SELF-DETERMINED LEARNING THEORY

Construction, Verification, and Evaluation

Edited by

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LEA LAWRENCE ERLBAUM ASSOCIATES, PUBLISHERS
2003 Mahwah, New Jersey London

Lawrence Erlbaum Associates, Inc., Publishers
10 Industrial Avenue
Mahwah, New Jersey 07430

Cover design by Kathryn Houghtaling Lacey

Library of Congress Cataloging-in-Publication Data

Self-determined learning theory : construction, verification, and evaluation / Dennis E. Mithaug . . . [et al.].
p. cm.
Includes bibliographical references and index.
ISBN 0-8058-3698-5
1. Learning, Psychology of. 2. Adjustment (Psychology). 3. Autonomy (Psychology). I. Mithaug, Dennis E.

LB1060 .S39 2003
370.15′23—dc21 2002024115
CIP

Books published by Lawrence Erlbaum Associates are printed on acid-free paper, and their bindings are chosen for strength and durability.

Printed in the United States of America
10 9 8 7 6 5 4 3 2 1

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The Effects of Problem-Solving Instruction on the Self-Determined Learning of Secondary Students With Disabilities

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Although the findings in chapter 9 were consistent with the claim that improvements in opportunities and self-regulatory capacities optimize adjustments and maximize learning during independent work, they did not show how the same conditions promote discovery learning, too. In this chapter we present an instructional model to show this effect. The model presents self-regulation problems that students can solve by reducing the discrepancy between what they know and what they want to know. It contrasts the approach of chapter 9, which encouraged students with disabilities to reduce the discrepancy between what they expected to accomplish during independent work and what they actually accomplished. Both problems are similar nonetheless in that they deal with discrepancies between goal-state expectations and actual-state circumstances.

In chapter 8, students solved these problems by regulating their expectations, choices, actions, and results to reduce the discrepancy between the points expected and points produced; they succeeded to the extent that the points they produced equaled the points they expected. In this chapter, students solve a similar problem by regulating their expectations, choices, actions, and results to reduce the discrepancy between the knowledge they have and the knowledge they want to have. Hence, they also succeed to the extent that the knowledge they acquire equals the knowledge they want to acquire. In both cases the adjustments required to learn depend on the student's ability to self-regulate in order to meet their self-set goals (Mithaug, 1993). We call this self-direction to learn something new *discovery learning*, and we show that students engage it when they are motivated to regulate their expectations, choices, actions, and results to discover what they don't know. The following prescription reflects this instructional approach.

> Prescription 2: To increase discovery learning, teach students to regulate their problem solving to learn what they want to know.

DISCOVERY LEARNING

As discussed in chapter 2, Newell and Simon (1972) provided the foundation for understanding how actors regulate their problem solving to produce new information about unknown circumstances. They tracked the behavior of adult problem solvers who tackled difficult problems of not knowing something. They discovered those learners used a similar strategy to move from an actual state of not knowing something to a goal state of knowing it. This research also showed how interactions between the unknown circumstance and the subjects' self-regulated problem solving incrementally improved their knowledge of the circumstance at the same time as it improved their regulatory capacity to learn from it.

These findings are consistent with self-determined learning theory, which predicts that optimal opportunities and adjustments interact to sustain the self-regulation needed to maximize learning. As learners act on opportunities to learn something they don't know, they alter the optimality of those circumstances and hence make them slightly more favorable for subsequent self-regulated problem solving. This in turn improves their prospects for attempting more learning. The effects of this optimization of circumstances are sustained engagement, repeated adjustment, and maximized learning, as predicted by the theory.

Newell and Simon identified a strategy used in self-regulated problem solving by observing subjects as they thought aloud to solve various problems of not knowing something. They discovered that subjects used the same four-step strategy. First, they identified the discrepancy between the goal state, which was what they wanted to know, and the actual state, which was what they knew. Second, they found an operator to reduce the discrepancy (a procedure that would get them the information they needed). Third, they used that operator to reduce the discrepancy (they acted on that information to solve the problem). Last, they returned to the first step to determine whether the discrepancy was still present and repeated the other steps if it was. When the discrepancy was eliminated, the actual state equaled the goal state and they knew what they wanted to know. Newell and Simon validated the approach by programming a computer to do the same thing, which it did to solve complex problems in chess, memory, learning problems, physics, engineering, education, rule induction, concept formation, perception, and understanding. Simon (1989) described the problem-solving strategy used by the General Problem Solving (GPS) program as follows:

> A problem is defined for GPS by giving it a starting situation and a goal situation (or a test for determining whether the goal has been reached), together with a set of operators that may be used, separately or severally, to transform the starting situation into the goal situation by a sequence of successive applications. Means–ends analysis is the technique used by GPS to decide which operator to apply next:
>
> 1. It compares current situation with goal situation to detect one or more differences between them.
> 2. It retrieves from memory an operator that is associated with the difference it has found (i.e., an operator that has the usual effect of reducing differences of this kind).
> 3. It applies the operator or, if it is not applicable to the current situation, sets up the new goal of creating the conditions that will make it applicable. (p. 36)

The program repeated these steps until the actual state equaled the goal state and the problem was solved. In this sense, then, the GPS program regulated its problem solving using the means–ends strategy similar to the one Newell and Simon (1972) used to get a boy to nursery school. That example also showed how the learning challenge (the opportunity) improved incrementally as Newell moved through the means–ends chain. By step 4, the opportunity was optimal enough to act, which Newell did by calling the repair shop to have a new battery installed in his car. This got him to step 5 and a problem he could solve by driving his son to school.

This illustrates how self-regulated problem solving interacts with circumstances to improve situations and adjustments incrementally until actual states equal goal states. As Newell moved through the means–ends chain, his adjustments improved, as did his chances of producing the goal state: his son at nursery school. By that stage in the process, the suboptimal opportunity of step 1 was now the optimal opportunity of step 5, and Newell could drive his son to school.

Note also that the motivation to problem solve always emanated from a discrepancy between what was wanted and what existed, an inconsistency between an actual state and goal state. Newell's expectation to use his car was inconsistent with the circumstances of having a working car (step 1). This motivated him to construct the next link (step) in the chain, where he discovered yet another discrepancy, his expectation to replace the car's battery with a new one which was discrepant with the actual circumstances of having a battery on hand to replace the dead one (step 2). This motivated him to create another link, where he discovered that his expectation that a repair shop would replace the dead battery was discrepant with the fact that the repair shop was unaware of what he wanted done (step 3). Finally, in step 4 Newell identified a discrepancy he could act on and eliminate, which he did. He called the repair shop to have a new battery installed, which solved this problem and made his circumstances optimal for getting his son to school (step 5). Then he acted on this optimal opportunity by driving his son to school.

This is how discovery learners construct discrepancy conditions (how they define problems) that motivate them to persist in their engagement until they discover what they want to know. Like Newell, they define problems of not knowing something based on *their* expectations and circumstances. Then they search for a means of getting that knowledge and in the process revise and adjust their expectations, choices, and actions until they get results that match their expectations. Discovery learning is the adjusting of expectations, choices, actions, and results in these means–ends sequences leading from what learners know to what they want to know. Each step in these sequences generates new learning, as does the final step that yields the discovery of what they want to know.

ENCOURAGING DISCOVERY LEARNING

This chapter describes the Self-Determined Learning Model of Instruction, which was designed to provoke students with disabilities to learn through discovery and, in so doing, become causal agents in their lives (Mithaug, Wehmeyer, Agran, Martin, & Palmer, 1998; Wehmeyer, Palmer, Agran, Mithaug, & Martin, 2000). Both optimality factors—choice opportunity and self-regulated adjustment—are incorporated in the model's three phases, which are presented in Figs. 10.1–10.3. Each phase poses a problem for students to solve, and a series of questions for them to answer in order to solve it. Although the questions vary, they always comprise the basic steps of self-regulated problem solving. Figure 10.1 depicts the first phase ("Set a Goal"), which provokes students to answer the question "What is my goal?" and then to define a discrepancy between what they know and what they want to know. The questions posed in this phase provoke students to find something they can do to discover what they want to know. The last question in that first phase, "What can I do to make this happen?," provokes students into setting a goal to do something to get the information they need. Figure 10.2 depicts the second phase of the

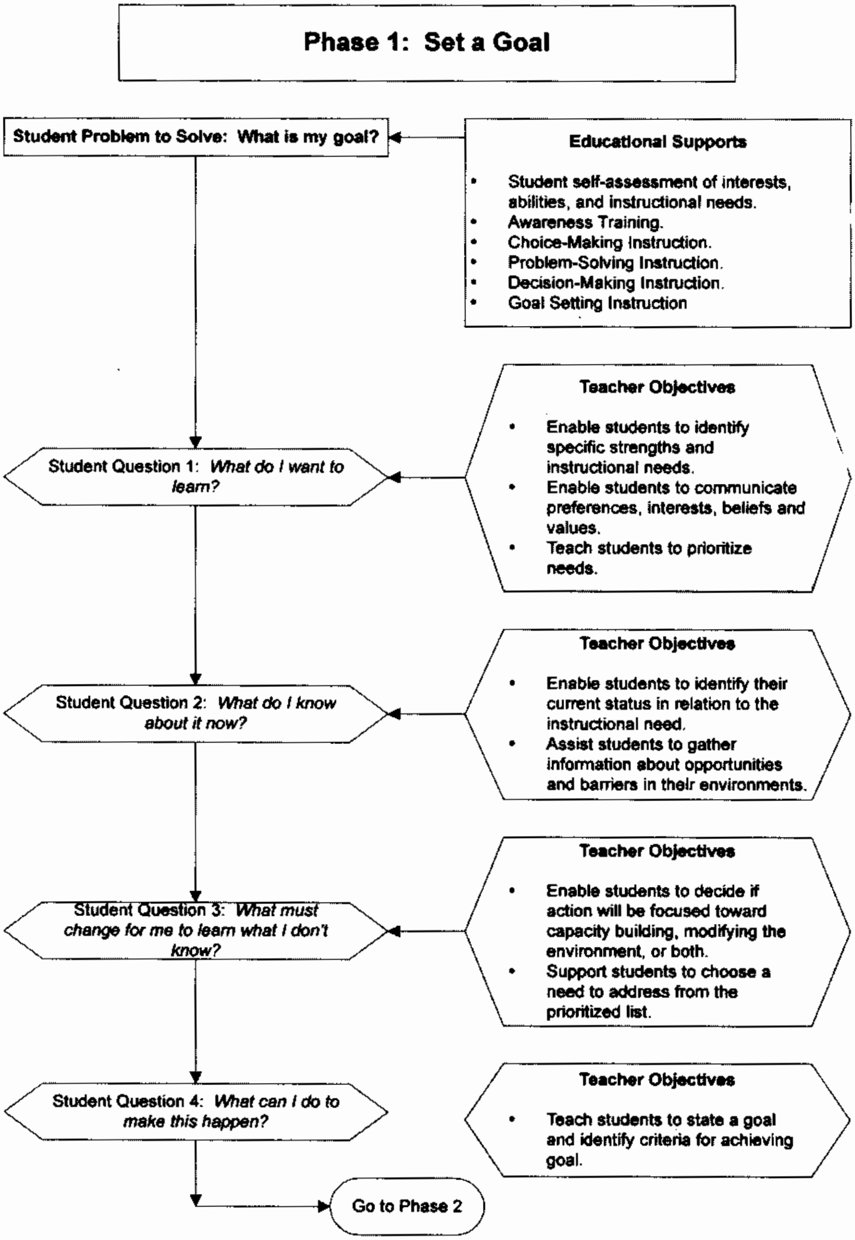

FIG. 10.1. Phase 1 of the Self-Determined Learning Model of Instruction.

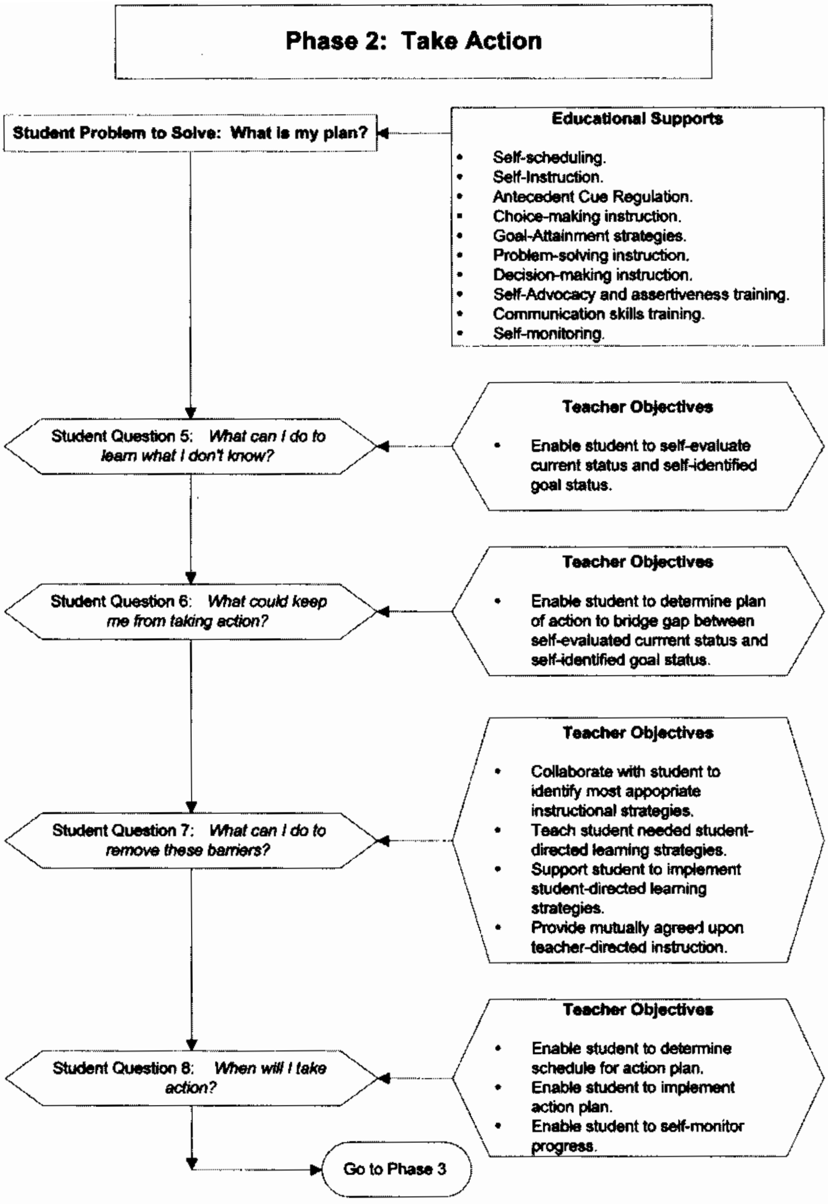

FIG. 10.2. Phase 2 of the Self-Determined Learning Model of Instruction.

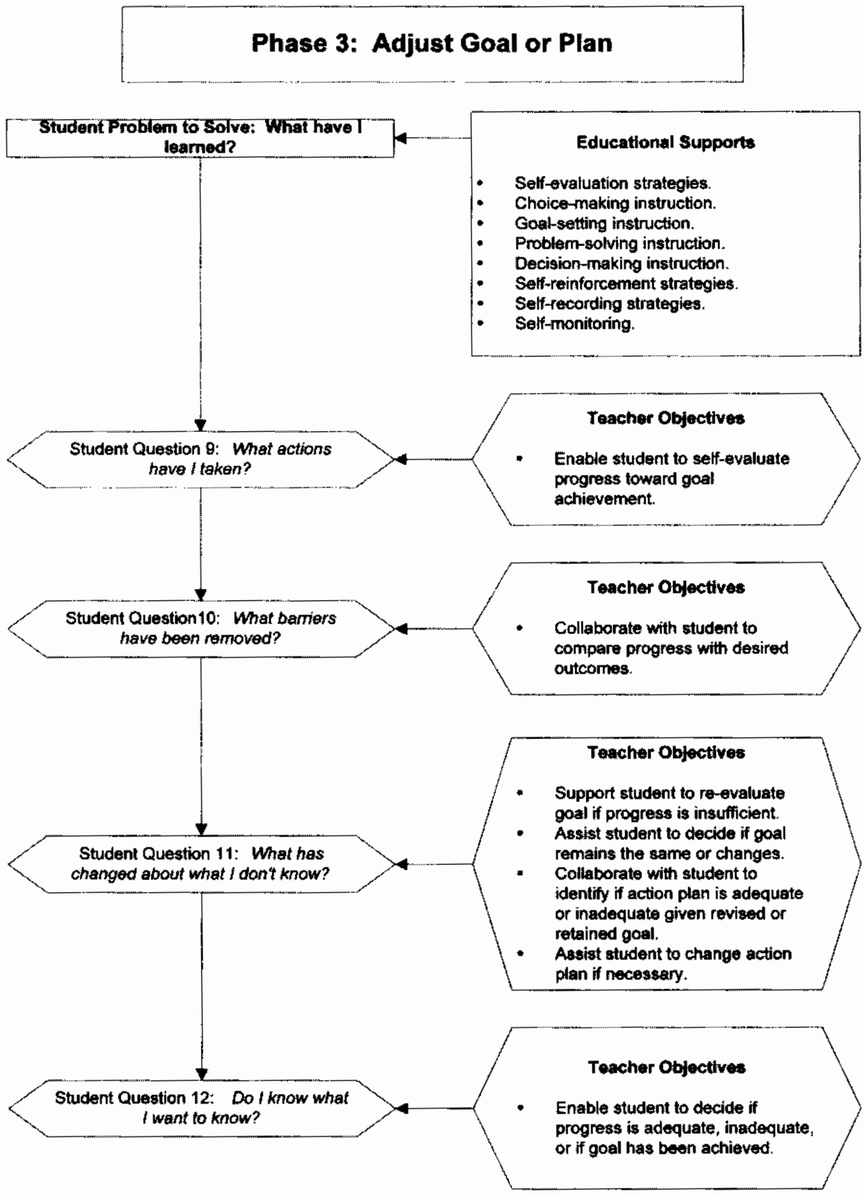

FIG. 10.3. Phase 3 of the Self-Determined Learning Model of Instruction.

model, which solves the problem of knowing how to solve the problem. The question "What is my plan?" provokes students into defining the discrepancy between the action that is necessary to find what they need to know and the action they are capable of taking. This stage in discovery ends with a plan of action reflecting that capability: "When will I take this action?" Figure 10.3 depicts the third and final phase of the model, where a student asks "What have I learned?" and then defines the discrepancy between plans and actions taken on the one hand and what the student expected to learn and actually learned on the other. Here the students are provoked into solving problems that may still be preventing them from getting the information they need or want. Answering these questions may direct them back to phase 2, where they identify new actions to remove obstacles, or take them back to phase 1, where they update the discrepancy between what they want to know and what they know, which may require additional searches and hence continued engagement.

The purpose of the Student Questions is to provoke discussions between teachers and students about how students might solve problems of not knowing something. The Teacher's Objectives in the model guide teachers in providing assistance. The Educational Supports, which are not part of the model per se, identify instructional strategies and educational supports that are likely to help students regulate their problem solving. These methods and tactics come from self-management research, which has proved effective in assisting students with and without disabilities regulate their learning in various settings.

RESEARCH ON THE SELF-DETERMINED LEARNING MODEL OF INSTRUCTION

We tested the model with teachers of elementary (Palmer & Wehmeyer, 2001) and secondary students with disabilities (Agran, Blanchard, & Wehmeyer, 2000; Wehmeyer et al., 2000). This section reviews some of those studies.

Study 1

In one study, Wehmeyer et al. (2000) conducted a field test with 21 teachers and their adolescent students with disabilities who received services in Texas and Wisconsin. Each teacher identified several students to receive instruction using the model. In total, 40 students with mental retardation, learning disabilities, or emotional/behavioral disorders participated. During the model's phase 1 of instruction, the test group selected a total of 43 goals, with three students choosing two goals each. Of this total, 10 goals focused on social skills and knowledge, 13 on such behaviors as compliance to rules, self-control, and adaptive learning, and 20 goals related to academic skills.

The goal attainment efficacy of the students was examined using the Goal Attainment Scaling (GAS) process (Kiresuk & Lund, 1976). This approach has been used with students receiving special education services and, according to Carr (1979), "involves establishing goals and specifying a range of outcomes or behaviors that would indicate progress toward achieving those goals" (p. 89). In this study, GAS scores were attached to each goal identified by students. This was done by having teachers identify five goal attainment outcomes, which ranged from being most favorable to being most unfavorable for attainment. The midpoint of that range was the outcome that teachers considered satisfactory. The other outcome possibilities were assigned values from –2 to +2, from that 0 midpoint.

On completing an instructional activity, teachers used the scale to assess the level of students' goal attainment. They selected an outcome value on the scale for the goal that matched the student's achievement level. These goal rating data were then analyzed using a raw-score conversion key for Goal Attainment Scaling developed by Cardillo (1994). Then raw scores were converted to standardized *T*-scores (Kiresuk & Lund, 1976), which had a mean of 50 and a standard deviation of 10. This transformation allowed goal attainment comparisons across different subject matter. A *T*-score value of 50 was an acceptable outcome level in that it was consistent with teacher expectations for achievement in that subject area. Standardized scores of 40 or below were below that expected outcome and scores of 60 and higher were above teacher expectations. GAS scores for students who worked more than one subject area were the averages of the standardized scores for the subject areas covered. Pre- and posttest scores were also collected on students' self-determination using the Arc's Self-Determination Scale (Wehmeyer, 1996), on students' locus of control, and on student reports of their self-regulation using the AIR Self-Determination Scale (Wolman, Campeau, Dubois, Mithaug, & Stolarski, 1994). The six self-regulation items taken from the AIR scale are presented in Table 10.1.

Self-Regulation. As indicated in Fig. 10.4, there were significant increases in students' self-regulation effectiveness from pre- to posttest sessions. Those increases included goals setting (adaptable expectations), planning, self-monitoring, self-evaluating (rational choosing), and school engagement (efficient action).

Control. There were also significant differences between pre- and posttest scores on the Arc's Self-Determination Scale and on the locus of control measure. The postintervention scores were significantly higher

TABLE 10.1
Questions Comprising the Self-Regulation Questionnaire

Do you have any interests right now?
Do you have any goals right now?
Do you have any plans for meeting the goal you mentioned?
Do you know when you will meet your goal?
Have you thought about whether your plans are working or not?
Do you have ways at school to reach your goal?

than preintervention scores on both measures. This is consistent with proposition 3 of self-determined learning theory, which claims increased self-regulated engagement will result in a greater sense of control over learning. It is also consistent with the claim that greater control over learning improves prospects for self-determination.

Learning. The field test also showed the model to be effective in provoking students to meet their goals. The mean GAS score for the sample was 49. Twenty-five percent (25%) of the standardized GAS scores equaled 50, and 30% were higher than that, which means that 25% of the goals met teachers expectations for achievement whereas 30% of the goals exceeded expectations. Of the remainder, slightly more than 25% of the GAS scores were between 40 and 49, indicating that they did not meet teacher expectations. In about 20% of the goals, there was no progress.

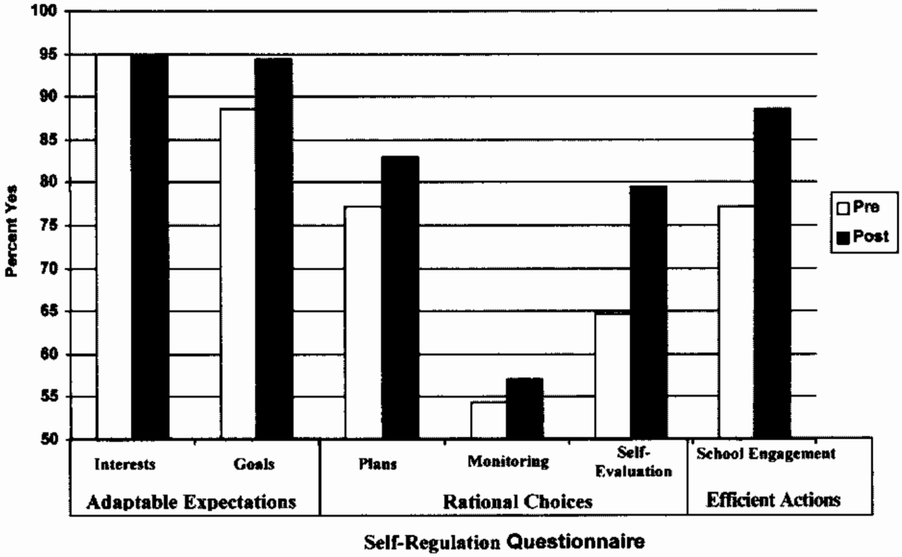

FIG. 10.4. Responses from self-regulation questionnaire.

Study 2

Agran et al. (2000) used the Self-Determined Learning Model of Instruction for students with moderate to severe disabilities. In this study, 19 adolescents received the instruction prescribed by the model in a delayed multiple-baseline across-group design. Students collaborated with their teachers in the first phase of the model to identify their goals, which covered work, social, academic, and community living skills. One student who was visually impaired had a goal to call a bus service, to schedule appointments, and then to be transported to different locations in the community, and another student wanted to learn how to monitor his blood sugar level. Prior to implementing phase 2, teachers and researchers collected baseline data on student progress toward their goals. At staggered intervals following baseline, teachers implemented the model. Data were also collected on goal attainment using the GAS procedure. At the conclusion of the training period, teachers were asked to report details of student progress. Additional data were obtained on responses to worksheets developed to assist implementation of the model. Students responded to these questions: "What has changed?" "Did I do what I said I would do?" "What do I like about it?" Additionally, anecdotal information from students was collected.

Results were positive for all but 2 of the participants. For 17 students, learning gained from baseline to intervention and maintained at high levels thereafter. Also, 12 of the 19 students provided feedback on the model. All of these students indicated that the model helped increase their skills and independence, and 5 students indicated it improved their confidence. This group also reported that they did what they said they would do and that they liked this method of instruction. The reasons given were that they liked problem solving, enjoyed talking with their teachers about themselves, liked making choices, and liked learning skills that were based on those choices.

Sense of Control. Four of the six teachers in the study completed a social validation form for 13 of the students. The forms allowed them to identify factors that helped students complete the three phases of the model. All of these teachers indicated that their students enjoyed the approach, that students were willing to work toward their goals, that they enjoyed being in charge of their learning, and that they liked being responsible for making decisions and taking actions. One teacher thought that teachers should be able to talk with students about the skills they needed to learn in order to promote their self-determination in community employment and adult living. Another teacher suggested that there be time allocated to helping students set goals, as this was difficult for some.

Learning. Again, the students showed that they could reach their goals through problem solving. The mean GAS score for the sample was 60, indicating that on average students exceeded their teachers' expectations for goal attainment. Twenty-one percent (21%) of the standardized GAS scores were 50, indicating that students attained a satisfactory level of achievement. And 68% were higher than 50, indicating that two-thirds of the students exceeded teachers' expectations. Only two students failed to make progress on goals, which meant that 89% of the participants met or exceeded their teachers' expectations.

These finding are consistent with results reported McGlashing, Agran, Sitlington, Cavin, and Wehmeyer (2001), who taught four transition-age students with moderate to severe mental retardation to use a self-regulated problem-solving procedure to enhance their vocational competence. Also, Agran, Cavin, and Wehmeyer (2001) taught three students with mild to moderate learning disabilities who were employed at Pizza Hut and WalMart to use a problem-solving strategy to enhance their job initiation, task completion, and task sequencing skills.

DISCUSSION

The model of instruction described in this chapter was designed to enable teachers to "teach" students to engage in self-regulated problem solving by associating their learning opportunities with their needs and interests and by encouraging goal setting, choice making, action taking, and results monitoring to take advantage of those opportunities. According to self-determined learning theory, this approach was predicted to work because it optimizes opportunities and adjustments. The model guided instruction toward the optimizing of opportunities by connecting learning challenges to students' needs, interests, and choices, and it guided instruction toward optimizing adjustments by encouraging means–ends problem solving as students set expectations, made choices, took actions, and monitored results. Indeed, the test findings were consistent with the theory's predictions and prescriptions. Students became better self-regulators, they felt in control of their learning, and they learned from their self-regulated problem solving.

Unfortunately, most students never feel in control when learning something new. One reason, according to Mithaug (1993), is that these optimal experiences require matches between expectations and performance on the one hand and between learning demands and personal gain on the other. Recall our description from the first chapter of Carey, who never experienced the rewards of overcoming difficult challenges. The reason for her dim prospects was traced to her deficiencies in self-regulated problem solving. She could dream about what she might become when she grew up, but she never acted on her dreams. She never connected them to expectations and expectations to plans or actions. This was evident in how she set goals. She set them so high that no amount of planning or working could meet them, or she set them so low that any amount of planning and working would achieve them. Either way, she never had to alter what she expected, what she chose to do, or how she acted in order to get where she wanted to go. Her poor adjustments at school reflected those difficulties. So did her lack of self-determination.

In the studies reported in this chapter, students like Carey were well represented in that the study participants had a full range of disabilities and had little or no experience with discovery learning. But unlike Carey, these students received instruction on how to regulate their problem solving to discover what they did not know. As a result of this instruction they developed control over their adjustments, produced new learning, and had an enjoyable experience. Indeed, some of these students may have had experiences similar to those Csikszentmihalyi (1990) and others call optimal. Again, these optimal experiences come from gaining control over challenge, which these students defined for themselves when they set their own goals. The control was experienced when they met their own goals.

This raises the possibility that prospects for self-determination can be enhanced directly through similar instruction on problem solving to meet self-set goals. Indeed, we would expect that if students were allowed to choose any goal and then encouraged to solve problems related to its attainment, their prospects for self-determination would increase proportionately. The next chapter examines this possibility by determining whether instruction on self-regulated problem solving improves students' prospects for self-determination.

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