COMING OF AGE

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Error Monitoring

A Learning Strategy for Improving Adolescent Academic Performance

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THE FIELD OF learning disabilities (LD) is experiencing an increased demand for programs designed to serve learning disabled students in secondary schools. In response to this demand, several curriculum options have been developed (Deshler, Lowrey, and Alley 1979). One of these options — the learning strategies model — has been the focus of much research and programming efforts in recent years. As described by Alley and Deshler (1979), a learning strategies approach is designed to accomplish the following goal: to teach learning disabled adolescents strategies that will facilitate their acquisition, organization, storage, and retrieval of information, thus allowing them to cope with the demands of the secondary curriculum. In short, this approach is designed to teach students "how to learn" rather than specific content. For example, the teacher may teach the LD students techniques for clustering and organizing material that must be learned for a social studies test rather than actually teaching the social studies content. Furthermore, these same strategies can often be generalized across settings, contents, and time.

The thrust of the intervention research being conducted by the University of Kansas Institute for Research in Learning Disabilities has been the learning strategies intervention model. This programmatic research effort is designed to study not only underlying assumptions of this model but also to determine the power and robustness of specific learning strategies that are designed to facilitate the secondary LD student's ability to cope with the demands of the secondary school. Such strategies as self-questioning, visual imagery, multipass (for reading comprehension), test-taking, and error monitoring are being studied. The purpose of this paper is to present data from one segment of this programmatic effort, error-monitoring, as illustrative of the techniques being developed to impact the performance of the LD adolescent.

The specific learning strategies researched by The University of Kansas Institute for Research in Learning Disabilities must meet the

basic conditions. First, they must have a high probability of helping the LD adolescent cope with the demands of the secondary setting. Second, they must address deficit areas found in a large proportion of the LD adolescent population. Third, they must be based on principles of cognitive psychology and learning. Error monitoring is considered to be an important learning strategy for LD adolescents because it meets the above three conditions. The remainder of this section will discuss error monitoring in relation to the three conditions stated above.

First, the curricular requirements of the secondary school place heavy written expression demands on students. Teachers expect students to take notes during class lecture and most assignments and tests require written expression (Moran 1980). Students' written products are often judged as much for spelling and punctuation accuracy as for content (Cuthbertson 1979). Consequently, students who have strategies to monitor errors in their work before handing it in usually receive better grades. Another demand placed on students in secondary settings is to assume responsibility for their performances. Typically, junior and senior high school students do not have the close interaction with and supervision of teachers that they enjoyed in the elementary grades. In elementary school, many of the study assignments and reviews were conducted under the watchful eye of the teacher. In these highly structured situations, teachers assumed much responsibility for monitoring errors on the students' work. To succeed in secondary schools, students are expected to assume more responsibility for the correctness of their assignments. For many LD students, the absence of teacher assistance in such activities can prove devastating. In short, the demands of the secondary school require students to assume responsibility for more of their actions and performances, including the monitoring of errors in their work.

Second, research on the characteristics of LD adolescents indicates that these students have deficits in monitoring errors in their performance. Alley, Deshler, and Warner (1979) have found that LD specialists report that a deficit in monitoring errors in spelling occurs four times as often in a learning disability as in a non-learning disability population. To learn a skilled, highly integrated response and to perform in a competent, accurate, rapid, and expert fashion, one must respond to feedback data generated from one's own response and to external information. Siegel (1974) has suggested that a faulty feedback mechanism in older learning disability students may impede their ability to act appropriately in social situations. Deshler, Ferrell, and Kass (1978) have found that learning disabled high school students evidenced a monitoring deficit on academic tasks which required their detection of self-generated and externally-generated errors. On a creative writing task for example, LD students detected only one-third of the errors they com-

mitted. The repercussions of such performances in academic and future employment situations are obvious. The need to make LD adolescents aware of the quality of their performance in written work is evident.

Third, the important role of monitoring or the detection of errors in learning and performance is clearly documented in the psychological literature. Powers (1973), for example, maintains that much successful human behavior is oriented around the ability of the individual to use feedback information to monitor errors in his/her performance. Adams (1971), in summarizing his research on error monitoring, states: "knowledge of results is the foremost source of information which results in corrections that eventually lead subjects to a correct response. Thus, the monitoring of errors and the use of feedback information is a most critical variable controlling learning and performance" (p. 122). While significant attention has been given to error monitoring in psychology, much less emphasis has been given to this topic in the learning disability literature. Deshler (1974), in a review of the most frequently used textbooks in learning disabilities and special education, found only one that discussed the important role of error monitoring in learning and performance for LD populations. The neglect of this topic is ironic given the significant problems that many LD students encounter in discriminating between correct and incorrect responses. Even the general education literature has not given major attention to strategies for error monitoring. That is, most instructional techniques that deal with error monitoring do not treat it as a primary instructional goal but rather as an incidental by-product of another intervention (Hamacheck 1968; Laurita 1972). Even less emphasis has been given to error monitoring as a learning and performance variable in the learning disability literature. This is unfortunate given the curricular demands for the skill, the monitoring deficits found in LD students, and the important role of monitoring as a learning and performance variable.

The purpose of this study therefore was to determine the effect of teaching LD adolescents an error-monitoring learning strategy. A specific instructional methodology was used to teach students the new strategy. The student's ability to apply the strategy to *both* teacher-generated and self-generated written products was measured.

METHOD

Subjects

Nine secondary students, seven males and two females, participated. All nine students were currently being served in programs for learning disabled students. The students were selected after reviewing their school records and interviewing their LD teachers. Only those students

who had IQ scores in the normal range (i.e., above 80), exhibited deficits in one or more achievement areas, and did not exhibit evidence of physical or sensory handicaps, emotional disturbance, or economic, environmental, or cultural disadvantage were asked to participate. The participating students had IQ scores ranging from 88 to 117 ($\bar{x}$ = 99), grade level reading scores ranging from 3.9 to 8.0 ($\bar{x}$ = 6.2), and grade level writing scores ranging from 2.3 to 8.5 ($\bar{x}$ = 5.3). Their ages ranged from 12.5 to 18.0 years ($\bar{x}$ = 15.8 years) and they were in grades 8 to 12 ($\bar{x}$ = 10).

Learning Setting

The study took place in a classroom-like setting in a community center which had been converted from a school. Each student was seated at a desk or small table. The teacher circulated among the students to give them individual instruction and feedback. The teacher taught four or five students at a time.

Instructional Materials

The teacher was provided with a manual which contained a step-by-step description of the instructional procedures. Following these procedures, the teacher developed a set of instructional materials (hereafter referred to as "teacher-generated materials"). These materials included handwritten, one-page passages into which the teacher inserted specific writing errors. In each passage, the teacher made five capitalization errors, five appearance errors, five punctuation errors, and five spelling errors. The teacher made two sets of these passages for each student such that the readability of one set of the passages was at the student's reading ability level and the readability of the other set was at the student's grade level. This was accomplished by the teacher selecting the passages from materials which had already been scored for readability,* writing the passages on lined notebook paper, inserting the specified errors, and xeroxing the pages.

*This teacher used *66 Passages to Develop Reading Comprehension* and *88 Passages to Develop Reading Comprehension*, by M. Gilmore, A. Sack, and J. Yourman, published by College Skills Center, 1250 Broadway, New York, to construct the teacher-generated passages. The reason she used these materials was that they contained a series of short, high-interest passages which had already been judged for readability. The readability of the passages in *66 Passages* ranges from first to eighth grade and in *88 Passages* ranges from sixth grade to college level.

Procedures

Instructional procedures

The instructional steps used by the teacher in teaching the monitoring strategy were adapted from those suggested by Alley and Deshler (1979) and Deshler, Alley, Warner, and Schumaker (1980). They were as follows:

Step 1: Test to Determine the Student's Current Monitoring Skills
In this step, the teacher tested the student's monitoring skills first in the teacher-generated materials at both ability and grade level and then in a passage written by the student him/herself. After testing was completed, the teacher discussed the results with the student, affirming that the student exhibited a deficit in the way he/she monitored for errors and, as a result, left a number of errors in his/her work.

Step 2: Describe the Error Monitoring Strategy
Next, the teacher described the steps involved in the Error Monitoring Strategy to the student and contrasted them with the student's current checking habits. The steps included the specific behaviors in which the student should engage and the sequence of behaviors which should be followed. As each step was explained, a rationale was given for why the behavior was important and how it would help the student to produce a better written product.

Step 3: Model the Strategy
In this step, the teacher modelled the Error Monitoring Strategy for the student. Thus, the teacher demonstrated the strategy by acting-out each of the steps previously described to the student while "thinking aloud" so the student could witness all of the processes involved in the strategy.

Step 4: Verbal Rehearsal of the Strategy
Here, the student verbally rehearsed the steps involved in the Error Monitoring Strategy to a criterion of 100 percent correct without prompts. This instructional step was designed to familiarize the student with the steps of the strategy such that he or she could instruct him/herself in the future as to what to do next when performing the strategy.

Step 5: Practice in Ability Level Teacher-Generated Materials
In this step, the student practiced applying the strategy to successive passages written at his or her current reading level. This reduced the demands on the student such that he/she could concentrate on the application of the new strategy. As the student became proficient in monitoring, he or she was encouraged to progress from overt self-instruction to covert self-instruction while practicing the strategy.

Step 6: Feedback
The teacher gave the student positive and corrective feedback after he or she completed monitoring each passage. When the student reached a criterion of detecting and correcting 90 percent of the errors in a given passage, the student went on to Step 7.

Step 7: Test on Teacher-generated Passages
Here, the student received two tests in Teacher-generated passages, one at ability level and one at grade level. These provided measures of each student's progress in learning the strategy. If the student reached criterion on the ability level test but not on the grade level test, Steps 5 & 6 were to be repeated using grade level materials. If the student reached criterion on both tests, the student progressed to Step 8.

Step 8: Individual Analysis of Common Errors
For this step, the teacher analyzed with the student the types of errors the student commonly was making in his or her written work. For this purpose, the student and teacher used products the student had recently written. The result of this analysis was a list of the kinds of errors the student should be specifically careful to monitor. The list was secured in the student's notebook.

Step 9: Practice in Student-generated Paragraphs
The student was instructed to write a paragraph and to apply the monitoring strategy to that paragraph.

Step 10: Feedback
Each time the student completed monitoring a new paragraph, the teacher gave the student positive and corrective feedback about his or her use of the monitoring strategy to detect and correct errors. Steps 9 and 10 were recycled until the student's final copy of a paragraph had fewer than one error for every 20 words.

Step 11: Test on Student-generated Paragraph
The student was asked to write a paragraph and monitor that paragraph as a final test of the student's monitoring skills.

Error Monitoring Strategy Procedures

As described above, the student first learned to detect and correct errors in Teacher-generated passages. For this purpose, the student followed these procedures:

1. Read each sentence separately.
2. Ask yourself the "COPS questions" (see description below).
3. When you find an error, circle it and put the correct form above the error if you know the correct form.

4. Ask for help if you are unsure of the correct form.

The "COPS questions" were questions the students were to ask themselves to cue themselves to look for four kinds of errors. These four categories of errors were devised after reviewing many samples of LD students' written work. An effort was made to minimize the number of categories while covering the largest number of errors the students were making. The "COPS" acronym, as part of the learning strategy, was chosen in light of the detecting and correcting activities involved in the strategy. The COPS questions and the errors the student looked for were as follows:

C— Have I capitalized the first word and proper names?
O— How is the *o*verall appearance? (Here the student looked for errors involving spacing, legibility, indentation of paragraphs, neatness, and complete sentences.)
P — Have I put in commas and end punctuation?
S — Have I *s*pelled all the words right?

Each of these categories and the types of errors subsumed under each category were fully described to the students in the Describe Step (Step 2).

When the student began monitoring his or her own work, these were the steps to be followed:

1. Use every other line as you write your rough draft.
2. As you read each sentence, ask yourself the COPS questions.
3. When you find an error, circle it and put the correct form above the error if you know it.
4. Ask for help if you are unsure of the correct form.
5. Recopy the paragraph neatly in a form for handing in to the teacher.

Measurement Systems

Each of the four categories of errors was subdivided into subcategories of the types of errors which were emphasized with the students. There were 12 subcategories in all. For example, capitalization errors were subdivided into three subcategories: the first letter of the first word of a sentence not capitalized; proper nouns not capitalized; and capital letters improperly used. Each of these types of errors was objectively defined. Scorers became familiar with these definitions and received two hours of scoring training. This training consisted of an explanation of the scoring procedures, practice scoring actual passages and paragraphs, and discussion and feedback after calculating reliability between scorers.

For teacher-generated passages, answer keys were provided. Thus, the scorers merely had to categorize and tally the errors the students detected and the errors which they corrected correctly. Interscorer reliability was obtained by having two scorers independently score one randomly selected pre-test and post-test at ability level and at grade level for each student. The scorers' tallies were compared category by category and occurrence reliability calculated by dividing the number of agreements by the number of agreements plus disagreements. The percentage of agreement was 91.6 percent for errors detected and 90.5 percent for errors corrected.

For the student-generated passages, the scorers first had to categorize and tally all the errors the student made in his/her rough draft. Then, the errors remaining in the student's final draft were also scored. These tasks were accomplished on a tally sheet whereby the errors the student made on each line of his/her paragraph were categorized into the twelve subcategories of errors. Two independent scorers scored one pre-test paragraph and one post-test paragraph for each student. Interscorer reliability was determined by comparing their tally sheets line by line and category by category. An agreement was scored if both observers tallied an error as occurring in the same subcategory of errors and on the same line of the paragraph. Again, occurrence reliability was calculated. The percentage of agreement on errors was 75 percent. This percentage, although acceptable, is somewhat low due to the difficulty in categorizing some of the errors. For example, making a decision between whether a word was mispelled or whether it was illegible (an overall appearance subcategory) was difficult. Some words that were illegible to one scorer were readable for another scorer. The percentage of agreement when the total number of errors tallied by both scorers were compared was 85 percent.

Experimental Design

A multiple baseline design across three students (Baer, Wolf, and Risley 1968) was employed and then was replicated twice with two more sets of three students each. The first student in each group of three students received only one set of pretests before instruction began. The second student received two sets of pretests and the third student received three sets of pretests.

RESULTS

Figure 12.1 shows the pretest (baseline) results, the practice (or training) results and the post-test results for the first three students, S_1, S_2 and S_3, in Teacher-generated passages. The percentage of errors detected is shown in the closed symbols and the percentage of errors corrected is

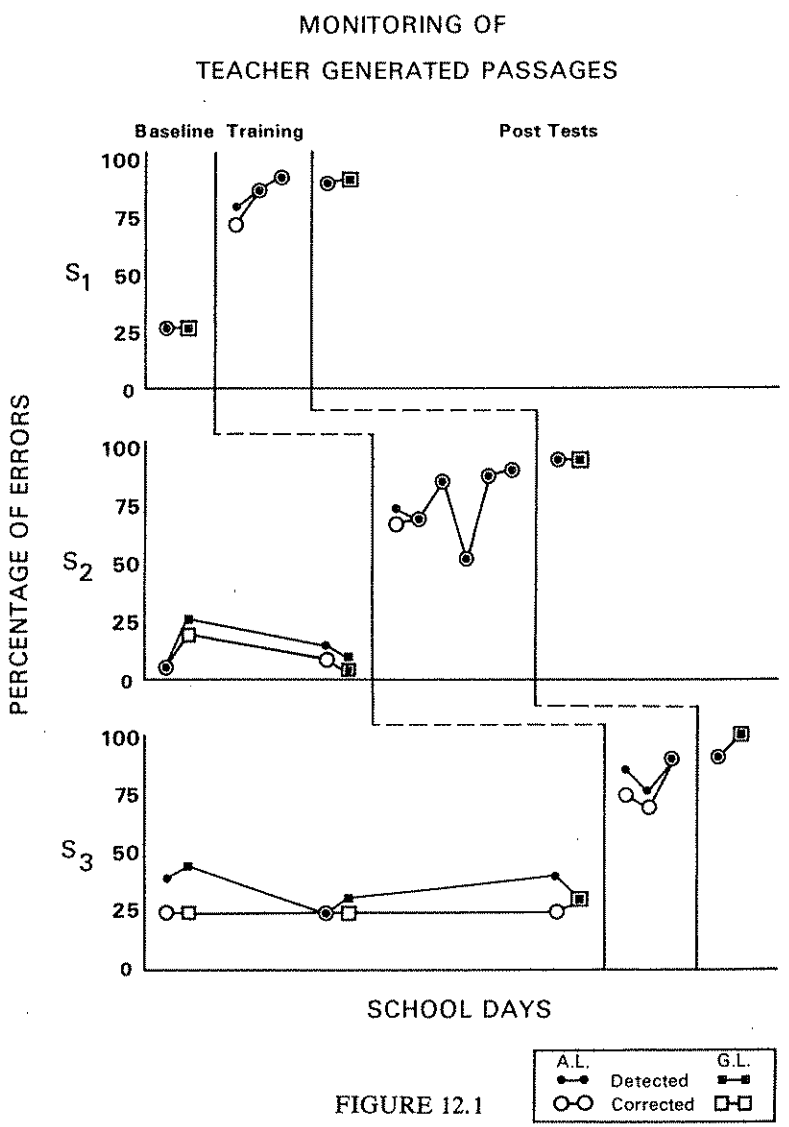

FIGURE 12.1

shown in the open symbols. The ability level (A.L.) test results are depicted with circles and the grade level (G.L.) test results are depicted with squares.

Before training, none of the students was correcting more than 25 percent of the errors in either ability level or grade level materials. Detection of errors was slightly higher than correction for S_2 and S_3. During training, S_1 required three practice passages, S_2 required 6 practice passages, and S_3 required three practice passages to reach the criterion of detecting and correcting 90 percent of the errors. Posttest results showed the students readily and immediately generalized their monitoring skills to the more difficult grade level passages. All three students scored at or above criterion level for both ability and grade level post tests.

Figure 12.2 shows the results for the student-generated passages for the same three students. The dots show the number of errors per word the student made before monitoring his/her work. The circles show the number of errors per word remaining after the student checked his/her work. During baseline, S_1 was making and failing to correct one error for every three words in his paragraph, S_2 was making and failing to correct one error for every four words, and S_3 was making and failing to correct as many as one error for every two words. S_1 and S_2 required two practice paragraphs and S_3 required only one practice paragraph before reaching criterion. On the final post-test, S_1 and S_2 had no errors in their final drafts and S_3 had fewer than one error for every twenty words.

The results for the other six students are very similar to these results.* None of the nine students required instruction in the grade level materials. Most of the students required only three practices in teacher-generated passages; six practices was the highest number required. Five of the students had one practice and four had two practices in student-generated paragraphs before reaching criterion.

The teacher time involved in the instruction was four hours of group instruction for the Describe and Model steps (Steps 2 & 3). Each practice on a teacher-generated passage took a student about 20 minutes with 5 to 10 minutes for scoring and feedback by the teacher. The individual analysis required about 20 minutes of teacher and student time. Each paragraph took about 30 to 35 minutes for the students to

*To obtain figures of these data, write to the authors at the Kansas Institute for Research in Learning Disabilities, 313 Carruth-O'Leary Hall, University of Kansas, Lawrence, Kansas 66045.

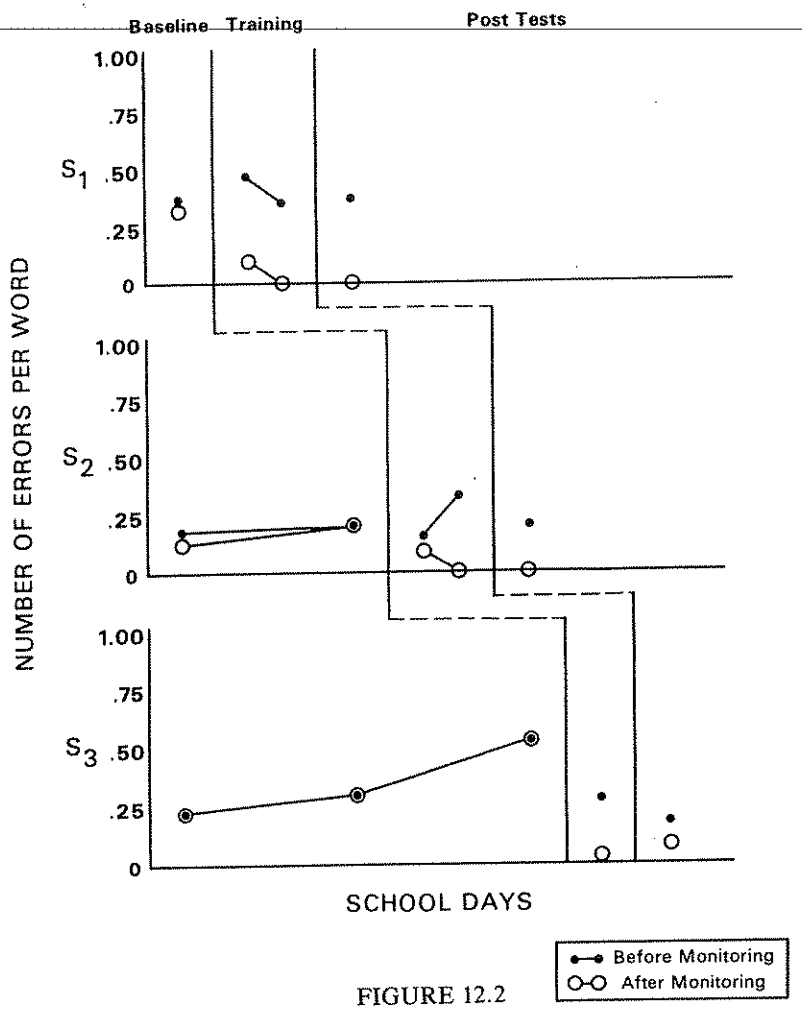

FIGURE 12.2

write and monitor and an additional 10 minutes for the teacher to score and give feedback. Thus, the average total amount of instructional time for a given student was about 7½ hours.

DISCUSSION

The instructional procedures appear to be effective in teaching a learning strategy, specifically error monitoring, to learning disabled adolescents. Three replications of a multiple baseline design across students demonstrated that improved performance did not occur until after each student received instruction in the strategy. All of the students showed marked improvement immediately following instruction in their first practice lessons. Only one student (S_2) had what was termed "difficulty" by the teacher in reaching criterion on the Teacher-generated passages. When the lesson was couched as a "detection game" for this student, whereby the student could earn up to five points for the errors found and corrected in each of the COPS categories, the student improved quickly.

This study, unlike others reported in the literature on error monitoring, measured the effects of teaching a specific detection strategy to LD adolescents. While most previous research on error monitoring has focused on it as a learner characteristic, this study has demonstrated the efficacy of a monitoring procedure to successfully improve the performance of LD adolescents in both teacher-generated and self-generated materials.

The instructional procedures involved in teaching this strategy appear to be practical in that instruction can be imparted in relatively few hours while insuring criterion level gains in a majority of LD students. This is especially true since the initial instruction can be accomplished in a group format. It is unclear, however, whether all of the instructional steps are necessary in teaching this strategy. Indeed, it may not be necessary to teach the strategy using teacher-generated passages first. The reasoning behind this tactic was: (1) to eliminate any emotional attachment to the material being monitored while the student was initially learning the strategy, and (2) to give the student experience monitoring a wide variety of errors. Most of the students were making idiosyncratic errors and there were not opportunities to make some errors given the structure of our test situation. For example, there were few opportunities for a paper to be torn or crumpled since each paper was given to the teacher immediately after it had been written. The teacher-generated passages allowed the student to be confronted with a torn paper and necessitated a discrimination of when a given tear constituted an error necessitating remediation.

One limitation of the procedures is that they have not been tested with students reading below the 3.9 grade level. The student in this study who had the widest discrepancy between actual grade level and current

reading level was in the 10th grade and was reading at the 3.9 grade level. Thus, the procedures have not been tested with students exhibiting wider discrepancies. Nevertheless, the wide discrepancy did not seem to hinder the student in our study. In fact, when compared to the other students, she was one of the quickest learners of the strategy, requiring only four practices in all to learn the whole strategy.

Another limitation of the procedures is that the COPS categories are somewhat restricted. Only the most frequent kinds of errors committed by students doing relatively simple writing were included in the categories. The strategy is not intended to be a means of teaching the many subtleties and complexities of grammar and syntax. The use of the individual analysis step (Step 8) allows the teacher to identify idiosyncratic errors for each student which may not be specified in the COPS questions. Thus, the procedure does not preclude the identification and discussion of errors not included in the COPS categories.

A final consideration regards the problem of generalization. From the results of this study, it remains unclear how the procedures will impact the students' performances in the regular class. This study took place in the summer. Thus, there were no opportunities to collect products the students completed in other classes; our class was the only one in session. Current and future research is focusing on the students' use of the new strategies they have learned outside of the resource room environment.

In summary, this study has exemplified some of the intervention research on learning strategies currently being conducted by the Kansas Institute for Research in Learning Disabilities. Single-subject designs are being utilized to validate the effectiveness of a general teaching methodology across a wide variety of learning strategies. The strategy featured here, error monitoring, appears to be effectively used by learning disabled secondary students after training such that they can eliminate most if not all of the errors in their own writing. This skill, if properly used, should enable the learning disabled student to better respond to the demands of the secondary setting in light of the many instances of written work required in that setting.

REFERENCES

Adams, J. A. "A Closed-loop Theory of Motor Learning." *Journal of Motor Behavior* 3 (1971): 111–49.

Alley, G. R., and D. D. Deshler. *Teaching the Learning Disabled Adolescent: Strategies and Methods*. Denver: Love Publishing, 1979.

Alley, G. R., D. D. Deshler, and M. M. Warner. "Identification of Learning Disabled Adolescents: A Bayesian Approach." *Learning Disability Quarterly* 2(2) (1979): 76–83.

Baer, D. M., M. M. Wolf, and T. R. Risley. "Some Current Dimensions of Applied Behavior Analysis." *Journal of Applied Behavior Analysis* 1 (1968): 91–7.

Bilodeau, I. A. "Information Feedback." In *Principles of Skill Acquisition*, edited by E. A. Bilodeau and I. A. Bilodeau. New York: Academic Press, 1969, pp. 255–85.

Cutherbertson, E. B. "An Analysis of Secondary Testing and Grading Practices." Masters thesis. Lawrence, Kansas: The University of Kansas, 1979.

Deshler, D. D., G. R. Alley, and S. C. Carlson. "Learning Strategies: An Approach to Mainstreaming Secondary Students with Learning Disabilities." *Education Unlimited* 2(4) (1980): 6–11.

Deshler, D. D., G. R. Alley, M. M. Warner, and J. B. Schumaker. "Promoting the Acquisition and Generalization of Learning Strategies by Learning Disabled Adolescents." In *Learning Disabilities: Perspectives and Practices*, edited by D. G. Bachor. In press.

Deshler, D. D., W. R. Ferrell, and C. E. Kass. "Monitoring of Schoolwork Errors by LD Adolescents." *Journal of Learning Disabilities* 11(7) (1978): 10–23.

Deshler, D. D., N. Lowery, and G. R. Alley. "Programming Alternatives for Learning Disabled Adolescents: A Nationwide Survey." *Academic Therapy* 14 (1979): 54–63.

Hamacheck, D. E. "Teaching Techniques to Enhance Motivation and Learning." *Journal for Special Educators* 10 (1968): 71–77.

Laurita, R. E. "Rehearsal: A Technique for Improving Reading Comprehension." *Academic Therapy* 8 (1972): 103–11.

Moran, M. R. *An Investigation of the Demands on Oral Language Skills of Learning Disabled Students in Secondary Classrooms*. Research Report No. 1. Lawrence, Kansas: The University of Kansas Institute for Research in Learning Disabilities, 1980.

Powers, W. T. *Behavior: The Control of Perception*. Chicago: Aldine Publishing, 1973.

Schumaker, J. B., D. D. Deshler, G. R. Alley, M. M. Warner, and F. Clark, *Multipass: A Learning Strategy for Improving Reading Comprehension*. Research Report No. 32. Lawrence, Kansas: The University of Kansas Institute for Research in Learning Disabilities, 1981.

Siegel, E. *The Exceptional Child Grows Up*. New York: Dutton, 1974.

Welford, A. T. *Fundamentals of Skill*. London: Methuen, 1968.