby acknowledging the integral role of *how* to learn in conjunction with *what* is to be learned. Additionally, we need to adopt the view that effective learning is facilitated through appropriate strategy use and critically, both strategies and content knowledge need to be taught in ways that support strategy transfer across tasks and content areas.

Strategy instruction

When discussing strategy instruction in the context of transfer, it is important to clarify the relationship between instruction, learning and transfer. Instruction, learning and transfer are related and dependent to the extent that transfer of instruction assumes initial learning. Research into strategy instruction reveals that there is a range of variables that determine the success of an instructional program. These variables include task factors such as the type and variety of tasks used for practice during the instructional period, learner factors such as beliefs about strategy effectiveness, and other factors such as the duration of the instruction and the instructional procedure, for example, priming strategy use through hints. Being able to produce strategies when directed and independently recognising occasions for use are vital outcomes in strategy instruction programs. Paris Lipson, & Wixson (1983) refer to this as conditional knowledge, that is, knowing why, where, and when to apply strategies.

Even though the education community has shown enthusiasm for strategy research and theory, incorporating it into existing courses and curriculum has been a slow process (e.g., King, 1994; Schumaker & Deshler, 1992). This can be attributed to the fact that even though attention has been given to learning strategy instruction in general education over the last 25 years (Pressley, Forrest-Pressley, Elliot-Faust, & Miller 1985), most of this interest has been on the part of researchers who have focussed on basic paradigms (e.g., paired-associate learning, list learning) that do not represent well or completely the complexity and requirements of educational tasks. However, more recently, research has been directed towards studying learning strategies that are more appropriate for the tasks learners ordinarily encounter in the educational context and have encouraging findings about the effect of strategy instruction.

The more recent research indicates that there are at least three reasons to be optimistic about strategy instruction as it has progressed (e.g., Baron, 1985; Cohen, 1994; Glaser, 1985; Kidd and Marquardson, 1996; Najar, 1997; Pressley, Borkowski, & O'Sullivan, 1984; O'Malley & Chamot, 1990; Oxford, 1996; Pressley, Goodchild, et al., 1989; Sternberg, 1979). First, more realistic information-processing models of competent performance have become available. Compared to previous theories that focussed only on cognitive factors, more recent models capture the cognitive, metacognitive, social-personality and style factors that can affect classroom learning (Brown, Collins, & Duguid, 1989). Second, there are more complete information-processing models of instruction that address the many factors involved in good thinking and classroom learning (Gagne, Yekovich, & Yekovich, 1993). Third, researchers are becoming far more sophisticated at conducting both laboratory and classroom research that is informative about realistic educational goals.

Instruction and transfer

Salomon and Perkins (1989) refer to the process of transfer as being a "rocky road" (p. 113) and quite justly so. Research in transfer has revealed that experience with particular problems often yields little transfer to other, even similar, problems. Furthermore, transfer from one task to another, for example, the classroom task to tasks that more closely mirror their real world counterparts, can not be assumed as a spontaneous result of instruction (Caramazza, McCloskey, & Green, 1981; McCloskey, 1983). Even transfer from one version of a classroom task to another may be unsuccessful (Bassok & Holyoak, 1989; Ross, 1987).

For example, this point is discussed by second language acquisition (SLA) researchers in reference to the effect that linguistic and sociocultural factors have on transfer of learning strategies from the L1 to the L2 (Bialystok, 1990; Grabe, 1986; O'Malley & Chamot, 1990). One point raised in the discussion is that learners who read and comprehend well in their L1 may not be able to transfer comprehension strategies to their L2 (Grabe, 1986). The failure to transfer comprehension strategies may be attributable to not only the classroom context but the language of instruction and practice. Another point noted in the SLA literature is that once a language is learned, it provides an underlying framework for learning and understanding subsequent languages (Nation & McLaughlan, 1986). Learners, therefore, have strategies they could transfer when learning a new language (Cummins, 1983). However, the transfer of both cognitive learning strategies and language learning strategies may be affected by similarities between the L2 and the L1 (Meyers, 1995).

Further examples of the difficulties of successful transfer can be seen in other areas outside of SL learning, for instance, transfer of analogies with adult learners. Many of the difficulties of transfer appear to involve the process of recognizing "problem isomorphs" (Rumelhart & Norman, 1981; Simon, 1979), that is, recognizing that a new situation is similar to one encountered previously. For example, in an often cited study, Gick and Holyoak (1980) presented college learners with a story problem, such as Duncker's (1945) classic radiation problem. In this problem, the situation is that a certain ray can destroy a malignant tumour. The problem is that, at an intensity sufficient to destroy the tumour the ray will also destroy healthy tissue. The solution is to send several weaker rays from different angles so that they meet simultaneously at the tumour point and hence, summate to produce the required intensity. Healthy tissue are not destroyed because the weaker rays are not strong enough to do damage.

Learners who had witnessed the solution to the ray problem were then given a similar problem. A fortress is located in the centre of a country; many roads radiate out from the fortress but they are guarded such that any large body of soldiers attempting to infiltrate the fortress would be captured. A general who wishes to attack the fortress must adopt the solution of dispersing his troops and sending them in small groups to meet at the attack point, the fortress. The disperse and summate rule is nearly identical to the rule required for the radiation-tumour problem. In the absence of hints to use the initial story to help them solve the new problem, college learners' transfer is poor.

Subsequently, Gick and Holyoak (1983) examined mechanisms that promote transfer. Some of these mechanisms were so successful that almost all college learners came to transfer the original problem solution across isomorphic situations. Among the most successful of these was the "hint" provided by a condition wherein learners viewed two related problems prior to a transfer task and were then required to state the principal similarity between them. This forced the learners to concentrate on the solution, the only thing that the stories had in common, and thus facilitated transfer to a third problem. It seems that any manipulation that stressed the similarity of the original problem to the transfer solution encouraged transfer. Even the simple ploy of telling learners to use the prior story to help them solve the new problem increased the incidence of transfer. Consequently, Gick and Holyoak (1983) argue that the problem in transfer is often one of noticing the analog. Therefore, noticing appropriate occasions of use rather than applying the rule has been identified as one of the main sources of difficulty in transfer. The difficulty in noticing appropriate occasions of use rather than applying the rule as identified by Gick and Holyoak (1983) is discussed by Paris, Lipson, and Wixson (1983)

and Pressley et al., (1987) as the role that conditional knowledge or specific strategy knowledge plays in effective strategy use.

In 1977, Belmont and Butterfield reviewed over a 100 studies that attempted to train a variety of types of learners on a range of strategies, none of which were successful in obtaining transfer. A common factor that has been noted in each of these studies is that none of them required the learners to reflect on the success or non-success of their strategy use during the training phase. This is an example of the impact of the degree of initial learning affecting the outcome of the transfer tasks. The lack of metacognitive strategy use during the training phase in these studies has been attributed as the cause of transfer failure. To verify this, Belmont, Butterfield, and Ferretti (1982) reviewed seven studies of strategy training that did require learners to reflect on the success of their strategies, and in six of the seven, transfer was obtained.

In one of these studies, Brown, Campione, and Barclay (1979) compared a group of children who were trained to give themselves self-tests to judge whether or not they were ready for a recall test with a group that was not trained to self-test. Both groups were taught an effective rehearsal strategy. The group trained to self-test showed transfer of the strategy to new memory problems a year later while the other group did not. Since this study, other studies have been conducted that confirm the importance of a self-evaluation process for transfer and maintenance (Pressley et al., 1984; Bereiter & Bird, 1985).

Gagne, Yekovich, and Yekovich (1993) draw our attention to some of the positive examples of transfer related to school learning. For example, a learner may be instructed in facts about the United States' history in order to pass a test and later use these facts to understand historical references in a presidential speech. Another learner may learn how to write essays in high school English and later use this skill in writing reports in a job. According to Gagne, Yekovich, and Yekovich (1993), examples of transfer of this nature "abound." Indeed, one of the main assumptions of formal schooling is that knowledge does transfer, and therefore what knowledge learners acquire in schools will be useful outside of the school context.

In summary, an important feature that successful studies on instruction and transfer share is recognition of the dual role of cognitive strategy and metacognitive strategy instruction in the training programs. Typically, successful strategy programs include instruction which involves the use of self-evaluation (e.g., Belmont and Butterfield, 1977; Brown, Campione, & Barclay, 1979), the need to understand how and when to apply the cognitive strategy (Gagne, Yekovich & Yekovich, 1993; Gick & Holyoak, 1980), as well as teaching learners to understand the conditions of the task at hand (Gick & Holyoak, 1980). These instructional features when combined with appropriate tasks and consideration of the learner's experience increase the likelihood of successful instruction in strategy training programs and subsequent transfer.

Determinants of transfer

Learning itself is a complex process, which in the context of higher education must be considered in conjunction with the evidence of learning, that is transfer. The development of learning strategies in which learner independence is nurtured and supported, is therefore consistent with one of the primary goals of instruction in higher education, that is, the learning and subsequent transfer of information, concepts and

techniques. Unfortunately, the instructional context often presumes the transfer of abstract, decontextualised formal concepts. The learning task and the context in which the initial learning takes place is frequently regarded as ancillary to learning – pedagogically useful, but essentially distinct and even neutral with respect to what is learned.

Task as a determinant of transfer

Understanding the conditions of the task at hand requires the learner to be able to recognize salient task similarities. In describing salient conditions of the learning task in regard to the transfer task, the transfer literature on problem-solving suggests that it may be useful to distinguish three general conditions of applicability: surface content, underlying structure, and context (Bassok & Holyoak, 1989). Furthermore, strategy transfer research indicates that learner variables contribute significantly to the process. Strategy transfer research suggests that variables such as learner motivation (Garner & Alexander, 1989) and learner self-efficacy (Bandura, 1977) also effect the outcome of transfer tasks.

Firstly, surface content, or content cues, constitute salient features of the specific domain from which tasks are drawn, that is, the content of the tasks. An example of this may be seen in the study in physics of inclined planes. It is within the content area of inclined planes that the learners can develop an understanding of Newton's laws of motion. However, Newton's laws of motion are not the only solution to inclined plane problems. The solutions taught for solving pulley problems may be used to solve inclined plane problems as well. However, learners are often unable to apply the principles involved in solving the pulley problems to the inclined plane problems. The learners do not see beyond the difference in the surface content of the tasks to the similarities in structure between the two content areas.

Ross (1987) states that content cues are likely to trigger reminding, that is, the memory retrieval of earlier learning examples. However, content cues may not bear any relationship to underlying structural features of the task. That is, just because the surface content of a task is similar to a previous task does not mean that the problem at hand is the same. On the other hand, as noted in the previous example of inclined planes and pulleys, just because the surface content of the task is different does not mean that the underlying structure of the problem is different. For example, a physics problem may concern an inclined plane, but depend upon laws of physics other than Newton's laws of motion. Reliance on content therefore, may lead to negative transfer, resulting from dependence on irrelevant surface features in the transfer task (Bassok & Holyoak, 1989). Negative transfer, that is inappropriate transfer (Brown, 1982), has been noted particularly among beginning learners, or 'novices' (Ross, 1987). It appears that novices, due to a lack of understanding of problem structures and/or salient features of the task, rely on superficial similarities for making decisions about what problems go together (e.g., Chi, Feltovich, & Glaser, 1981; Schoenfeld, 1985). This results in the surface content of the task influencing the way in which tasks are viewed and presumably solved.

A second applicability condition is underlying structure, or structural cues. These cues, often relational in nature, are less salient features than surface content. They relate directly to the conditions under which particular solutions are in fact appropriate. For example, formerly in much high school physics instruction the structural features of a problem determined which physical laws should be applied in order to solve it, not the

content corresponding to the previously learned problem. These structural features corresponded to specific physics concepts learned within the classroom. Hence, the structure of the classroom problem often did not reflect the structure of its real world counterparts. As a result, physics knowledge was often learned in a manner that allowed it to be applied to textbook situations, but not to everyday physical phenomena encountered outside the classroom context (Caramazza, McCloskey, & Green, 1981; McCloskey, 1983).

Thirdly, context, or contextual cues, derive from the learning environment in which the initial information is encoded or learned, as opposed to surface or underlying features of the problem. It appears that if the context of the transfer task differs substantially from the learning task, transfer will be impaired (Spencer & Weisberg, 1986). Of course, the reverse of this is also true. If the context of the transfer task is similar or the same as the learning task, then transfer will potentially be high.

Learner variables as a determinant of transfer

It is important to note that context is not limited to the physical attributes of the environment but also the psychological context. An example of the psychological context is the set of expectations learners have about the problem-solving task in which they are engaged, and how these influence the learners' ability to transfer. The effect of context on task performance has been noted amongst novices and experts (Schoenfeld, 1985). Schoenfeld (1985), analysing components of mathematical knowledge, referred to such psychological expectations as "belief systems." He found that learners were quite capable of using deductive argumentation while solving geometry proof problems, yet failed to invoke their deductive knowledge when solving geometry construction problems, for which they believed the appropriate solution was trial and error.

The psychological context is discussed in more detail in the strategy transfer literature. According to Gagne, Yekovich, & Yekovich (1993), problem-solving transfer depends a great deal on the amount of overlap or common elements between the learning task and the transfer task. In strategy learning, the dual role of cognitive strategy use and metacognitive strategy such as the learner's conscious evaluation of strategy effectiveness is noted as a key factor (see also Bassok & Holyoak, 1989; Gick & Holyoak, 1983; Caramazza, McCloskey, & Green, 1981; Holyoak & Koh, 1987; McCloskey, 1983; Ross, 1987; Schoenfeld, 1985).

From this research, it is apparent that it is particularly important for the learner to understand that the strategy benefits a particular aspect of performance and that there is increased strategy transfer when strategy utility is made obvious, such as when the teacher includes utility information as part of strategy instruction. It appears that possession of such beliefs by learners motivates use of the strategies to which the beliefs are attached (Clifford, 1984).

As well as the need for learners to consciously evaluate strategy effectiveness, five other psychological factors have been identified as key contributors to strategy transfer (Gagne, Yekovich, & Yekovich 1993; Pressley, Borkowski, & Schneider, 1987). The first two contributor to strategy transfer are directly related to strategy utility. Learners not only need to have developed strategies at their disposal, but also need to know when and how to apply them. This is referred to by Pressley, Snyder, & Cariglia-Bull, (1987) as "specific strategy knowledge" (p.83) and by Paris, et al., (1983) as conditional

knowledge. That is, the learners are able to recognize the general features of a situation that indicate when the strategy in question can be used effectively (e.g., Pressley, Borkowski, & O'Sullivan, 1984; Pressley, Levin, & Ghatala, 1984). One reason learners may fail to transfer strategies is that they do not really know when the strategy should be used. According to Gagne, Yekovich, & Yekovich (1993), knowledge of how and why a strategy works is actually a form of conceptual understanding where what is being understood is one's own cognitive processes.

An example of this is the use of a keyword strategies for associative learning. When key word strategies are taught as an aid to vocabulary learning, learners are instructed to recode unfamiliar, to-be-learned vocabulary words (e.g., *carlin*, which means "old woman") to associatively similar words (i.e., keywords). The learner then creates interactive relationships between the keywords and definitions (e.g., for *carlin*, an image of an old woman [definition] in a car [keyword], or the sentence, "The old woman in the car."). While using the strategy, good strategy users might also discover, or infer, that the method and variation of it work, firstly, whenever associative learning is required, secondly, when there is enough time to execute the strategy, and thirdly, if one invests the effort necessary to carry out the strategy. Once in possession of these three pieces of specific strategy knowledge, good strategy users are far more likely to transfer the strategy.

The third key contributor in strategy transfer is the learners' tendency to attribute success to effort and the use of strategies. In addition to specific strategy knowledge about procedures, good strategy users tend to attribute their success to effort. According to Gagne, Yekovich, & Yekovich (1993), these type of learners have more success in transferring strategy knowledge because when the going gets tough, they persist.

One example of a situation in which the going is difficult is a transfer situation. If the learner believes that success in transfer situations is due to luck, then the learner is unlikely to put much effort into thinking about details of the task, that is, how similar or different it is to other tasks, and what strategies might be used to perform the task successfully. However, if the learner believes that success is due to effort and use of strategies, then the learner is likely to persist and try some different strategies to see what works. Thus, good strategy users are those who have a strong belief in their own role in success and are therefore more likely to transfer strategies.

The fourth contributor in strategy transfer is the learners' ability to screen out distracting thoughts, and potentially debilitating emotions. The good strategy user engages in what Kuhl (1985) identifies as "action control." Kuhl's research shows that learners with high action control are more strategic in approaching tasks and ultimately more successful.

For example, consider the case of two learners in a low level English as a second language (ESL) class. So far, classroom instruction has been mostly listening and speaking in conversational activities. The only reading has been reading everyday conversations after the learners have practiced them orally. Then one day, their teacher asks them to read a story in English and answer comprehension questions about the story. Both learners have experienced a mixture of success and failure in the class so far. When confronted with this (novel) task, they both initially balk at it, thinking, "I can't do this. We haven't learned how to do this yet." However, the learner who is better at screening out distracting thoughts stops thinking these thoughts and instead turns to analysing what is actually required for the task. This leads the learner to realise that she

has strategies from her first language that she can use in approaching reading in a second language. The learner who is less able to screen out distracting thoughts continues to dwell on her lack of experience in the SL context and her sense of inadequacy. Thus, the learner does not have opportunity to determine what strategies might be effectively used and to transfer them.

Finally, strategic knowledge is not the only knowledge good strategy users possess. They also know a lot about the world in general and that learners having an extensive declarative knowledge base is a contributor to strategy transfer. The knowledge base can affect strategy transfer in a number of ways. First, it often contains information that makes use of a strategy unnecessary. For instance, a learner encounters the word precursor in an article they are reading. Because the learner has previously learned that the prefix pre means to go before, she is able to guess at the meaning of the word. A learner who lacked a comparable knowledge base would have to draw on all the content clues available in the passage to infer the word's meaning and, if that failed, to use the strategy of consulting a dictionary.

Second, sometimes material that is learned by relying on the knowledge base stimulates strategy use for material that is not so similar to the learners' prior knowledge. For example, when learners process highly related items in a categorical fashion, it may occur to them that categorisation is a useful learning technique, and in turn, prompt the use of categorisation strategies even with materials that are not so highly related (Bjork & Jacobs, 1985).

Third, many strategies can only be executed by learners who possess a lot of knowledge because the broad knowledge base enables strategy execution. For example, a desirable reading comprehension strategy is for learners to activate what they know about a topic before reading material about it. Learners can do this, however, only if they possess knowledge about the topic. If they have a well-developed knowledge base, the knowledge activation strategy results in many appropriate and comprehension-facilitating inferences. However, no such inferences are possible if there is nothing stored away that can be activated (e.g., Hasselhorn & Korkel, 1986).

Reasons for failure in transfer

In summary, transfer can be attributed generally to one or more of the following variables: first, instruction; second, the task; and third, the learner. First, instructional programs must combine metacognitive strategy instruction with cognitive learning strategy instruction over a sustained period of time. One obvious reason for failure of transfer in short-term studies is the poor level of initial learning attained. This is related to the duration of any particular intervention. How can we expect to change well-established ineffective routines with relatively brief instructional programs? A prerequisite for transfer is, of course, the degree of original learning. Original learning includes a range of variables; for example, Salomon and Perkins (1989) suggest that initial practice is usually rather limited. Also, whatever practice does occur, happens within the context of the instruction itself, not within the context of extensive varied practice which stretches the strategy beyond its original context of learning. Furthermore, the degree of initial learning combined with a metacognitive knowledge of the learning strategy promoted maintenance of the strategy. Instruction also includes other elements such as the use of hints or explicit instruction by the teacher to foster

strategy use by drawing the learner's attention to the similarities between the current task and a previous one.

Second, to expose the learner's strategy use to contexts beyond that of the original learning is necessary, otherwise, the learning may remain fixed to the original instructional setting. A great deal of transfer in real life is triggered mainly by reinstantiations of the original occasion of use. If the task conditions reinstate enough similarity or identical elements in common with the occasions of learning and previous use, transfer may occur (Brown, Bransford, Ferrara, & Campione, 1983). If such similarity does not exist, then someone needs to arrange for transfer, that is, supply a hint by telling the learner that this is an occasion for the application of a known solution or strategy. Brown, Bransford, Ferrara, and Campione (1983) observe that unless there is explicit instruction for transfer, learners may fail to make the connection and the strategy remains welded to the original instructional setting.

The use of hints in promoting transfer yields a relatively higher occurrence of transfer. This is perhaps not surprising as hints are a part of our learning experience. In the normal course of socialising children into their culture, adults engineer appropriate transfer by arranging demonstrations of applicability (e.g., "It's just like X") or instructing the child to use prior knowledge in the new situation. Everyday life is full of situations where transfer is mediated socially, and little problem solving is left to the individual. As discussed earlier, in both the Gick and Holyoak (1980, 1983) studies, only a minority of learners showed unaided transfer from one isomorphic version of a problem to another. The type of hints that induced such transfer in adult learners also worked with young learners. The most successful hint was the simple ploy of telling the learner that the tasks were the same, thus bypassing the need for noticing the analogy.

Third, the pliability of the learner, or lack of it, is yet another reason why transfer is unsuccessful. According to Garner and Alexander (1989), for older learners, one aspect of instruction is moving the learners to a point of acknowledging that old, less effective routines no longer work as well as the new, instructed ones (Garner, 1990). This, however, takes time and many demonstrations of the advantages of the new strategies. In anxiety-inducing situations such as test situations, it is probably the case that many learners revert to practiced, though perhaps ineffective strategies.

Brown (1982) suggests that part of the result of unsuccessful transfer can also be attributed to the use of inappropriate transfer tasks, inappropriate because the transfer tasks used were too difficult for the capabilities of the learners. Brown (1982) gives the example of tasks that were suitable as cognitive exercises for school-age learners were given also to a sample of preschoolers, who performed abysmally. The issue here according to Brown (1982), is whether the transfer tasks were suitable vehicles for asking and answering questions about younger children's ability to transfer. Brown goes on to suggest that the finding of superior transfer in the older group may simply be an artifact of the inappropriate match between the younger learners' capabilities and the task on which their ability to transfer is being measured.

Brown (1982) also discusses the idea that a major impediment to successful transfer is often not lack of transfer across tasks, but rather, inappropriate transfer. Efficient transfer involves the priming of conditional knowledge (Paris et al., 1983) such as strategy utility, that is discriminating when, where, and what to transfer rather than blind application of known information. Simply knowing that transfer is desirable from prior

situations to the current one, or from the current one to future ones, is itself part of the battle.

Conclusion

Strategy instruction and transfer is a major issue in education. Previous research has suggested that strategy transfer is affected by three variables: first, instruction; second, the task; and third, the learner. Instruction involves the amount of practice, especially practice that varies in content and difficulty (Salomon and Perkins, 1989), the amount of guided feedback (Crisafi & Brown, 1983), that the success of initial instruction is sufficient to assume learning (Salomon & Perkins, 1989) and whether or not the learner is able to successfully use a strategy. Instruction also includes the priming of conditional knowledge through the use of hints or explicit instruction to use a particular strategy (Paris, et al., 1983; Pressley, et al., 1984). A strategy instruction program must also include instruction aimed at developing the learner's awareness of strategy use in conjunction with cognitive learning strategy use.

Second, transfer is enhanced by task similarity but also affected by structural cues and contextual features at the time of learning. However, generally, the probability of transfer from one task to another is increased when the new task is similar to a previous task (Ross, 1987), and the learner understands the conditions under which the strategy applies (Pressley, Borkowski, & O'Sullivan, 1984; Pressley, Levin, & Ghatala, 1984).

Third, learner variables include variables such as the degree of control learners have over a strategy (Salomon & Perkins, 1989). This again involves the degree of initial learning of the strategy, whether or not the learners consciously evaluate strategy effectiveness and whether or not learners attribute success to their own efforts in conjunction with strategy use (Gagne, Yekovich, & Yekovich, 1993). It also includes whether or not learners can screen out distracting thoughts when trying to analyse a new problem (Kuhl, 1985) and the degree of relevant declarative knowledge possessed by the learners (Bjork & Jacobs, 1985). Finally, as an extension of the previous point, in order for learners to transfer strategies, they must recognise the new task as an appropriate context for strategy implementation (Bransford, Sherwood, Vye, & Reiser, 1986; Brown, Bransford, Ferrara, & Campione, 1983; Gagne, Yekovich, & Yekovich, 1993; Pressley & Levin, 1983).

Resulting from a review of the literature, I would argue that forces shaping the new curriculum must embrace an approach in which not only the *what* but also the *how* to learn is addressed. It is through an approach such as this, that student success within and across content areas can be maximised and student diversity in higher education supported and maintained.

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