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Basic Skills Resource Center: Report on the Preliminary Research Findings

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Five interrelated research efforts on learning strategies are conducted through the Basic Skills Resource Center. This report contains papers presented by the five principal investigators at the American Educational Research Association 1984 Annual Meeting. Each paper describes the purpose, objectives, methodology, and where possible, preliminary findings related to the author's respective research effort.

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EXECUTIVE SUMMARY

Basic Skills Resource Center:

Report on the Preliminary Research Findings

The Basic Skills Resource Center (BSRC) is to be developed and operated by InterAmerica Research Associates, Inc. under contract with the U.S. Army Research Institute (ARI). The BSRC project has two interfacing components: the implementation and monitoring of basic research in the area of adult basic skills education; and the design, implementation, and operation of an information service. The research component incorporates the conduct of five interrelated research studies designed to contribute to research findings in the areas of basic skills education and learning strategies, and to explore the applications of educational technology to strategies instruction. This report provides a preliminary description and summary of each of the five research efforts.

Included in this report are five papers that have been prepared by the respective staffs of the BSRC research projects. Each paper describes the purpose, objectives, methodology, and where feasible, preliminary findings stemming from the BSRC research activities. The paper titles and authors are noted below.

- "Computer-Based Learning Strategy Training Modules: A Progress Report." Author: Donald F. Dansereau, Texas Christian University.
- "Principles of Content-Driven Comprehension Instruction and Assessment." Authors: Beau Fly Jones, Lawrence B. Friedman, Margaret Tinzmann (Northwestern University) and Beverly E. Cox, Chicago Public Schools.

- "Enhancements to Motivational Skills Training for Military Technical Training Students." Author: Barbara L. McCombs, Denver Research Institute.

- "A Study of Learning Strategies with Students of English as a Second Language." Authors: J. Michael O'Malley, Anna Uhl Chamot, Gloria Stewner-Manzanares, Rocco P. Russo & Lisa Kupper, InterAmerica Research Associates, Inc.

- "Teaching Reading Comprehension to Adults in Basic Skills Courses." Authors: M.C. Wittrock & L.R. Kelly, University of California, Los Angeles.

The individual papers were presented at a research symposium entitled "Recent Advances in Learning Strategies Training and Links with Instructional Technology" organized by InterAmerica project staff. This symposium was part of the 1984 American Educational Research Association annual meeting.

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Introduction

In an effort to expand and improve its basic skills programs, the Department of the Army contracted InterAmerica Research Associates, Inc. to develop and operate the Basic Skills Resource Center (BSRC) project. Funded through the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), Contract Number MDA 903-82-C-0169, the BSRC project has been conceptualized to assist the Army in meeting its information and research needs relative to basic skills educational activities. This goal is accomplished by tasks undertaken through two interfacing components: an information component and a research component.

The information component includes activities that are structured to develop and operate an information service whose purpose is to provide practitioners, administrators and researchers within the Department of the Army with information that is responsive to their education, training and research needs. This purpose is achieved through the operation of the Military Educators Resource NETWORK which offers its users a variety of services. These services include: an inquiry response service, a current awareness service, a referral service, and a publications development and distribution service.

The research component has been designed to develop and implement a plan of related research activities relevant to basis skills education in the Army. InterAmerica project staff, working closely with ARI personnel, developed a research agenda that included the conduct of five research studies designed to contribute to research findings pertinent to basic skills education, learning strategies and, when feasible, investigate the applications of educational technology. As planned, four of the research studies are to be completed through subcontracts with leading professionals and institutions in these fields. The fifth study is to be undertaken by InterAmerica capitalizing on its expertise in the area of second language acquisition, specifically English as a second language.

Following the development of the research plan, InterAmerica first identified professionals whose expertise related directly to the BSRC research goals. Potential principal investigators were identified based on their past and ongoing research activities, their professional publications, as well as the review of concept papers outlining and describing suggested research activities relevant to the project goals. Next, BSRC project staff contacted these individuals and requested from them the submission of a research proposal related to their specific area of expertise. Following the submission of these proposals, BSRC and ARI staff reviewed and critiqued the proposed research studies. As part of the review process, a research symposium was held to formally refine the proposed studies prior to their initiation. The symposium, conducted in May 1982, provided an opportunity for each study to be reviewed and critiqued by researchers from various federal agencies as well as the educational community. The five studies were initiated in June and July 1982.

Purpose

The primary purpose of this report is to compile a single source document that presents the preliminary findings that have resulted from each of the

BSRC research studies to date. Each of the five research staffs were requested to prepare a report that outlines the purpose and objectives of their respective study, the research activities undertaken as well as preliminary findings. These papers are included in the following sections of this report. In addition, the papers were presented at the American Educational Research Association Annual Meeting held in New Orleans, Louisiana in April 1984. InterAmerica project staff have designed a symposium entitled "Recent Advances in Learining Strategies Training and Links with Instructional Technology," to highlight and disseminate information about the BSRC research component activities and their results. Thus, the goal of this report and the associated symposium is to provide a means through which the results and findings of the BSRC project can be shared with and hopefully utilized by the research community. A brief summary of each research study is presented below.

Study One. A study entitled "Development and Evaluation of Computer-Based Learning Strategy Training Modules" is being undertaken by Texas Christian University under the direction of Dr. Donald Dansereau. The purpose of this sudy is to develop computer-based learning strategy training modules that will help technical trainees acquire and use information more effectively. Two learning strategy modules that incorporate training on self-monitoring and self-management of learning strategies are being developed and evaluated. The modules combine two instructional techniques: Computer-assisted instruction and cooperative learning (CACL) and focus on training students in summarization and networking strategies. Each module is to be formally evaluated by comparing CACL training with lecture/text training and with students who receive no training in these techniques. Final modification of the two

CACL modules will be based on the outcomes of the experimental evaluation studies.

Study Two. Dr. Beau Jones of the Chicago Public Schools is the principal investigator for the study entitled "Embedding Learning Strategies in Well Marked Texts for Military Training Materials." The purpose of this study is the development of a training manual which teaches military curriculum writers the following: (1) how to write well-organized, clearly marked texts and graphic materials, (2) how to embed learning strategy instruction in the instructional text, and (3) how to develop the component parts of a mastery learning instructional model. An analysis of instructional objectives and texts is being undertaken to identify the appropriate type of text structure needed to support particular types of instructional objectives. This analysis will then proceed to identify appropriate learning strategies needed for learning different text/instructional objective combinations. These analyses are based on research findings from cognitive psychology and from practical application in designing and implementing Mastery Learning and Content Driven Comprehension Instruction in the public schools.

Study Three. The Denver Research Institute is undertaking a study entitled "Self-Motivational Skill Training for Improving Performance in Army Technical Training." Dr. Barbara McCombs serves as the principal investigator. The purpose of this study is to evaluate the efficiency and effectiveness of computer-assisted instruction (CAI) in training self-motivational skills and reducing instructor requirements. A previous research effort designed to develop and evaluate a Self-Motivational Skills Training package, established that students receiving the instructor presented training exhibited higher motivation and higher achievement scores during their military technical training than their peers in a control group. This study will design CAI materials to present portions of the skills training. In addition, this research effort will test the efficiency and effectiveness of CAI compared with the same training presented by instructors. Based on these comparison, recommendations will be developed for the most efficient and effective use of CAI and instructors for delivery of this training.

Study Four. "A Study of Learning Strategies for Acquiring Skills in Speaking and Understanding English as a Second Language" is being undertaken by InterAmerica Research Associates, Inc. with Dr. J. Michael O'Malley serving as the principal investigator. The purpose of this study is to identify learning strategies that will help students from non-English language backgrounds improve their speaking and understanding skills in acquiring English as a second language. Through classroom observations and interviews with teachers and students of English as a Second Language, the range and characteristics of learning strategies used in the acquisition of speaking and understanding skills by second language learners will be delineated. In addition, teaching modules, embedding learning strategies, will be developed and tested. The experimental test will determine, for specific learning activities, whether or not different combinations of learning strategies enhance performance on outcome measures designed to assess English language skills.

Study Five. Dr. Merl C. Wittrock of the University of California at Los Angeles is the principal investigator for a study entitled "Research in Reading Comprehension." The purpose of this study is to investigate generative reading strategies that will increase the ability of educators to teach people, especially, low ability young adults, to read with understanding. Three experimental studies will be conducted that investigate generative reading strategies that are most effective for various types of text, including technical instructional materials. Working with military personnel, the first studies will concentrate on identifying the generative reading strategies that facilitate comprehension of different types of text and determine the problems in reading comprehension. The third study will build upon the results of the prior studies and lead to the construction of self-instruction materials/ procedures or a sequence of computer-assisted instructional materials that teach generative reading strategies.

The following sections of this report include five research papers that have been prepared by the respective research staffs of the studies described above and which outline the preliminary research results and findings to date.

Computer-Based Learning Strategy Training Modules:

A Progress Report

Donald F. Dansereau

Texas Christian University

The research reported in this paper was supported in part by Grant MDA-903-82-C-0169 from the Army Research institute. The views, opinions, and findings contained in this report are those of the authors and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other official documentation.

Paper to be presented at the Annual Meeting of the American Educational Research Association, New Orleans, April 1984.

Computer-Based Learning Strategy Training Modules: A Progress Report

I. Overview and Background

The purpose of this paper is to provide information on a project designed to develop and evaluate computer-based learning strategy training modules. In this section of the paper we will provide background information, in the next section we will describe our first evaluation study, and in the final section we wil outline briefly the work we have in progress, and our future directions.

In recent years there have been a number of research and development efforts oriented toward the direct improvement of cognitive strategies employed by learners (see Dansereau, in press, Holley & Dansereau, in press; O'Neil, 1978; O'Neil & Spielberger, 1979). Although this work is in its infancy there is substantial evidence that an individual's capacity for acquiring and using information can be enhanced by direct training on appropriate information processing strategies (e.g., Dansereau, Collins, McDonald, Holley, Garland, Diekhoff, & Evans, 1979a; Dansereau, MCDonald, Collins, Garland, Holley, Diekhoff, & Evans, 1979b; Holley, Dansereau, Mcdonald, Garland, & Collins, 1979; Dansereau, in press). More specifically, metacognitive strategies which encourage students to monitor their learning activities, and cognitive strategies which require the transformation of text into alternate forms (e.g., verbal summaries and networks) appear to be particularly promising.

In a recent review of the status of learning strategy research and development, we have emphasized the need for improved strategy training methodologies (Dansereau, in press). Although there appear to be a number of effective cognitive and metacognitive strategies emerging from basic research efforts, their utility is severely limited by difficulties in communicating them to learners. Training adults to incorporate new learning strategies into their repertoires is plagued with all of the problems present in complex motor skills re-training (e.g., Singer, 1978), plus additional complexities arising from the covert nature of cognitive and metacognitive activity. Before effective and efficient learning strategy training can become a practical reality, improved training methodologies must be developed.

To remedy this situation, the present project was designed to develop strategy training modules that combine the strengths of two promising instructional techniques: computer-assisted instruction and cooperative learning (peer tutoring). In overview, pairs of cooperating college students interact with a microcomputer and each other in learning metacognitive and cognitive strategies for processing complex, scientific information. The microcomputer provides strategy instructions, initiates training tasks, monitors the training activities, and provides expert content and process feedback and reinforcement to the learner. The students serve as models for one another, and, in cooperation with the computer, assist each other in analyzing and diagnosing the productions that emerge from applying the strategies.

This combined methodology, which is labeled Computer Assisted Cooperative Learning (CACL), capitalizes on the economical source of content and process expertise and management capabilities that can be programmed into the computer, and the interpretive capabilities and potential for social modeling available in human interactions.

CACL modules are being developed to train students on unstructured summarizing, structured summarizing, and networking (mapping). Embedded within these packages is training on meta-cognitive strategies. These include an overall processing strategy we have developed for guiding substrategy initiation (labeled MURDER; Dansereau et al., 1979b). All of the strategies have been previously studied using texts and lectures as training tools. Although positive results for the strategies have been achieved with this approach, CACL is expected to ultimately provide a more efficient, economical, and effective training technology than has been employed previously.

In order to provide the reader with additional background, we will provide brief discussions of the learning strategies and training methodology selected for inclusion in the present project.

A. Learning Strategies

Over the past nine years we have developed, evaluated, and modified components of an interactive learning strategy system. This system is composed of <u>cognitive</u> strategies, which are used to operate on the text material directly (e.g., comprehension and memory strategies), <u>affective</u> strategies, which are used by the learner to maintain a suitable cognitive climate (e.g., concentration strategies) and <u>metacognitive</u> strategies, which are used to plan and monitor the flow of learning activities and the progress of the learner. Assessments of the overall strategy system and system components indicate that strategy training significantly improves performance on selected text processing tasks (Collins, Dansereau, Holley, Garland, & McDonald, 1981; Dansereau, 1978; Dansereau et al., 1979a; Dansereau et al., 1979b; Holley et al., 1979; Dansereau, in press).

The present project is focused on training a subset of the cognitive and metacognitive strategies developed within this system.

With regard to cognitive strategies, it has been demonstrated repeatedly (see Dansereau, in press for details) that the most crucial activity in learning involves the transformation of the incoming information into an alternate form (one's own words, a picture, or an alternate representational system such as a network). This activity allows a student to personalize the information, test degree of understanding, and enter multiple encodings in memory. Although transformation processes have been often recommended to students by educators (e.g., SQ3R; Robinson, 1946), very little has been done to train students on the details of how to accomplish such activities. This is indeed unfortunate in light of the potential gains that seem to occur with in-depth strategy training in comparison to strategy prescriptions without training (e.g., Weinstein, Cubberly, Wicker, Underwood, Roney, & Duty, 1981).

In our previous work we have focused principally on two transformation activities: summarization and networking. In summarization the student is trained by successive approximation to capture and elaborate the main ideas and supporting details of a body of text in his or her own words. Prior research has indicated that this activity significantly improves delayed recall of scientific text in comparison to students using their own methods (Dansereau, 1978; Spurlin, Dansereau, & Brooks, 1980). However, an examination of the summaries produced following training indicates that most individuals still have substantial room for improvement. It is expected that the CACL methodology will provide more effective and efficient training on the summarization technique.

In using the networking transformation strategy the student identifies important concepts or ideas in the material and represents their interrelationships in the form of a network map. To assist the student in this endeavor he/she is taught a set of named links that can be used to code the relationships between ideas. The networking processes emphasize the identification and representation of (a) hierarchies (type/part), (b) chains (lines of reasoning/temporal orderings/causal sequences), and (c) clusters (characteristics/definitions/analogies). Application of this technique results in the production of structured two-dimensional maps. These networks provide the student with a spatial organization of the information contained in the original training materials. While constructing the map, the student is encouraged to paraphrase and/or draw pictorial representations of the important ideas and concepts for inclusion in the network.

When faced with a test or a task in which the learned information is to be used, the student is trained to use the named links as retrieval cues and the networking process as a method for organizing the material prior to responding. Assessments of networking (Dansereau et al., 1979b; Holley et al., 1979) have shown that students using this strategy perform significantly better on text processing tasks than do students using their own methods. However, as with summarization the networks of the trained students are extremely heterogeneous in quality. We expect that the overall quality of the networks and the efficiency of the networking process would be improved by more effective training.

In our previous work we have successfully used summarization instruction as a prelude to network training. It also appears that some students find one technique preferable to the other or that including both in their repertoire allows them to use either one or both as the circumstance dictates. Consequently, our goal is to develop training modules for both activities to be used independently or in combination.

With regard to metacognitive strategies, recent research has indicated that students of all ages tend to have difficulty monitoring their cognitive activity (e.g., Baker, 1979; Markman, 1979; Schallert & Kleiman, 1979). This difficulty manifests itself both in terms of knowing when something has been comprehended or sufficiently memorized, and when and how comprehension failures should be remedied. To some extent it appears that training on producing "good" summaries and networks will lead to improved metacognitive activity. Having attempted to produce a summary or network provides the student with concrete information concerning the adequacy of his or her present level of knowledge about the topic. Based on this information the student can initiate activities to correct knowledge gaps and errors.

Another important aspect of metacognitive activity involves the existence of an effective overall framework or executive routine which the student can use to guide the flow of activities required for successful learning and subsequent performance. This metastrategy should include a sequence of substrategies which lead the student to an adequate state of knowledge. We have developed and evaluated metastrategies which can be used to both guide the flow of activities during the CACL training and can be internalized by the student for use in other learning environments (Dansereau et al., 1979b; Dansereau, in press). The input strategy, 1st degree MURDER, includes six steps for learning text material: (1) setting a proper Mood for learning, (2) reading for Understanding, (3) Recalling the information by creating summaries or networks, (4) Detecting errors or omissions in the recall, (5) Elaborating to make the material more easily remembered, and (6) a final Review.

The 2nd Degree MURDER strategy includes six steps for using the acquired information during task performance: (1) getting into a proper Mood for the task, (2) Understanding the goals and conditions of the task, (3) Recalling information relevant to the task, (4) Detecting omissions, errors, and ways of organizing the information, (5) Elaborating the information into a proper response, and (6) Reviewing the response to modify it if necessary.

B. Training Methodology

The approach used in training the learning strategies results from a combination of two technologies: computer-assisted/managed instruction and cooperative learning (peer tutoring). In the following subsections we will discuss briefly the strengths and weaknesses of the two technologies with regard to cognitive strategy training and then provide an overview of how they are combined.

1. Computer-Assisted/Managed Instruction. With the advent of flexible, economical microprocessors it is clear that in the future computers will be one of the major instructional delivery systems. With respect to learning strategy training, computer-assisted/managed instruction has several important strengths. Specifically, it can (a) provide an economical (in comparison to human experts) source of expertise in both subject matter and process, (b) control, monitor, and reinforce the flow of learning activities in an objective and efficient manner, (c) keep track of subject responses for future analysis, and (d) tailor training activities to the students based on pre-training individual difference measures and on responses to tasks within the training sequence.

On the other hand, there are two major weaknesses with this approach as it applies to strategy training. First, effective learning strategies usually require the learner to produce alternate versions of the text information (e.g., summaries and networks). Although there has been progress in the development of natural language interpreters, we are a long way from having systems that can analyze and diagnose a student production of the type discussed in previous sections of this proposal. This is unfortunate not only for strategy training but instruction in general, since free recalls of text are clearly important indicators of the degree to which a body of knowledge has been acquired.

A second weakness is the fact that computers cannot provide a convincing model for students to imitate and to use as a basis for evaluating their own relative strengths and weaknesses. Most students view computers as having cognitive and affective characteristics and capabilities quite different from those of humans and would thus have great difficulty using them as models for their own behaviors and attitudes. This is unfortunate, in that it is clear (Dansereau, in press) that one of the most potent methods of communicating skills and strategies in general and learning strategies in particular is social modeling (i.e., demonstrations of strategy usage). As will be discussed in a subsequent section, the CACL approach has been designed to capitalize on the strengths of computer-assisted instruction and compensate for its weaknesses.

2. Cooperative learning (peer tutoring). There has been a growing interest in the potential of students interacting with one another to improve their acquisition of academic knowledge and skills. Among other things, orchestrated student-student interactions may serve as:

a. Procedures for facilitating the learning and recall of textbook information. Dansereau et al. (1979a), and McDonald, Dansereau, Garland, Holley, and Collins (in press), provided evidence that students cooperatively studying textbook material in dyads (pairs) performed better on delayed recall and recognition measures than did students studying individually.

b. Vehicles for the transmission of learning strategies, self knowledge, and life skills. McDonald et al (in press) found positive transfer of learning skills from a dyadic learning experience to individual studying. Sharan (1980) and Slavin (1980) reviewed research indicating that experiences in cooperative learning subsequently led to positive effects on measures of self-esteem, altruism, and mutual concern.

c. Data sources for evaluating cognitive/educational theories and for analyzing individual differences in processing academic materials. For example, taped protocols of dyadic interactions have been used to delineate text processing strategies (McDonald et al., in press).

With regard to training cognitive strategies, the cooperative learning paradigm, utilizing two students interacting over a segment of text, has two salient strengths. First, the participants have an opportunity in this situation to observe and imitate each other's processing. In fact, interviews with students following dyadic learning experiences suggest that they learn new strategies from their partners even without instructions to do so. In addition to acquiring strategies, cooperating students also report that they gain insights with regard to their relative levels of cognitive effort, persistence, and affective control. If subsequent adjustments are made based on these insights then it is likely that the effects of cooperative learning will generalize beyond academic endeavors to other life situatiosn. Second, the students can evaluate, diagnose, and correct each other's productions (e.g., summaries and networks). Since at this time only humans are able to tolerate semantic ambiguities and transcend grammatical misconstructions, it is clear that they are the only available processors that can interpret unrestrained natural language. In analyzing summaries and networks, the students can point out comprehension failures and omissions. In addition to helping the "producing" student to pinpoint processing difficulties, this activity may also be internalized by the "analyzing" student in such a way that his/her own productions are subsequently improved.

Obviously, the cooperative learning paradigm is not without weaknesses. In our experience the most important of these is that often neither cooperating student has the necessary content and/or process expertise to maximize the learning experience. This can result in a type of "blind leading the blind" scenario which may be detrimental for both parties involved. In addition, many pairs of students have difficulty staying on the task and effectively managing their available time and resources.

3. <u>Computer-Assisted Cooperative Learning (CACL)</u>. As stated earlier the CACL methodology combines aspects of the typical computer-assisted instruction paradigm with elements of cooperative learning to enhance the training of metacognitive and cognitive strategies for processing scientific and technical materials. This methodology is designed to capitalize on the strengths of computer-assisted instruction and cooperative learning and compensate for their weaknesses. The computer:

-- presents the learning tasks

-- provides strategy instructions. The MURDER metastrategies are communicated along with the specific recall strategy (summarizing or networking)

-- controls the flow of activity (e.g., signaling when a new task should be initiated)

-- Assists the students in evaluating their productions (summaries and networks) by providing lists of important points that should have been included and rationale for their inclusion, and by providing idealized and flawed sample productions for evaluation by the students

-- provides tests over the training materials and, based on responses, branches to further strategy instructions

-- assists the students in processing the training experience in order to facilitate transfer to other situations (individual learning or on-the-job activities)

-- provides reinforcing messages for good performance on all aspects of the task.

The two cooperating students take turns applying the strategies to the computer-provided tasks and thus serve as models for one another. in adition, the student not responsbile for strategy application (with the assistance of the computer) analyzes, diagnoses, and corrects the other student's productions. The students also cooperate on interpreting the computer's instructions and feedback.

In general, it is expected that the CACL methodology can be a more efficient and effective approach to training strategies, and, perhaps learning in general, than either of the two component paradigms (computer-assisted instruction and cooperative learning) used in isolation.

In the next section we will describe our first evaluation of CACL as a vehicle for training MURDER using summarization as the recall/transformation strategy.

II. CACL Evaluation: MURDER With Summarization as the Recall/ Transformation Strategy

As a first evaluation, a group of students were given instructions and practice via the CACL methodology on using 1st and 2nd degree MURDER in learning and recalling medically related text excerpts (summarization was taught as the recall sub-strategy). To evaluate the effectiveness of this approach the students trained in this fashion were compared with students given the same instructions and practice individually via written materials, and with students who studied the practice materials using their regular study and test-taking methods. Following training, all students, regardless of group affiliation, individually studied and took free recall tests over two passages. The first passage, which was medically related, was included to assess direct (near) transfer of training, and the second, which contained technical but non-medical content, was included to assess indirect (far) transfer.

A. Method

1. Participants. Participants in this experiment were 89 students from introductory psychology classes at Texas Christian University who were fulfilling a course requirement.

2. Materials. The training materials used in this experiment were designed by the authors to guide the students in the use of the $MURDER_1$ and $MURDER_2$ strategies.

In designing the CACL training module, we were guided by two major objectives. The first was that modules should be simple, in terms of both software and hardware. Toward this end, we constrained ourselves to a program that would run on an Apple II equipped with only one disk drive and a monochrome monitor.

The more important element of our design philosophy involved limiting the computer's role to those functions at which it is better than a partner. Thus, we made no attempt to program the computer so that it would appear to be intelligent, since the learner's partner is likely to make a much more convincing model than is the computer. At the same time that we relied on the partner to evaluate the learner's productions, we programmed the computer to provide feedback and examples of good productions. Thus, after the partner examined the production, the learner was prompted to enter an assessment of his or her production and the computer provided feedback and in some cases suggested that a specific portion of the lesson be reviewed.

The summarization module teaches students the MURDER strategies, using paraphrasing and imagery as aids in the recall and elaboration steps. After an animated logo accompanied with music is presented, an animated character named Maxwell is introduced. Each student enters his or her name and partner's name. In addition, the partners choose which of them is to be partner "A" and which will be "B." These designations are used internally by the program to alternate activities between partners, though from this point on the students are consistently referred to by name, not letter.

Next, an overview of the lesson is provided, along with a "pep talk" about the virtues of active studying. First Degree MURDER is described as Maxwell walks from letter to letter of the acronym. After the six steps of MURDER have been described, one partner quizzes the other on the names of the steps.

For this and all other student-student interactions, each partner's computer provides different but coordinated instructions. For instance, if two students named Jack and Bob were working together, Jack's screen might read "Jack, quiz Bob to see if he knows what each letter of MURDER stands for." At the same time, Bob's screen would read "Bob, Jack is going to ask you what each letter of MURDER stands for."

After this student-student interaction, the computer provides ten descriptions of study activities. Working together, the partners enter the name of the MURDER step that each activity represents. If less than 4 are answered correctly, a review is suggested and provided if requested.

Next, the partners read a short passage and receive detailed instruction on applying each of the steps. The pattern of mixing student-student interactions and student-computer interactions is maintained and diagnostic quizzes provided. The training on First Degree MURDER is completed by having the students practice on each of three sections of a passage on wounds. As they practice, they alternate responsibility for each of the steps and see examples of the optimal completion of the steps requiring production (i.e., recall and elaboration).

Second Degree MURDER is taught in the same general way and finally the students are instructed in ways to use what they have learned about studying when they are studying without the aid of a computer.

Practice passages containing medical information were provided during training. Two additional passages were used to assess the effectiveness of the strategy training. The first, which focused on descriptions, causes, and treatments of tumors (1,100 words), was selected to be similar to the practice passages. Performance on this served to assess direct (or near) transfer. The second passage was also technical in nature, but did not contain medical information. This 800-word passage, which described the fictional development and operation of an orbital tower connecting the earth to a satellite, served to assess indirect (or far) transfer.

Two individual difference measures were used as covariates in the analysis of treatment effects. The Delta Vocabulary Text (Deignan, 1973) is a 45-item multiple-choice test that correlates moderately with other measures of verbal aptitude (Dansereau, 1978). The Group Embedded Figures Test was developed by Oltman, Raskin, and Witkin (1971) to assess field dependence/independence. The individual must detect a simple geometrical figure contained within each of 18 more complex figures. This measure has been shown to be positively correlated with text processing performance (Witkin, Oltman, Raskin, & Karp, 1971).

3. Procedure. Each participant attended three two-hour sessions. During the first session participants were randomly assigned to one of three conditions: a Computer-Assisted Cooperative Learning (CACL) group (n=30), an Individual Learning Strategy Group (n=28), or a No-Treatment Group (n=31).

The CACL group worked in randomly assigned same-sex pairs and received computer-based training in paraphrasing and the use of imagery as a means of implementing the 1st and 2nd Degree MURDER strategies. The pair partners interacted with one another and the Apple II microcomputers in learning these strategies.

Medically related passages served as practice materials during this training.

The Individual Learning Strategy group was given transcripts of the CACL computer programs as training materials. They studied this material individually. Training was identical to that of the CACL group. The No-Treatment group was exposed to all of the practice passages given the other two groups. They were told to use their own methods in studying these passages.

During the second session, the CACL and Individual groups took 15 minutes to complete their training. The Control group spent this time writing an essay on the practice content material. Each group then studied a medically related passage on tumors for 30 minutes and a non-medically related passage on the fictional construction of an orbital tower for 40 minutes. All participants studied both passages individually.

During the third session all participants took free recall tests which required them to list all the important ideas and facts they remembered from each of the two assessment passages (Tumors test--15 minutes; Orbital Tower test--18 minutes). Then the subjects completed the Delta Vocabulary Test (Deignan, 1973)--10 minutes, and the Group Embedded Figures Test (Oltman, Raskin, & Witkin, 1971)--12 minutes. These two measures were used as covariates in the analysis of free recall performance. Subsequently, the CACL and the Individual groups completed a Satisfaction Questionnaire of 26 items, and the No-Treatment group answered an open-ended question about how they studied the passages.

B. Results

Trained raters scored the lists of ideas according to a predetermined key for main ideas and details without knowledge of a participant's group affiliation. There was one team of three raters for each of the passages. Two raters on each squad scored half the free recalls, and the third rater scored a subset of each of the other two. The Orbital Tower passage raters achieved inter-rater reliabilities of 0.86 and 0.81 for main ideas and 0.96 and 0.87 for details. The Tumors passage raters achieved reliabilities of 0.96 and 0.96 for main ideas, and 0.92 and 0.92 for details.

Two-way analyses of covariance with passages as the repeated measure and the Delta Vocabulary Test and the Group Embedded Figures Test as covariates indicated significant differences among the three experimental groups for totals of main ideas and details $F(2,86) = 4.50$, $p < 0.02$, for main ideas only, $F(2,86) = 4.28$, $p < 0.02$, and for details only, $F(2,86) = 3.43$, $p > 0.04$. Effects due to passages and passage-treatment interactions were nonsignificant. Adjusted and unadjusted means and standard deviations for each group are listed in Table 1. The parallelism of the within-cell regression slopes was tested for each analysis, and in all cases the regression slopes were found to be homogeneous.

Insert Table 1 about here

Post hoc analyses indicated that the significant main effects could all be accounted for by the differences between the CACL group and the Control group. Tukey's HSD was exceeded by the differences in the means for the CACL group and the Control group for total points, for main ideas, and for details ($p < .05$). No other differences reached significance.

Principal components factor analysis of the satisfaction questionnaire revealed two factors: one, an evaluation of the overall effectiveness of the learning strategy and the other, a judgment of how the training experience affected the student personally. The first factor accounted for 45.7% of the variance and the second for 17.7%.

Two scales were constructed by adding together (with unit weightings) those items with factor loadings greater than 0.50. Using this criteria twelve items were included in the creation of the first scale and seven items were included in the second. To assess group differences on the scales, two t-tests were run, and results indicated that the CACL group evaluated their training program as more effective than did the individuals, $\underline{t}(56) = 2.30$, $\underline{p} < 0.03$; and also reported more personal gain, $\underline{t}(56) = 1.98$, $\underline{p} < 0.06$. Table 2 has the means and standard deviations for the questionnaire scales.

Insert Table 2 about here

C. Discussion

Statistical analysis of the scores on free recall tests over a medically related passage (near transfer) and a non-medically related passage (far transfer) demonstrated significantly better performance for the CACL group than for the Control group. In addition, although the differences were nonsignificant, the CACL group consistently performed better than the Individual strategy group. These findings support the contention that computer-assisted instruction and cooperative learning can be combined to produce an effective delivery system for the MURDER/ Summarization learning strategy. The positive findings for both dependent passages suggests that the strategy acquired is substantially content-independent and consequently, should be generalizable to a variety of text materials.

In addition to group differences in performance on free recall tests, analysis of the two salient factors of a post-experimental questionnaire indicated that the CACL group had significantly higher ratings than the Individual group on both factors. The CACL group viewed the learning strategies they received as more effective and their personal gain from the experimental experiences as more positive than the Individual group. Thus it can be speculated that the members of the CACL group were able to benefit from the social modeling provided by the other person in the pair or from the management properties written into the computer program or from an interaction of both technologies.

III. Work in Progress and Future Directions

In addition to the CACL module on MURDER/Summarization discussed in the previous section, we have also developed modules for MURDER/Networking and MURDER/Structured Summarization, and are now in the process of formally evaluating these modules. The MURDER/Networking module is analogous to the MURDER/Summarization module except that the student is taught networking as the recall/ transformation sub-strategy. In the MURDER/Structured Summarization module the student is taught to use a structural schema as a mechanism for organizing the intermittent summaries. This schema, given the acronym DICEOX, has six major categories into which the student places the information gained during reading: Description of the major concept or idea, Inventor/historical background of the idea, Consequences of the idea, Evidence for or against the idea, Other competing or complementary ideas, X-tra information that does not easily fit into one of the above categories. Our prior work (Brooks & Dansereau, 1983) has shown that training on use of this structural schema during acquisition and testing improves text recall.

The ordering of these three modules with regard to novelty and complexity for college students is: Summarization, Structured Summarization, and Networking. Summarization being the least complex and novel and Networking being the most. It is expected that students differing in aptitude and cognitive style will differentially prefer and benefit from these three alternatives. Eventually we would like to establish these relationships so that the strategy training can be tailored to the characteristics of the learner.

In addition to exploring other strategy modules we also plan to run an experiment to determine the relative contribution of the two technologies (i.e., computer-assisted instruction and cooperative learning) to the effectiveness of the CACL methodology.

Finally, in the future we also plan to explore the possibility of using CACL as a method for directly communicating content information. Instead of being designed to train learning strategies, CACL would be used to help students directly acquire and use academic material.

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Table 1

Standardized Means and Standard Deviations for CACL Group vs. Individual Strategy Group vs. Control Group on Recall of Total Ideas, Main Ideas, and Detail Ideas

			TOTAL		MAIN		DETAIL	
			Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
CACL	Tumors	M	0.36	0.29	0.30	0.24	0.37	0.32
(n=30)		SD	1.01	0.86	1.00	0.93	1.00	0.85
	Orbital	M	0.43	0.37	0.33	0.27	0.33	0.28
	Tower	SD	0.98	0.97	0.96	0.93	1.00	0.96
Individual	Tumors	M	-0.04	-0.02	-0.06	-0.05	-0.01	0.01
Strategy		SD	1.06	0.96	0.98	0.88	1.05	0.97
(n=28)	Orbital	M	0.00	0.02	0.19	0.20	-0.03	-0.02
	Tower	SD	1.01	0.93	0.92	-0.86	1.02	0.97
Control	Tumors	M	-0.34	-0.31	-0.23	-0.19	-0.36	-0.31
(n=30)		SD	0.89	0.71	0.99	0.75	0.86	0.81
	Orbital	M	-0.33	-0.29	-0.46	-0.41	-0.21	-0.17
	Tower	SD	1.01	0.83	0.97	0.91	1.00	0.83

Table 2

Means and Standard Deviations for CACL Group vs.
Individual Strategy Group on Factor 1 and
Factor 2 of Post-Experimental Questionnaire

	Factor 1 (12 items)		Factor 2 (7 items)	
	Mean	SD	Mean	SD
CACL (n=30)	6.39	0.93	5.99	1.43
Individual Strategy (n=28)	5.68	1.35	5.18	1.68

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PRINCIPLES OF CONTENT-DRIVEN COMPREHENSION INSTRUCTION AND ASSESSMENT

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CONTENT-DRIVEN COMPREHENSION INSTRUCTION AND ASSESSMENT

A Summary

Organization of Principles

Principle 1	The Definition of Text
Principle 2	The Use of Readability Formulas
Principle 3	Text Development and Considerate Text
Principle 4	Text Evaluation and Comprehensible Text
Principle 5	The Nature of Comprehension and Achievement
Principle 6	Differences in Comprehension and Achievement
Principle 7	Learning Strategies and Text Conditions
Principle 8	Levels of Processing
Principle 9	Content-Driven Strategy/Skills Instruction
Principle 10	Instruction, Content, and Prior Knowledge
Principle 11	Sequencing Instruction within Lessons
Principle 12	Sequencing Instruction between Lessons
Principle 13	Referencing Structures, Frames, and Levels
Principle 14	The Concept of Curriculum Alignment
Principle 15	The Concept of Instructional Testing
Principle 16	Criterion-Referenced Field Testing

The model of instruction and assessment described herein was conceptualized through work simultaneously undertaken for InterAmerica Research Associates, Inc., through a contract with the Basic Skills Resource Center, Contract No. MDA-903-82-C-049, funded by the U.S. Army Research Institute for the Behavioral and Social Sciences, and work undertaken with the Chicago Public Schools for project CIRCA (Collaboration for Improvement of Reading in the Content Areas), the collaborators being the Center for the Study of Reading, University of Illinois at Urbana-Champaign, and the Chicago Public Schools.

A. Preface

In developing instructional materials, the instructional designer must begin with these questions: What content is there to be learned? What is the nature of comprehension and achievement? What is the nature of instruction that will yield specified outcomes of comprehension and achievement? What variables of learning and classroom assignments impact on instruction and achievement? What is the best delivery system for the model of instruction?

The theoretical framework proposed here provides the working principles for the development of textual and instructional materials for three large-scale projects: (1) the Vocabulary Learning Strategies strand of the Chicago Mastery Learning Reading program (CMLR), currently being developed by the Chicago Public Schools for grades K-8; (2) the CIRCA project involving the development of textual and instructional materials for U.S. history for grades 7 and 8, developed jointly by the Chicago Public Schools and the Center for the Study of Reading, University of ILlinois at Urbana-Champaign, and (3) a curriculum development manual for the U.S. Army. The proposed framework is, however, intended to be used to develop content-area texts and instructional materials for any subject area at any grade level, including kindergarten through college and including highly technical subject areas. Thus, it is hoped that these principles will be useful to publishers, curriculum specialists, instructional designers, and teachers.

It is important to understand at the outset that this framework constitutes a synthesis and extension of existing theories. Existing theories of learning and instruction focus largely on understanding how students comprehend prose texts and on developing principles of comprehension instruction. While these theories are vital to develop effective materials, they do not address important elements of achievement and instruction in the classroom. To explain: many of the existing theories of comprehension and recall use research paradigms such as recognition and free recall; these really deal only with on-line processing, i.e., how the student comprehends the meaning of a given text, which is usually a prose text, during the process of reading. Moreover, these paradigms generally use only one text, such as a single list, paragraph, or passage. Such paradigms fail to deal with three important features of achievement in schools.

First, students are usually required to process information from more than one text. Many questions, for example, require the student to integrate information from a content text, the teacher's instructional input, a class discussion, and/or a film or demonstration. Second, achievement in schools is seldom based on free recall or on on-line processing measures which provide the text as a part of the assessment measure. Third, most courses require the students to use specific (student-generated) text structures in responding to questions calling for written responses. Moreover, responses to many questions require an interaction of prior knowledge and in-depth processing before, during, and after reading, using texts which are typically not available at the time of the test.

In the framework proposed here, schema theory, text structure research, and learning strategies research are welded together and extended to form new conceptions of text, achievement, instruction, and assessment which address key conditions of achievement in schools. This framework is constructive because all of the principles seek to facilitate constructing meaning from text. It is described as interactive because it seeks to account for the interaction of the text, the reader, the teacher, and the questions to which the reader must respond in order to achieve in school. Constructing meaning from text and responding to questions involve the interaction of four elements: (1) the prior knowledge of the students, (2) in-depth processing before, during, and after reading, (3) integrating information from various texts, and (4) responding from memory to questions about the text using prescribed text structures.

This conceptualization of achievement leads to a conceptualization of instruction in the classroom as having three phases: readiness instruction to activate and control for individual differences in prior knowledge, comprehension instruction to help students understand the meaning of what they read as they read (i.e., to facilitate on-line processing) and after they read (i.e., in-depth processing), and response instruction to help students integrate information from different sources and respond to questions about the text. What is important here is not that there are prereading, during reading, and postreading instructional activities. Rather, each phase of instruction and achievement involves an interaction between the reader, the text, and the questions, on the one hand, as well as a sequence of readiness, comprehension, and response instruction, on the other hand. What follows are 16 principles with specific assumptions about the definition of text, comprehension, achievement, instruction, assessment, and classroom variables as they relate to the development of instructional materials which provide for readiness instruction, comprehension instruction, and response instruction.

It is also important to note that while there is a strong emphasis on teaching strategies and high-order thinking skills, instruction is fundamentally content driven. That is, strategies and skills are only taught as a <u>means</u> to understanding the content. Thus, the 16 principles are essentially principles to teach reading and writing in the content areas, including literature and technical texts.

Principle 1 (The Definition of Text)

> The word text refers to all meaningful messages which may be given in various media: prose texts, oral texts, graphic texts, and demonstration texts.

Definitions

(a) Prose texts--include discourse in printed materials and formal lectures.

(b) Oral texts--include messages in daily classroom instruction given by the teacher, conversations, class discussions, cassettes, and the audio components of audio-visuals.

(c) Graphic texts--include all types of diagrams, charts, and graphs in printed materials, pictorial illustrations, and the visual component of audio-visuals.

(d) Demonstration texts--include model behaviors given for the purposes of instruction (i.e., a dynamic graphic).

Rationale

The widespread conceptualization of meaning as being contained only in prose texts is both limiting and inappropriate for a general theory of comprehension. Consider the military services, for example: much of the content to be learned and assessed in recently published materials is contained in graphics, audio-visuals, or live demonstrations. Consider also the amount of content that is contained in lectures, speeches, and other instructional activities and, more recently, the use of student essays as part of the content of a writing or research course. How should these content materials be conceptualized in a model of comprehension and instructional design? How should the content in graphics, oral discourse, and demonstrations be defined in terms of comprehension theories?

It can be demonstrated fairly easily that oral, graphic, and demonstration texts contain the same text structures and markers as prose texts. Many graphics and demonstrations use name/attribute text structures in describing the attributes of a weapon or sequential text structures in stating the steps in a procedure. Similarly, graphics, teachers, and demonstrations often provide compare-and-contrast or explanation text structures and markers that are functionally equivalent or identical to prose text markers. If it is true that there are many similarities in the type of content and structure of the various types of texts, then it is possible that many of the issues that arise regarding the readability and development of prose texts also arise for graphic and other types of text.

Similarly, if we consider that text includes all meaningful communications, then we can apply the research relating to author-generated texts in textbooks not only to teacher-generated texts but also to student-generated texts. We could, for example, teach teachers and students to use the same types of texts and text markers that authors use. We could also teach teachers and students to use the same content-specific organizing principles that authors use. In general, we could teach teachers and students the criteria we use to develop and evaluate texts.

Principle 2 (The Use of Readability Formulas)

Traditional readability formulas should not be used to evaluate or develop texts.

Elaboration

Traditional readability formulas focus on syntax variables such as word length (number of syllables) and/or sentence length to determine the grade level equivalent of a given text.

(a) Evaluation

Currently, traditional readability formulas are used to assess level of difficulty of a given text. The level of difficulty is given in terms of specific grade levels. Principle 2 argues that while the syntactical variables do affect comprehension, they reflect only one aspect of comprehension and should not be used as the major measure or the exclusive measure of text difficulty.

(b) Development

Increasingly, it has been the case that an author will write a given text using his/her normal vocabulary and style; then the publishing company or developer will use a readability formula to adapt the text to specific grade levels. Thus, the formula is used to lower the level of difficulty of the text. It is argued that developing texts in this way works to destroy the meaning and style.

Rationale

There has been extensive research, emanating especially from the Center for the Study of Reading, which shows that traditional readability formulas are not reliable. First of all, many of them were validated against each other rather than on some established measure of comprehension. Second, there is abundant evidence that they do not measure comprehension. It is possible, for instance, to obtain a readability measure using disorganized sentences. Obversely, highly sophisticated stories such as those by Sartre may have a readability value of grade 6 or 8 but be extremely difficult to comprehend (Amiran, 1980).

Additionally, Center staff have taken it as a major goal to assess the effects of using traditional readability formulas to adapt a high level text to a lower grade level. They have numerous analyses showing how sentence splitting, the removal of connectives and multisyllable nouns, and the process of rewriting either changes or alters the meaning of the text or inhibits comprehension. That is, these procedures force the reader to infer causal or other relations within and between sentences without adequate context clues. Such texts are "inconsiderate" because they make the text unnecessarily difficult to read.

Principle 3 (Text Development and Considerate Text)

Texts and instructional materials should be developed according to the concept of considerateness.

Definitions and Rationale

Considerateness (Armbruster & T.H. Anderson, 1981)

The concept of considerateness argues that the author and developer should provide maximum help to the reader to comprehend the meaning of the text/instructional materials.

Considerate Text

According to Armbruster and T.H. Anderson, authors can control four factors to maximize helping the reader:

- text structures, which have markers and frames
- cohesiveness
- unity
- audience appropriateness

(a) Text Structures

Numerous analyses have determined that there are about six text structures that are used in social studies texts. These are:

- description
- cause-and-effect or explanation
- compare-and-contrast
- problem-and-solution
- sequential
- concept/definition

Text Markers

Text markers are words that indicate the text structures. The words "first," "whereas," and "because" all indicate different text strutures (i.e., sequential, compare-and-contrast, and causal, respectively).

Frames

Frames are the content specific questions, categories, or slots in an outline (1) which authors use to organize their texts, and (2) which are generic to a discipline or field. Examples of frames are the use of the 5W questions (who, what, where, etc.) to organize segments of news articles, biographies, and social studies texts. Another example is the use of the conflict frame to organize descriptions of wars and clashes between peoples in social studies texts; this frame consists of descriptions of the goals, actions, interactions, and outcomes for each of the peoples involved in the conflict. Thus, understanding the frames in a text is fundamental to comprehension.

We contend here that there are instructional frames as well as content frames. That is, Anderson and Jones (1981) and others (e.g., Merrill & Reigeluth, 1980) have argued that there are four types of instructional objectives--information, procedures, concepts, and principles--and that instructional strategies should vary according to the type of objectives. These researchers then elaborated specific steps for each type of instructional objective (e.g., concepts involve identifying the domain or category of a concept, the critical features, examples, and nonexamples). We believe that the different types of instruction (procedures, concepts, etc.) are equivalent to text structures and that the steps in the instructional strategies are instructional frames.

Generally speaking, texts are easier to read if text structures are (1) appropriate to the author's purpose and (2) not mixed (e.g., a compare-and-contrast structure and a problem-and-solution structure within one text). Well-marked texts with clearly delineated frames are much easier to comprehend, compared to poorly marked texts.

(b) Cohesiveness

The text should be cohesive in that the ideas from one sentence to another should flow logically. Cohesiveness is thus a sentence-level criterion.

Specifically, cohesiveness refers to many aspects of the text, but most important, it refers to the use of connectives; explicit statements including explicit references to persons, places, and things; and the correct use of pronouns, indefinite articles, and demonstratives.

(c) Unity

Many authors destroy the cohesiveness of a text by interjecting irrelevant information. A unified text contains only relevant information.

(d) Audience Appropriateness

The text should be appropriate to the audience to whom it is addressed in terms of the difficulty of the text and the purpose.

On t: one hand, the concept of audience appropriateness addresses the widespread practice of having heterogenous classrooms in which the students are using texts two and three grade levels above or below the level that is appropriate for them. On the other hand, it refers to using a text for a purpose other than that for which it was written.

TABLE 1. TEXT LEARNING STRATEGIES AND TEXT CONDITIONS

TYPE OF STRATEGY	STRATEGY OPERATIONS AND COGNITIVE PROCESSES	TEXT CONDITION	TEXT FEATURES
GENERATIVE PROCESSES	- Use of previously learned information and associations to construct new associations and verbal abstractions	TEXT EXPLICIT	- Discourse or definitions; titles, subtitles, graphics that make *explicit* propositions
restatement paraphrasing visualizing	- Restating new information in terms of previously acquired vocabulary and associations - Restating verbal information in terms of previously acquired visual images	**Brief Descriptions**	- Organized discourse and definitions; could also be used for diagram/graph explanations
discourse elaboration visual verbal	- Creating short verbal stories and/or interactive images to comprehend concepts or integrate *component parts of* definitions	**Extended Descriptions and Definitions**	- Discourse containing new vocabulary (English or foreign) accompanied by definitions or English equivalents
inference translation interpretation prediction deduction	- Using prior knowledge and information given in the text to make inferences about word meanings, propositions, figurative language, and high level organization	TEXT IMPLICIT	- Discourse or graphics containing figurative language and implied meaning
analysis content organization	- Identifying the component parts of words, sentences, and passages; examining the relationship between the parts; selecting *important* information and main ideas; differentiating general and specific; recognizing new information interrelating ideas	**Complex Information**	- Discourse containing many component parts, levels of ideas, sequences of types of information; titles, subtitles, or graphics
summarizing	- Reducing important information to high level generalizations and abstractions	**Paragraphs/ Multi-Level Information**	- Discourse containing two or more levels of information (e.g., main ideas and details)

TABLE 1. TEXT LEARNING STRATEGIES AND TEXT CONDITIONS (Continued)

TYPE OF STRATEGY	STRATEGY OPERATIONS AND COGNITIVE PROCESSES	TEXT CONDITION	TEXT FEATURES
transformational representations linear outlining matrix outlining network outlining graphic notetaking	- Perceiving underlying structure of information plus transformation of prose into charts, tables, networks, maps, graphs, and symbols	**Extended Multi-Level Complex Discourse**	- Complex discourse • Descriptive information • Sequential information • Comparative information • Causal information
CONSTRUCTIVE STRATEGIES	- Strategies which redefine or create overall meaning and organization when it is not explicit or implicit, or when it is very complex	**TEXT INADEQUATE**	- Discourse that is very complex, abstract, unfamiliar, or unclear; discourse involving more than one prose passage
constructive inference comprehension monitoring hypothesis testing analogical thinking using other resources	- Identifying information that is unclear; constructing and testing hypotheses as to intended meaning; locating and interpreting information from additional resources (teacher's help, additional text, or dictionary)	**Unclear Discourse**	- Discourse containing contradictions, ambiguous or inconsistent information, inadequate examples or explanations
reconceptualization restructuring reorganizing summarizing	- Imposing a new organizational structure on complex discourse in which the imposed structure was not stated or implied by the author	**Very Complex Discourse**	- Discourse that is very complex or unfamiliar; poorly organized, or organized in different dimensions from that imposed by the learner
synthesis	- Imposing a single organizational structure on two or more different sets of previously unrelated, unorganized materials	**Multiple Texts**	- Two or more unrelated passages or stories usually containing extended description, unclear discourse, and/or multi-level discourse

Principle 4 (Text Evaluation and Comprehensible Text)

> Text and curriculum materials should be evaluated according to the concept of comprehensibility. Comprehensibility refers to the degree of text complexity, text explicitness, and text density as well as to the learning strategies and prior knowledge required to process the text.

Definitions

(a) The degree of complexity of the text -- This refers to the number of organizational levels (e.g., major idea, minor idea, details) and to the number of component parts (e.g., an article might be divided into four parts: a description of X, a history of its development, an analysis of its use, and an analysis of its implications).

(b) Text explicitness -- This refers to the degree to which the reader must infer the meaning of the ideas in the text and the relations between them.

(c) Text density -- This refers to the amount of new information that the reader must hold in memory to comprehend each sentence and paragraph. Publishers sometimes refer to this variable as concept density.

(d) Degree of world knowledge required -- This refers to the amount of prior knowledge required to comprehend the new information.

(e) Learning strategies required -- This refers to the amount and type of effort that the learner must exert to comprehend and recall what is read.

Rationale

The definition of comprehensibility above is based on analyses of numerous studies of what text variables do in fact influence comprehension (see Amiran & Jones, 1982). This concept assumes that reading usually takes place to answer particular questions and that each question requires a certain level of prior knowledge as well as the operation of specific learning strategies, depending on the text condition. Traditional readability formulas do not incorporate these variables to evaluate prose or other types of texts. However, these criteria make sense intuitively and can be applied fairly easily in a holistic manner.

Additionally, there is now a new measure of readability developed by The College Board for grade 3 through college. This new measure is called the Degrees of Reading Power (DRP) (Cooper, 1982). The DRP assesses the level of readability of whole paragraphs and is an extremely reliable measure, compared to other formulas. Interestingly, the DRP assesses both the level of comprehension of the student and the level of readability of a text. Consequently, it has the capability to establish student-text matches. Because the DRP consistently varies attributes of the text related to comprehension (i.e., text structure and cohesion), we would argue that both its components assess comprehensibility. Thus, the DRP is the only measure we would recommend to use to evaluate texts. Moreover, to the extent that readability formulas are used to develop texts, in spite of cautions not to, the use of the DRP is likely to produce more considerate texts than traditional formulas because it systematically varies the same variables of text that impact on comprehension.

Principle 5 (The Nature of Comprehension and Achievement)

(a) Comprehension is fundamentally a constructive, interactive process.

(b) Achievement requires both comprehension of the content texts and responses to questions about the text.

Definitions

(a) Comprehension

Schema theory assumes that the meaning of what is read is not inherent in the text; therefore, comprehension cannot be attained by merely reading the text and decoding the words. Rather, comprehension is a result of an interaction of:

- the cognitive characteristics of the reader (i.e., his/her prior knowledge and repertoire of learning strategies, including metacognitive strategies);
- the characteristics of the text (i.e., the extent to which it is considerate or inconsiderate);
- the context in which the text is given (context refers here both to the socio/cultural characteristics of the reader as well as to the physical or graphic context in which the message is given).

Comprehension is, therefore, an active process in which the reader uses prior knowledge and learning strategies to construct meaning from the text, using text markers and context clues when available.

(b) Achievement

Achievement involves analyzing and responding to questions. In ideal classroom situations, comprehending the meaning of what is read is only the second phase of a three-phase process. The first phase involves mentally reviewing what is already known about a topic before it is read, establishing a purpose in reading (deciding what information is likely to be important). Prereading activities may also include familiarizing oneself with difficult vocabulary, analyzing available questions, and/or predicting the contents from organizational markers and graphics. The second phase involves consructing the meaning of the text during and after reading. The third phase involves responding to questions about the text. Responding to questions is the primary means of assessing learning for both norm-referenced tests as well as criterion-referenced tests and teacher-made classroom tests.

Principle 6 (Differences in Comprehension and Achievement)

There seem to be two major differences between high and low achieving students:

(a) High achieving students have greater prior knowledge than low achieving students.

(b) High achieving students have a repertoire of learning strategies that low achieving students do not have, or cannot access easily.

Definitions

(a) Prior knowledge refers to the learning and vocabulary that the learner brings to a new learning situation.

(b) Learning strategies refer to the range of mental operations that are initiated, consciously or unconsciously, for the purpose of facilitating comprehension and recall. There are three different types of learning strategies:

- Vocabulary learning strategies (VLS) refer to the various strategies used to learn unfamiliar words. VLS vary according to the characteristics of the words to be learned; i.e., whether the words have affixes or not, whether the words are semantically related or not, and whether the word meanings are literal or figurative.

- Text learning strategies (TLS) refer to the various strategies used to learn prose and graphic texts. TLS vary according to the stages of learning: readiness strategies used before reading, comprehension strategies used during and immediately after reading, and response strategies used to respond to questions. The relationship between TLS and the different stages of instruction is elaborated in Principle 11 and Figure 3.

Metacognitive strategies involve the range of strategies needed to think about the process of learning and studying. Metacognition includes knowing what you know and do not know, deciding what is important and unimportant, and knowing how to find what you do not know that is important. Recent research (e.g., Armbruster, Echols, & Brown, 1983) indicates that the learner should think about four variables: the nature of the task; characteristics of the text; appropriate learning strategies; and learner characteristics that relate to the task, the text and learning strategies. Additionally, every VLS and TLS may involve two elements of metacognition: specifically, metacognitive knowledge of the strategy and metacognitive control of the strategy, including planning, monitoring, and evaluation.

Rationale

There is extensive research which suggests that differences in prior knowledge appear at early ages. Thus, low achieving students often arrive at school with deficits in prior knowledge. In contrast, learning strategies research suggests that low and high achieving students arrive at school with a narrow range of differences in learning strategies. As the curriculum becomes more complex, these differences widen. At about grades 4-6, high achieving students make a developmental shift in the use of effective learning strategies that low achieving students do not make at any time without intervention. There is, however, abundant evidence that explicit strategy instruction greatly facilitates comprehension and recall for low achieving students.

Principle 7 (Learning Strategies and Text Characteristics)

> The learning strategies needed to comprehend and respond to a given text vary according to three key text characteristics: content, structure, and level.

Definitions

(a) Content -- Content refers to the substance of the author's text and the student response. Different learning strategies are required if the content is familiar or unfamiliar.

(b) Structure -- Structure refers to the arrangement of ideas in author and student texts. Structure includes both micro structures such as syntax and word structures as well as macro structures such as text structures and frames. The text structures most often found in author and student texts are: description, problem/solution, compare/contrast, sequential or narration, and cause/effect.

(c) Level -- Level refers to the depth of processing needed to comprehend a text or respond to a question, given the author's text condition.

- text explicit -- In this condition, only literal or knowledge level processing is needed because the complete answer to the question is "right there." The student needs only to recognize the answer and state it verbatim or paraphrase it.

- text implicit -- In this condition, the complete answer or definition is "hidden there." That is, it is contained in the text, but it is only implied. The student must integrate information within the text, make inferences, translate figurative meaning or graphic text, and possibly analyze the component parts of the text, or apply the author's content.

- text inadequate -- In this condition, the complete answer to the question or definition is either "partly there" or "not there" at all because the text is unclear or incomplete in some way. In such instances, the student must use comprehension monitoring strategies, synthesis (integration of additional texts), and/or reconceptualization strategies.

Student texts may also be classified according to their level, given the conditions of the author's text.

- literal -- The student's answer is literal if it states verbatim or paraphrases the information in the author's text.

- inferential -- The student's answer is inferential if it involves integration of information within the author's text, translation of figurative language or graphics, or analysis of the author's text.

- interpretive -- The student's answer is interpretive if it involves a synthesis of more than one text, application of the author's content, reconceptualization, or evaluation.

Rationale

This conceptualization is based in part on research in question analysis. Specifically, Pearson and Johnson (1978) argue that existing efforts to classify questions are limited by the fact that such efforts do not account for the text conditions. The authors argue that accounting for text conditions is essential, not only for understanding that different questions require different levels of response (given specific text conditions) but also for teaching students how to analyze questions. Pearson and Johnson specify three types of text conditions: text explicit, text implicit, and script. Script is a text condition requiring world knowledge. The term text inadequate is preferred here because it is broader. A text is inadequate if there are inadequate clues, if the text is too ambiguous or incomplete, or if the questions require integrating two texts in some way. Raphael (1983) has established that classroom teachers can be taught to teach students to identify these conditions and the implied strategies for responding to the questions. Raphael has also shown that these procedures facilitate comprehension.

This conceptualization is also based on the assumption that learning strategies and thinking strategies are synonomous. Where behaviorism predominated many of the assumptions in psychological research, there was a sharp distinction between cognitive processes such as thinking, which was defined largely in terms of concept learning and reasoning skills, and the process of learning (commiting to memory) and reading. As memory and reading researchers began to document that comprehension and recall depended on mental operations such as categorizing, visualizing, finding the main idea, making inferences, and summarizing, the distinction between reading and learning and thinking began to merge. This merger was evident in a conference entitled Learning and Thinking Skills, sponsored by The National Institute of Education and The Learning, Research, and Development Center at the University of Pittsburgh, and such classic essays as Jenkins' article entitled "Remember that Old Theory of Memory? Well, Forget It!" Thus, in the conceptualization proposed here, reading and learning operations are fundamentally thinking operations which may be defined in terms of specific strategies or skills.

<u>Vocabulary Learning Strategies</u>

Once the text characteristics are known for a given question or vocabulary task, it is possible to specify precisely the strategies that are required to comprehend. Thus, a text inadequate condition necessarily requires integration of various texts, synthesis or evaluation, whereas a text implicit condition requires inferencing and integration strategies. Similarly, once the text condition for a given unfamiliar word or set of words is known, we can specify the appropriate vocabulary learning strategy/strategies. Figure 1 shows the text conditions for one type of text (vocabulary). Figure 2 shows the relationship between text conditions, word characteristics, and vocabulary learning strategies.

<u>Text Learning Strategies</u>

The definitions of specific learning strategies such as finding the main idea, summarizing, notetaking, and outlining vary according to the text structures and frames in the author's text. The rules for summarizing a compare/contrast paragraph, for example, vary somewhat from the rules for summarizing a narrative text structure. Similarly, the text structures in student notes, outlines, and written responses should be aligned with the text structures used by the author and/or those implied in the question (e.g., "Compare/contrast X and Y."). Again, learning strategies will vary depending on whether the content is familiar or unfamiliar. Familiar content requires far less inferential and interpretive levels of processing. Figure 3 shows the relationship between text learning strategies and text characteristics.

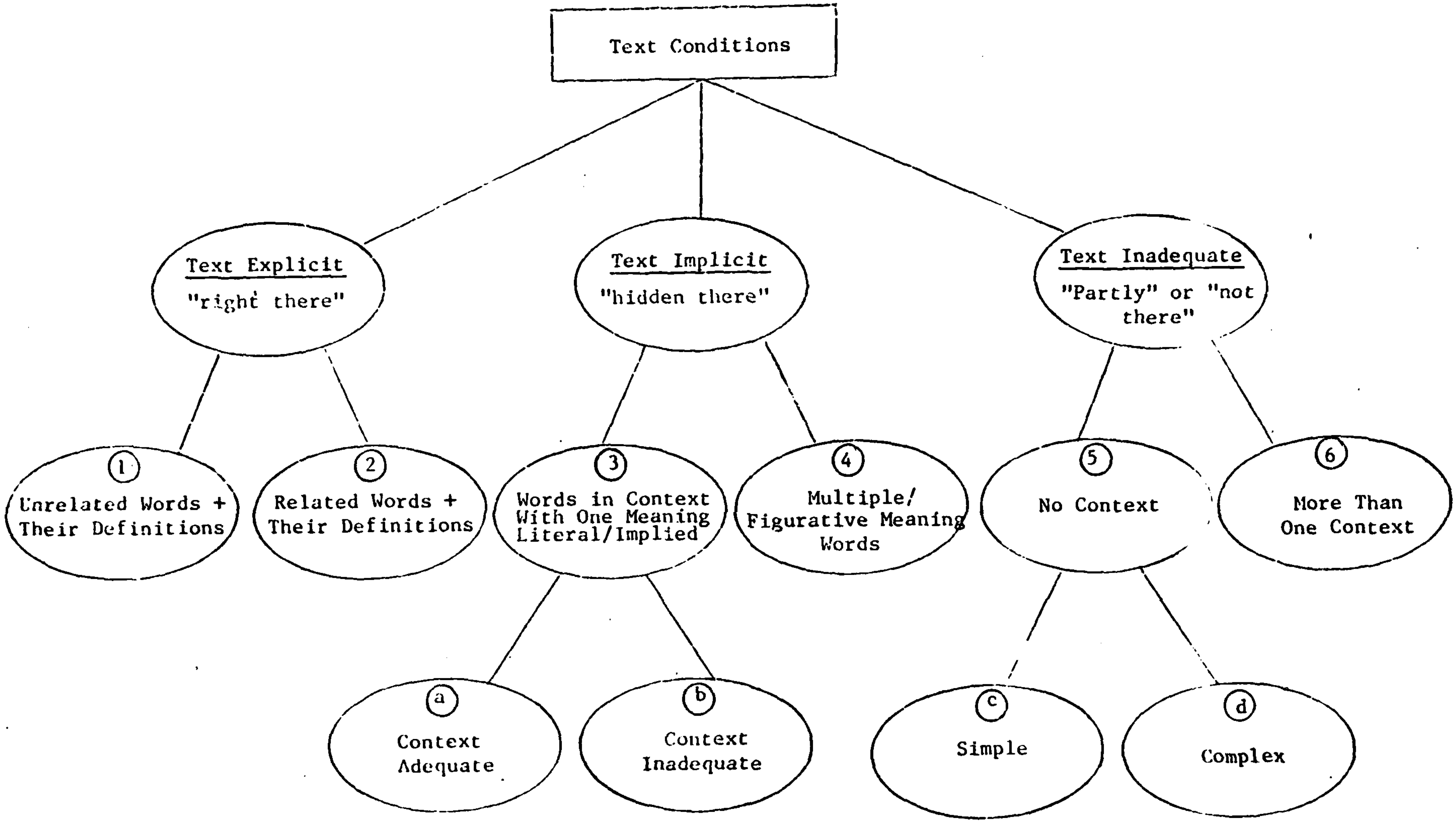


Figure 1. Types of Vocabulary Words and Text Conditions

Text Explicit (right there)

① Unrelated Words + Their Definitions	② Related Words + Their Definitions

① Unrelated Words + Their Definitions

Task/Learning Situation

Learning one unfamiliar word or a series of unfamiliar words from definitions in a glossary, dictionary, or prose text, given that
·· the words are not related to each other

Encoding Strategies

- analyze word parts
- visualize/draw the definition
- paraphrase the definition
- use word in sentence context

In-Depth Study Strategies

- identify key words/critical features
- determine the domain, synonyms, antonyms, related words
- generate new examples, applications, nonexamples, analogies
- demonstrate word meanings
- summarize word meanings

Memorizing Strategies

- elaborate (visual/verbal)
- rehearse the visual or verbal elaborations

② Related Words + Their Definitions

Task/Learning Situation

Learning a list of words from definitions given in a glossary, dictionary, or prose text, given that
·· the words are related to the same topic or category

Encoding Strategies

- analyze word parts
- visualize/draw the definition
- paraphrase the definition

In-Depth Study Strategies

- identify key words
- determine the domain, synonyms, antonyms, related words
- generate new examples, applications, nonexamples, analogies
- demonstrate word meanings
- summarize word meanings

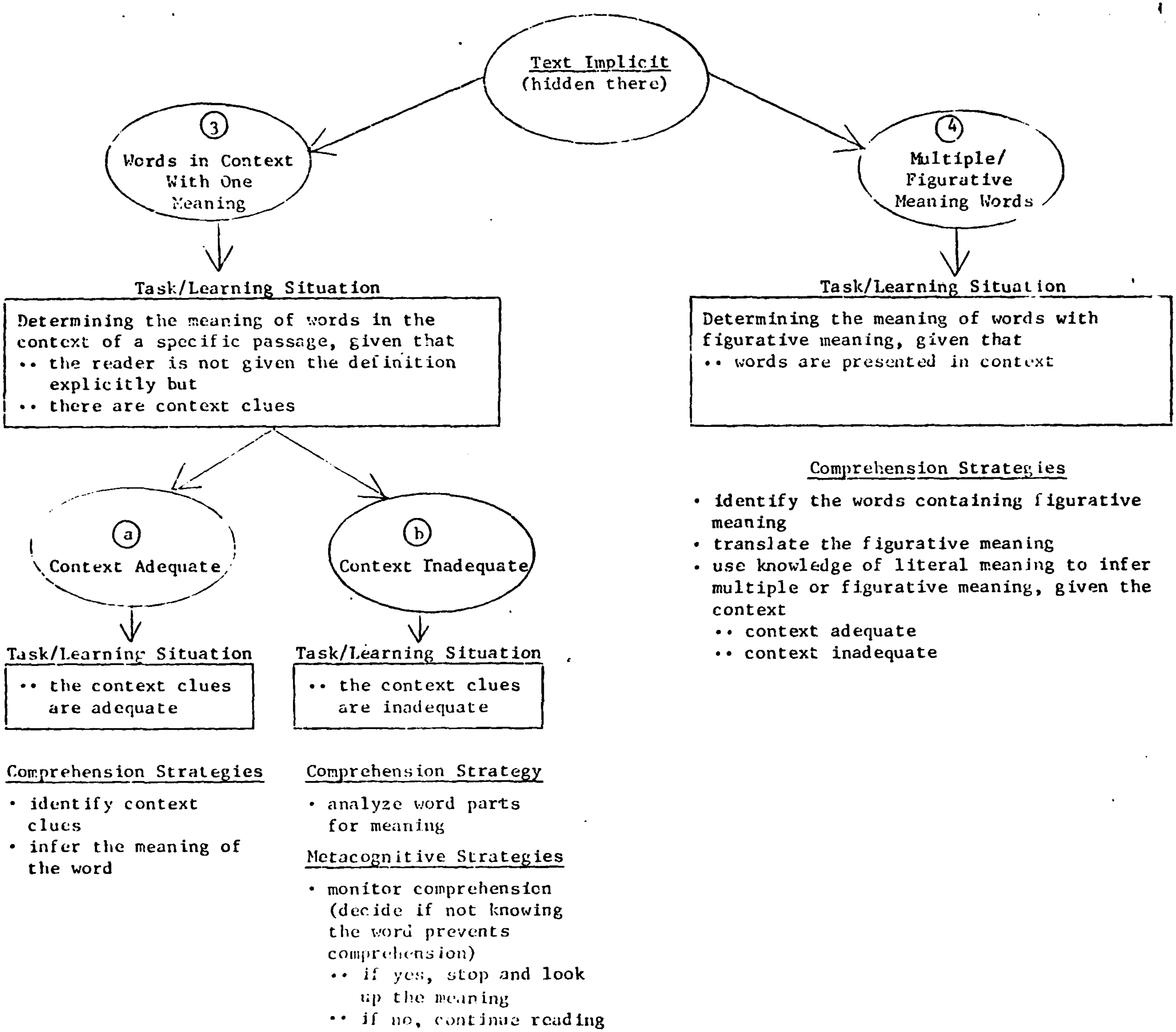
In-Depth List Study Strategies

- categorize (sort the words into subsets)
- compare the similarities and differences within and between each subset
- scale/cross-classify
- map word relations on semantic map

Memorizing Strategies

- elaborate the items within a category
- rehearse the categorized items

Figure 2. Types of Vocabulary Words, Text Conditions, and Vocabulary Learning Strategies


Text Implicit
(hidden there)
3
Words in Context
With One
Meaning
Task/Learning Situation
Determining the meaning of words in the context of a specific passage, given that
•• the reader is not given the definition explicitly but
•• there are context clues
a
Context Adequate
Task/Learning Situation
•• the context clues are adequate
Comprehension Strategies
• identify context clues
• infer the meaning of the word
b
Context Inadequate
Task/Learning Situation
•• the context clues are inadequate
Comprehension Strategy
• analyze word parts for meaning
Metacognitive Strategies
• monitor comprehension (decide if not knowing the word prevents comprehension)
•• if yes, stop and look up the meaning
•• if no, continue reading
4
Multiple/
Figurative
Meaning Words
Task/Learning Situation
Determining the meaning of words with figurative meaning, given that
•• words are presented in context
Comprehension Strategies
• identify the words containing figurative meaning
• translate the figurative meaning
• use knowledge of literal meaning to infer multiple or figurative meaning, given the context
•• context adequate
•• context inadequate

Text Inadequate
(partly, not there)

(a) No Context

Task/Learning Situation

- Having to determine the meaning of unfamiliar words in a vocabulary text, given that
  - the reader has only the word and the response choice

Comprehension/Test Taking Strategy

- analyze word parts
- eliminate incorrect choices

(a) Simple

Test Taking Strategy

- eliminate incorrect choices

(b) Complex

Comprehension/Test Taking Strategies

- analyze word parts for meaning
- eliminate incorrect choices

(b) More Than One Context

Task/Learning Situation

- Having to determine the meaning of technical term(s) given that
  - the text does not provide all of the information needed to define the term(s) fully

In-Depth Comprehension Strategies

- integration of information from different texts (e.g., integrate graphic and prose text or information from two prose texts)
- synthesis of information from different texts
- add prior knowledge
- demonstrate word meanings
- summarize word meanings

Principle 8 (Levels of Processing)

> The deeper the <u>level of processing</u>, the greater the level of comprehension and recall.

Rationale

Reading research indicates that comprehension and recall are facilitated by a variety of cognitive processes which have been referred to as learning strategies or thinking skills: paraphrasing, inferring, identifying key words or important ideas, underlining, notetaking, restructuring or reorganizing, outlining and summarizing, generating complex analogies or elaborations of the text. These cognitive processes constitute varying levels of processing. There is an increasing body of research which indicates that the higher the level of processing, the greater the comprehension and recall. This is true of word lists (Craik & Lockhart, 1972) as well as prose text (Glover, 1983). That is, while there are various definitions as to what the levels are, it seems evident that strategies which are typically defined as high level generally facilitate comprehension and recall more than low level strategies.

Principle 9 (Content-Driven Strategy/Skills Instruction)

Learning strategies and high order thinking skills should be taught as a means of facilitating comprehension and retention of the content, not as ends in themselves. Thus, strategy/skills instruction should be content driven.

Rationale

Currently, most educators assume that students must demonstrate knowledge of a text before they are taught high order thinking skills (such as translation, inference, application, analysis, synthesis, or evaluation). The view proposed here is just the opposite. In typical learning situations, most students can only understand the facts and ideas in a text as a result of making inferences, integrating facts and ideas, applying concepts to new examples, and so on. Furthermore, a close examination of Bloom's taxonomy suggests that the various levels of skills were intended to be conceptualized as means to comprehension. This is particularly true when the text is inconsiderate or when the questions involve text implicit or text inadequate conditions. This means that the practice of sequencing the objectives in Bloom's taxonomy in lock-step order from knowledge to evaluation is not sound pedagogy. Instead, students should be taught various high order strategies and thinking skills as the text and question conditions demand.

It is argued that teaching skills as ends in themselves fragments instruction. Reading is a holistic process involving comprehending whole passages which require a diversity of thinking skills, simultaneously and sequentially at various stages of reading and studying. Teaching skills as ends in themselves rather than as means to comprehension makes instruction skill-driven in that the sequencing of skills instruction drives the scope and sequence of what is taught. All content area instruction including literature should be content driven.

Since reading instruction involves no specific content to be learned, it does not drive the scope and sequence of the course and of strategy/skills instructi . That is, the instructional designer is free to sequence content and skills instruction from easy to difficult. However, such courses should be content driven in that the instruction should use the strategy or skill as a means to understanding the content of individual reading selections.

Additionally, strategy/skills instruction should be explicit both content and reading courses. More specifically, strategy/skills instruction should include the following:

- objectives which specify the content to be learned and the strategy to be used as a means to learning the content
- a brief, explicit, "top-down" statement of the strategy definition and the text/tasks to which it applies
- one or more examples with an explanation of how the strategy is used to learn the text for reading courses
- teacher-directed instruction (prompting) in the application of the strategy to the content to be learned for content coures (see Principle 11 also for sequencing strategy/skills instruction)
- modelling/demonstrating the thinking processes used to apply the strategy to the content
- embedding learning and metacognitive strategy prompts within the text and instructional materials.

Principle 10 (Content, Prior Knowledge, and Instruction)

A major function of instruction is to relate the content to prior knowledge by constructing meaning from text. This should be achieved using whole group instruction.

Rationale

One of the most difficult problems to solve in content teaching is the problem of differences in prior knowledge. Traditionally, schools solve this problem by offering different levels of instruction for students the same age so that low achieving students can read texts at their reading level. A major problem with this procedure is that the texts and instruction in traditional texts are poorly written (e.g., Armbruster & T.H. Anderson, 1980; Durkin, 1981; Osborn, 1981), and low achieving students often fail or progress slowly from one level to the next. One solution to this problem is to build in instruction to teach prerequisite content and/or vocabulary and skills instruction. Thus, the instruction progresses from material that is easy and familiar to material that is increasingly difficult and unfamiliar (Jones, Amiran, & Katims, 1983); see also Principle 11). However, as stated earlier, this instructional strategy can only be used for reading instruction because there is no set content to be covered; thus, individual selections can be sequenced in this way. In contrast, a content text can rarely be sequenced in this way because content courses are inherently unfamiliar and complex.

(a) Teaching/Learning Strategies

One solution to this problem is to design instructional strategies that relate the content and strategies/skills to be taught to the prior knowledge of the student. Any of the following procedures perform this function:

- Having the students predict the information in the text by analyzing titles, subtitles, and graphics activates content-related schema and establishes a purpose in reading: to confirm and correct the predictions (Stauffer, 1975).
- Asking the students to form an opinion about declarative statements about the content has similar functions (Herber, 1974).
- Preteaching difficult vocabulary helps greatly to familiarize the students with key concepts, provided that the instruction is systematic, focuses on word relations, and shows the relationship of the new word to the text to be read.
- Having students relate each new word to its domain or category and to related words they already know links new vocabulary to old vocabulary.
- Having the students plan strategies for comprehending the text and responding to questions activates prior knowledge of strategies, texts, tasks, and learner characteristics.
- Having the students use question analysis, predictions, and opinions as the basis for constructing semantic maps and/or summarizing after reading helps the students: (1) to construct meaning from text and (2) to relate the content and meaning to prior knowledge (because the students have used prior knowledge to make the predictions, give opinions, etc.).

(b) Functions of Constructing Meaning from Text as a Class

It is critical to note that constructing meaning from text as a class or at least in small groups has numerous important comprehension functions.

First, it enables all students to have access to the same meaning (schema) that is common to the teacher. Further, these group instructional strategies "level" meaning, to use a phrase coined by Cooper (1982). That is, these strategies provide an opportunity for students for whom the level of the text is difficult, to discuss and utilize a level of meaning typically attained only by high achieving students. This is possible because meaning is constructed orally and is represented in graphic notes or statements that all students have access to for study purposes. Additionally, our field observations of these procedures indicate that they are fun, are high time-on-task, and seem to motivate students.

Finally, these procedures solve a serious practical problem. In many large school systems, the teachers will not allow students to take their books home. Thus, all reading must be done in class. This means that there is no time to use strategies which require more than one reading of the text. Constructing meaning from text as a group solves this problem. Such procedures therefore provide a greater equality of educational opportunity than traditional strategies which focus almost entirely on reading and informal assessment of comprehension.

This commitment to group instruction should not be taken to mean that we have little value for independent learning. To the contrary, we recommend that students gradually learn all of these strategies to the point where each student can use them in independent study and in a self-directed manner (see Principle 12). Moreover, teachers can still use whole group instruction by allowing students to work independently as individuals or groups and then share the meanings they have constructed with the class as a whole.

(c) Teaching/Learning Strategy Relationships

The line between a learning strategy and an instructional strategy is clear in one sense. An instructional strategy is what the teacher does to facilitate learning, whereas a learning strategy is what the learner does to facilitate learning. However, it is evident that any instructional strategy becomes a learning strategy when it is utilized by the learner or a group of learners independently. This means that all the instructional strategies defined above may be conceptualized as learning strategies as well as teaching strategies. They were identified as instructional strategies because they are typically strategies that students do not develop spontaneously and because they require whole group or small groups for optimal benefit.

Principle 11 (Sequencing Instruction within Lessons)

> Instruction within each lesson should be sequenced to include three stages: readiness instruction, comprehension instruction, and response instruction. This is called vertical sequencing.

Rationale

Currently, many definitions of comprehension instruction refer to helping students understand the meaning of what they read and do not systematically cover preparing to read or studying and responding to what is read. It is argued that comprehension instruction must be complemented by readiness instruction and response instruction--in which the teacher and student interact with the text to construct the meaning of the text. More specifically, comprehension and achievement are a process involving three stages of learning: readiness, on-line processing that occurs during reading and in-depth processing after reading, as well as responding to questions about the text. Therefore, for each lesson or content segment to be learned, there should be three stages of instruction: readiness instruction, comprehension instruction involving both on-line processing instruction (e.g., underlining and note taking during reading) and in-depth processing (e.g., constructing semantic maps, evaluating what was not understood, etc.) and response instruction. This type of sequencing is called vertical sequencing because on a scope and sequence chart, it refers to the sequencing of stages of instruction within a lesson.

Figure 4 that follows summarizes the interaction between the teacher, the student, and the text through these three stages of process instruction.

Stage I: Readiness Instruction

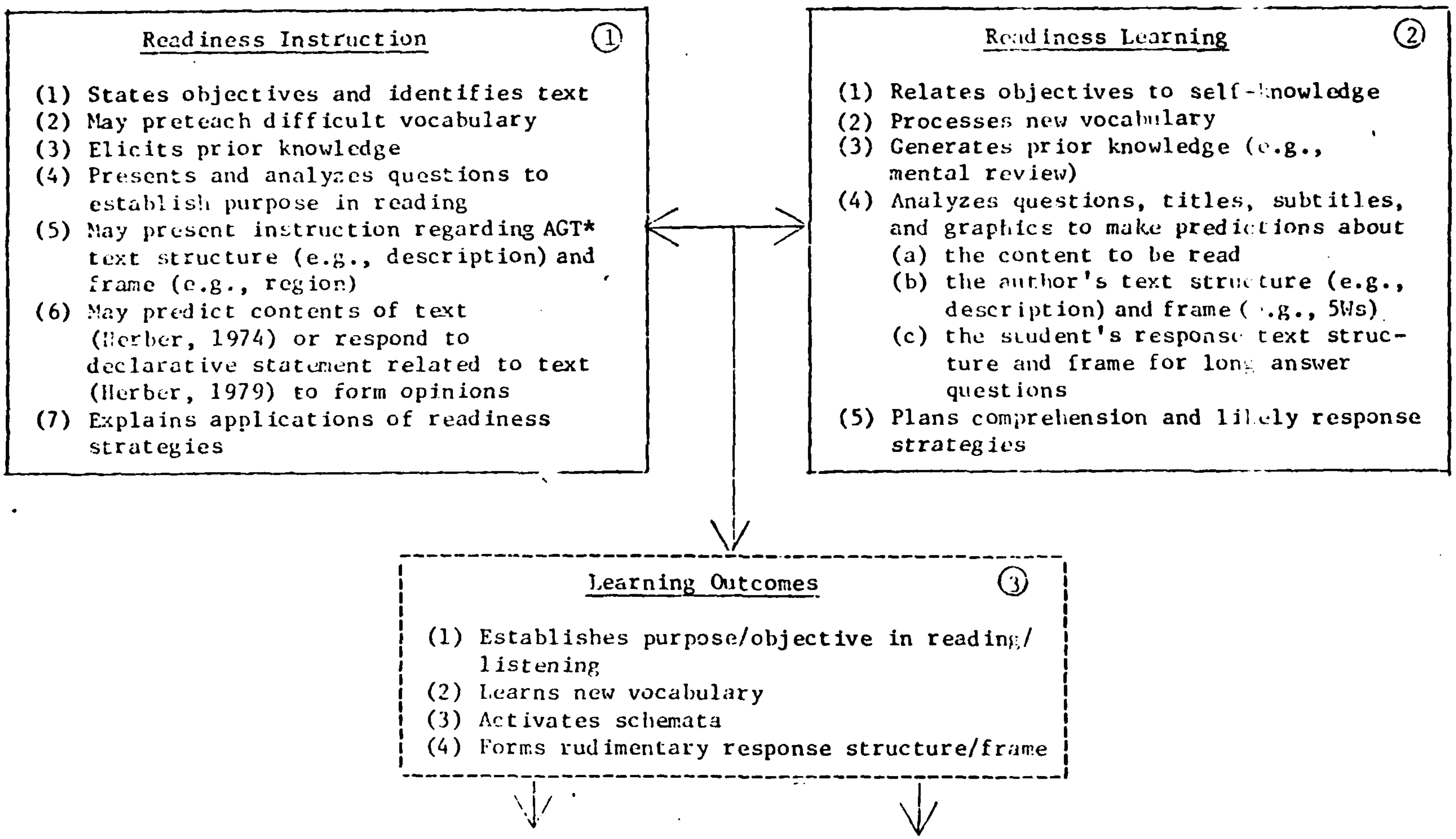


Figure 4. The Interaction of Learning Strategies and Instruction for Each Stage of Instruction

Stage IIA: Comprehension Instruction: For On-Line Processing (During Reading)

A. Presentation of Content Text: Text Characteristics (4)

(1) Considerate/Inconsiderate
(2) Explicit/Implicit/Inadequate
(3) Single Text/Multi-text
(4) Prose/Graphics/Oral/Demonstration
(5) Audience Appropriate/Inappropriate

A. On-Line Processing During Reading/Speaking (5)

(1) Decodes and comprehends text: links to schemata
(2) Searches for high level ideas
(3) Searches for information to answer questions
(4) Monitors comprehension; notes gaps
(5) May underline, take notes

Learning Outcomes (6)

(1) Engages schemata
(2) urface-level understanding
(3) Awareness of gaps in knowledge, possible errors
(4) Rudimentary knowledge of content and structure of response

Stage IIB: Comprehension Instruction: For In-Depth Processing (After First Reading)

B. In-Depth Comprehension Instruction (7)

(1) Monitors comprehension:
 (a) fills in gaps, corrects notes
 (b) clarifies confusions
(2) Guides students to construct meaning of the text
 (a) idea maps
 (b) elaboration
 (c) analogies
(3) Explains applications of comprehension strategy

B. In-Depth Processing Post Reading/Listening (8)

(1) Evaluates comprehension, identifies important information, asks questions to fill gaps and confusions about the text
(2) Re-examines text using higher level comprehension strategies
(3) Restructures notes
(4) Verifies predictions/ compares opinions

Learning Outcomes (9)

(1) Changes in conceptual schemata
(2) Increased extent of knowledge of concepts and facts
(3) Awareness of author's purpose, text structure, and content (idea) structure
(4) Awareness of comprehension strategy taught (B2) and the process of comprehension monitoring and evaluating

Stage III: Response Instruction

Response Instruction (10)

(1) Guides students to summarize gist of passage and answer questions
(2) Discusses predicted response structure (frames)
(3) Guides students to convert notes to frames for response to questions
(4) Establishes criteria for rough draft, editing, and final response
(5) Monitors writing process for class
(6) Elaborates writing strategy and applications

Response Processes (11)

(1) Summarizes orally or in writing gist of content, generates overviews
(2) Generates metaphors, analogies, examples
(3) Answers short-answer questions
(4) Verifies estimated response frame, adjusts accordingly
(5) Converts notes to response outline for longer questions requiring a paragraph or essay
(6) Writes rough draft, edits, revises
(7) Monitors and evaluates writing process

Learning Outcomes (12)

(1) Increased comprehension of content
(2) Increased knowledge of text structures and frames
(3) Increased awareness of writing process and applications
(4) Increased control over writing process

*AGT - Author-Generated Text

SGT - Student-Generated Text

Principle 12 (Sequencing Instruction between Lessons)

Instruction between lessons should be sequenced in four dimensions: content, instruction, teacher directedness, and learning strategies. Sequencing between lessons is called horizontal sequencing because on a scope and sequence chart, it usually involves sequencing across the lessons.

Rationale

(a) Sequencing Content
In content courses, the text is a given, and it is usually not possible to sequence the development of the content. The exceptions here are the content for reading and literature courses since the content of such courses is given in individual, self-contained selections. In such courses, the selections should proceed from text that is simple/concrete/explicit/familiar/short to text that is increasingly complex/abstract/inexplicit/unfamiliar/long. In this way it is possible to begin with information that is part of prior knowledge and build on that foundation.

(b) Sequencing Instruction
Content of examples and practice exercises in the instruction, where possible, should also proceed from information that is simple/concrete/explicit/familiar/short to content that is increasingly complex/abstract/unfamiliar/long.

(c) Sequencing Teacher Directedness
Explicit instruction should be sequenced to progress from teacher direction to student control in the following sequence between lessons:

- teacher-directed activities, directed entirely by teacher; heavily prompted
- guided practice activities, supervised by the teacher, whose function is to help the student understand the directions, task, and vocabulary
- independent practice activities, unsupervised by the teacher
- student-directed activities, organized and directed entirely by the student

This sequence may occur within one lesson, but in the vast majority of instances it will occur over a series of lessons, usually in a minimum of four lessons since there are four stages. However, this decision will depend on the length and structure of the content to be learned.

(d) Sequencing Learning Strategy Prompts

Prompts for learning strategy instruction should proceed as follows:

- step-by-step prompts (thinking aloud models)
- content-specific prompts
- general prompts (no reference to content)
- no prompts

Again, some or all of the learning strategy sequencing may occur within a lesson, but typically it takes place over several lessons or a whole unit.

The Embedded Curriculum
The embedded curriculum is a set of instructional materials in which specific strategy prompts have been embedded by means of adjunct questions. These may be questions as paragraph headings, "Think" statements, "Ask yourself" questions, or step-by-step thinking-aloud models. The addition of these questions makes the text more considerate because they help the reader to learn.

Table 1 shows the relationship between horizontal and vertical sequencing.

Table 1. Horizontal and Vertical Sequencing

		← Horizontal Sequencing →				
Vertical Sequencing ↕	Lessons	1	2	3	4	5
	Content	-specify gist of content Segment 1	-specify gist of content Segment 2	-specify gist of content Segment 3	-specify gist of content Segment 4	-specify gist of content Segment 5
simple ← content → complex	Readiness Instruction	-introduces question analysis -teacher directed -step-by-step prompt	-guided practice -content specific prompt	-independent practice -general prompt	-student directed -no prompt	
	Comprehension Instruction	←no new skills instruction→		-introduces new skill -teacher directed -step-by-step prompt	-independent practice -general prompt	-student directed -no prompt
	Response Instruction	←no new skills instruction→				-introduces summarization strategies -teacher directed -step-by-step prompt

Note: In content-driven instruction all of the instruction for each lesson is devised to teach the content of that lesson.

Principle 13 (Referencing Structures, Frames, and Levels)

Instruction should be: <u>structure referenced</u>, <u>frame referenced</u>, and <u>level referenced</u>.

Definitions

(a) Structure referenced -- The teacher should help the student identify the text structure in the author-generated texts as well as appropriate text structures for student-generated texts, i.e., response structures.

(b) Frame referenced -- The teacher should help the student identify the content-specific frames that are used to organize the author-generated and student-generated texts in terms of content.

(c) Level referenced -- The teacher should help the student to identify what comprehension strategies are needed to respond to a given question, given the text condition.

Rationale

Good writing and instruction generally provide recognizable text structures and frames. Teaching students to identify these text structures and frames helps them to locate information in a given passage as well as to comprehend the connection between the parts. Similarly, teaching students to use text structures and frames in their own texts (as responses to questions) helps to organize their thoughts and their writing.

Interestingly, a close examination of chapter questions in social studies texts (Anderson & Armbruster, 1983) indicates that most questions suggest a particular type of text structure for the response (e.g., "List..." in the question suggests a list type of response). Additionally, we know that questions may require quite different levels of thinking (literal, inference, translation, application, and so on) given specific text conditions. It is very helpful for students to identify if the text is text explicit, text implicit, or text inadequate (Pearson & Johnson, 1978).

To say that instruction should be structure referenced and frame referenced means that the teacher (or instructional text) should help the student identify text structures and frames in their own responses. To say that instruction should be level referenced means that the teacher (or instructional text) should help the student identify the level of the question, given the text condition (i.e., to identify the text condition).

Principle 14 (The Concept of Curriculum Alignment)

> The concept of curriculum alignment should be used to align the various parts of the curriculum with each other and with the instructional level of the student. Mastery learning is the most effective method to organize and align instruction and assessment. The DRP is the most effective method of aligning the student with the curriculum materials and evaluating the program.

Rationale

Curriculum Alignment

Practically, the term curriculum alignment refers to the alignment of the objectives, the textual materials, the thrust of the instruction, and the assessment measures. This means that if the objective refers to inferring the main idea, the teacher teaches the students to infer the main idea using textual materials which provide practice in inferring the main idea. As it is currently used, the concept of curriculum alignment does not involve the concepts that relate to the content and level of instruction.

(a) Content and Text Alignment

What is argued here is twofold. First, the curriculum should be aligned in regard to the content of the instruction. That is, Anderson and Jones (1981) and others (e.g., Reigeluth & Merrill, in press; Reigeluth & Darwazeh, 1982) have determined that the vast majority of the objectives in school and military settings involve only four types of instructional content: information, procedures, principles, and concepts. Both Anderson and Jones and Reigeluth and his associates have developed instructional strategies which are appropriate for teaching each type of objective. Thus, a conceptual objective should involve (1) a text that defines the concept, domain or category, critical features, examples, and nonexamples, (2) an instructional strategy that involves having the students define the concept, infer or define the domain or category, and critical features, generate new examples, and so on, and (3) a test that is consistent with the instruction.

(b) Level Alignment

It is a very common practice in schools to assign instructional materials to students according to their age, regardless of their level of instruction or achievement. Thus, all students in grade 5 may use the same text, even though many may have only grade 3 or grade 4 reading level. While some well-sequenced materials are robust enough or interesting enough to be effective in spite of 1-2 year differences in the level of the text and the reading level of the student, most often such large discrepancies are dysfunctional; typically, students fail to understand the instruction and may become frustrated and bored. It is advisable, therefore, to assign students materials which are within a year or so of their instructional reading level.

Mastery Learning

Mastery learning, as specified by Anderson and Jones (1981), constitutes considerate curriculum alignment because it involves the alignment of objectives, instruction, and tests with regard to content and text structure. Moreover, there is increasing evidence that mastery learning is a powerful instructional strategy in and of itself. This is largely because the curriculum is aligned. Moreover, the method of organizing instruction and assessment constantly corrects learning errors so that they do not accumulate (see Principle 15).

To explain, traditional instruction has only a two-phase cycle of instruction and testing: teach and test. Moreover, tests are scored according to the concept of norm-referenced tests whereby students' grades are compared to each other, with the net result that there is a normal distribution of scores. In contrast, mastery learning assumes that most students can learn, given appropriate teaching/learning conditions. Specifically, we should teach to a set of objectives, and learning should be assessed according to prespecified criteria. Instruction and assessment should be organized in four-phase cycles: teach, test, reteach or extend, retest. The heart of this cycle is the frequent diagnosis and correction of learning errors so that most students are equally ready for the next unit of instruction. That is, since achievement is criterion referenced, all those who attained mastery of that objective have the prerequisite knowledge and skills necessary for the next objective (provided that instruction is well sequenced). In this way, mastery learning controls for differences in prior knowledge.

Mastery learning ideally utilizes the following informal measures of diagnosing learning errors as well as the following tests: a formative test and retest for each unit and a summative test to assess learning over several units.

The Degrees of Reading Power

Currently, some schools which assign materials to students according to their instructional level typically use norm-referenced tests to make this assignment. This is unfortunate because these tests were not devised to diagnose individual reading levels. Others use a combination of norm-referenced tests and other measures (e.g., basal level, mastery level, teacher judgment). While a diversity of measures is preferable, compared to the use of norm-referenced tests alone, neither of these methods of aligning students and tests has the reliability of the DRP (Cooper, 1982; The College Board, 1982).

The DRP is a standardized test that is referenced in terms of DRP units which represent differences in comprehension of increasingly difficult paragraphs. Hence, whereas norm-referenced tests assess the level of student performance by comparing students to each other, the DRP assesses the level of performance in terms of the students' ability to comprehend increasingly difficult passages. Moreover, the DRP was specifically designed to match the level of comprehension of the student with the level of comprehension of the text, and there is increasing evidence that this match, in and of itself, yields important comprehension gains (Cooper, 1982). For these reasons, it is recommended that schools use the DRP to match students and text.

A word of caution is in order, however. The DRP is finely calibrated to assess small differences in comprehension. We are not suggesting here that the DRP be used to assign each student in the classroom a text that is closely calibrated to his/her DRP level. Such a system would be unmanageable and inconsistent with earlier assumptions about the usefulness of whole group instruction. Instead, what we are recommending is the use of the DRP to form classrooms of students who are at approximately the same reading levels (i.e., at about the same grade level or range of DRP units).

Additionally, the DRP may be used to establish criteria for promotion because the school system can set specific levels of comprehension according to its own philosophy and policy. Thus, a school can require its students to attain a level of comprehension using DRP comprehension scores and/or DRP text ratings for specific types of literature such as editorials, works of fiction, tax forms, laws and bills, and so on.

Principle 15 (The Concept of Instructional Testing)

> All classroom texts should be developed according to the concept of instructional testing. That is, tests should only assess content and skills that have been taught, and the results should be used to make decisions about subsequent instruction.

Definitions and Rationale

Types of Classroom Tests

(a) Independent Practice and Practice Tests

These should be used to assess that learning is taking place. The results of quizzes should drive subsequent instruction; i.e., high error rates indicate a need for reteaching the whole class or small groups.

(b) Formative Tests and Retests

These two tests should be criterion referenced for instructional purposes (1) to establish the level of mastery that is necessary before progressing to the next unit of instruction, and (2) to diagnose and correct learning errors so that they do not accumulate. Both tests should be parallel in all dimensions that affect readability.

(c) Summative Tests

These should be devised to integrate information across units. These tests should also be parallel to each other.

Principles of Instructional Testing

(a) Each test should be constructed as much as possible according to the concept of revelation; i.e., the test should reveal the student's thought processes by such methods as requiring notes for essay questions.

(b) Such tests should assess the student's knowledge of learning and metacognitive strategies, as well as the student's knowledge and reasoning regarding the content.

(c) The scoring of essay questions should be

- structure referenced
- frame referenced
- level referenced

This three-factor scoring procedure has two important implications for instruction. First, it allows a very high-level analysis of what is wrong with a given response and how to correct it. More specifically, this procedure allows the teacher to diagnose precisely whether the student is lacking in content or writing skills or cognitive processing or all three. Instruction can then be focused accordingly. Other scoring systems for written responses simply do not have this analytical and diagnostic-prescriptive capability.

Second, level-referenced instruction has additional implications for instruction. Besides analyzing what the student did, level-reference instruction allows the teacher to differentiate analytically and instructionally the difference between an "O.K. Answer" and various levels of "Better Answers." Suppose, for example, the questions required only inferences of the information given in the text. An O.K. Answer would be to provide the inferences. A Better Answer would involve application, analysis, synthesis, or evaluation. Explaining what better answers are, models to the student what a good answer would be. Level-referenced assessment also allows teachers and students to sequence instruction systematically to work through each level of comprehension. Additionally, students could contract to strive for specific levels. Thus, Principle 15 goes a long way towards turning testing systematically into instruction.

(d) Generally, test results should be used to organize subsequent instruction to correct learning errors by any of the following: reteaching individuals, small groups, whole classes; having students redo their work; or providing additional assignments.

Principle 16 (Criterion-Referenced Field Testing)

> All instructional materials should be developed according to the concept of criterion-referenced field testing. This means that the instructional designer is accountable for the success of the instruction.

Rationale

Those who are developing instructional materials must assume that the materials should be robust enough to be successful and stand alone without any inservice other than overview and implementation material provided with the materials. This is because it is impossible to be in every school or district using the materials. To help the materials stand alone, the developer should utilize the following concepts:

(a) Criterion-Referenced Field Testing

Using this concept, the developers assume responsibility for the success of the instruction. That is, the developer selects a set of classrooms that will represent the range of teachers and students likely to use the materials. This means making certain that the students are representative in terms of socio/economic status, ethnicity, and ability levels so that there are high, low and average achieving students. It also means making certain that "low yield" teachers can use the program as well as good teachers. Class size should be typical. In large cities, area of the city or type of school (e.g., magnet vs. regular) may also need to be controlled for.

Once the classrooms are selected, the materials should yield certain prespecified results on formative tests and retests. Thus, if 80% of the students do not obtain a grade of good, "B," 80%, or whatever, the materials are revised and tested until students attain that criteria. This concept places the burden of responsibility for success on the developer. We have the technology to develop successful instruction; therefore, we should demand it, using quantitative field test data to show that students use the materials successfully under diverse teaching/learning conditions.

(b) Self-Instructional Staff Development Materials

Because the instructional developer must assume that he/she cannot be there to control staff development presentations, it is useful to develop the materials needed to make the best possible inservice for a trained cadre of staff development presenters. This means providing the presenter with all of the materials and scripts needed to make a good presentation. These procedures are especially useful in large cities.

C. Summary

Principles 1-4 involve assumptions about the subject-related text. Principle 1 re-defines text in terms of the various texts that provide the relevant content to be learned (i.e., prose and oral texts as well as graphic and demonstration texts). Principles 2-4 provide guidelines for developing and evaluating the various types of texts. Texts should be developed according to the principle of considerateness and evaluated on the basis of analyzing the relationship between the text, the questions asked about the text, and the reader.

Principles 5-8 make statements about the nature of learning, comprehension, and achievement. Principle 5 defines comprehension in terms of schema theory. Principle 6 defines differences between high and low achievers in terms of differences in prior knowledge and strategy use. Principle 7 defines learning strategies and text conditions as text explicit, text implicit, and text inadequate. Principle 8 argues that the in-depth processing is essential for high level achievement.

Principle 9 involves assumptions about the relationship between content and skills instruction. It argues against the notion that low order thinking skills such as literal comprehension must be mastered before the student can be taught high order thinking skills such as inference and analysis. This principle argues that high order thinking skills should be taught as a means of comprehending the content and as a means of producing increasingly more sophisticated responses (i.e., responses involving increasingly higher levels of cognitive processing). The proposed instruction is therefore content driven.

Principles 10-12 concern sequencing instructional materials. Principle 10 seeks to make explicit an assumption about prior knowledge that lays the foundation for both principles 11 and 12: A major function of the instruction should be to relate the information to be learned to prior knowledge. This applies to the content to be learned as well as to strategies and skills to be learned. Thus, much of the total instruction takes place before reading. Principle 11 delineates the concept of vertical sequencing within lessons. This involves three phases of instruction for each day or lesson: readiness instruction, comprehension instruction, and response instruction. Principle 12 discusses the concept of horizontal sequencing, that is, sequencing between lessons. We argue that strategy/skills instruction should be explicit, and it should be sequenced over lessons to progress from teacher directed to student directed and from step-by-step prompting to no prompting.

Moreover, according to Principle 13, instruction should be systematically **structure-referenced**--related to the author-generated and student-generated text structures; **frame-referenced**--related to the broad categories, variables, and concepts that authors and teachers repeatedly address in their texts; and **level-referenced**--related to the level of cognitive processes that are required to answer a question, given a specific text condition as text explicit, text implicit, or text incomplete.

Principles 14-16 deal with **assessment** and **implementation.** Principle 14 argues that mastery learning is the most considerate system for organizing instruction. Principle 14 also provides guidelines for using formative, summative, and standardized tests. Principle 15 defines the concept of instructional testing. Principle 16 defines the concept of criteron-referenced field testing.

Enhancements to Motivational Skills Training for Military Technical Training Students

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Abstract

A computer-controlled audio capability for enhancing the effectiveness of motivational skills training for military trainees was developed for the Army Research Institute as part of its Basic Skills/Learning Strategies research program. This capability interfaces with an Apple IIe microcomputer system and provides for the personalization of computer-assisted introductory and practice segments for seven printed, self-instructional motivational skills training modules. The modules promote the development of self-management, personal responsibility, and positive self-control skills that underlie self-motivation. The implications of this research for providing a cost-effective technology for personalizing CAI training and for reducing the dependence of the motivational skills training on instructor and group process facilitation are discussed.

Introduction

Many students entering military technical training lack not only prerequisite basic reading skills and cognitive learning strategies, but also demonstrate skill deficiencies of an attitudinal or motivational nature. Although some attention has been given to programs that remediate reading skills, cognitive learning strategies, and study skills, little attention has been given to programs that can remediate the strategies and skills related to trainee motivation. The development and implementation of such a program promises to improve the military trainee's ability to positively adjust to the requirements of military technical training through the acquisition of a variety of self-management, personal responsibility, and self-control strategies which can increase trainee motivation. The program also has the potential of reducing the high costs associated with eliminating motivationally deficient trainees after they have completed sizeable portions of technical training.

A program for accomplishing the preceding goals in military technical training, entitled the Motivational Skills Training Package, has been developed and recently evaluated in a contract for the Defense Advanced Research Projects Agency (DARPA). The program includes seven self-instructional, printed modules that have been implemented in an instructor-led, small-group format which provides trainees with the opportunity to practice new strategies and skills, share experiences, and develop feelings of rapport with their instructors and fellow trainees. The evaluation of this program of self-instructional materials augmented by instructor support and group experiences in the Air Force's Precision Measuring Equipment (PME) course indicated that (a) trainees liked the program and found it helpful in both their coursework and personal lives and (b) trainees participating in the program had significantly higher block test scores and lower block test failure rates than control group trainees (McCombs & Dobrovolny, 1982).

Although the evaluation findings with the Motivational Skills Training Package clearly pointed to its success, several research questions remained. One set of questions concerns the issue of the format of this training package and the use of instructors and the group process to facilitate trainee acquisition and maintenance of strategies and skills included in the package. For example, could the cost effectiveness of the program be enhanced by reducing instructor-trainee requirements and/or group interaction requirements through the use of computer-assisted instruction (CAI) for selected portions of the training? An investigation of this question is currently being funded by the Army Research Institute (ARI). To date, CAI enhancements have been developed to augment the printed package and an evaluation study is now underway with military trainees at Ft. Sill's Electronics Communication School. The purpose of this presentation is to describe the design of CAI materials and the implications of the resulting technology for personalizing CAI training. As an introduction to these sections, the next section will briefly describe the content and strategies being taught in the Motivational Skills Training Package.

Motivational Skills Training Package

The content and structure of this motivational package was defined as a result of an in-depth experimental analysis of specific conative, affective, and cognitive skill deficiencies of Air Force trainees in four technical training courses at Lowry Air Force Base (McCombs & Dobrovolny, 1980). This analysis indicated that the primary deficiencies (i.e., characteristics that differentiated effective from ineffective learners) in the conative domain were that poorer students consistently had low motivation to learn, had few military or personal goals, could be classified as being low in maturity, with little self-discipline or the ability to take responsibility for their own learning. In the affective domain, poorer students were generally those with high levels of anxiety toward learning and taking tests, and who lacked effective skills for coping with the demands of technical training. In the cognitive domain, the poorer students were generally those with poor reasoning and comprehension skills, and/or those who lacked effective decision making and problem solving skills in technical or personal areas.

Based on this analysis which integrated relevant literature, student performance data, student and instructor interview results, and individual difference data, seven skill-training modules were defined (McCombs, 1982a, 1982b). The Introduction Module introduces students to the concept of personal responsibility and positive self-control, presents rudimentary techniques for controlling negative attitudes (e.g., use of positive self-talk and imagination), and explains the purpose of the skills training package. The Values Clarification or Self-Knowledge Module explains the role of values and beliefs in helping us define ourselves and what's important to us, stresses each person's responsibility in defining his or her own value system, and helps students explore their values and beliefs in a number of areas. The Career Development Module builds on students' newly acquired self-knowledge and helps them acquire the necessary decision-making skills to explore their career interests and make some career goals and plans. The Goal-Setting Module formalizes the previously learned goal-setting process by first describing the purpose of goals as directing and motivating human behavior, describing a general model for systematically thinking about and setting personal goals, and helping students work through exercises for setting specific long-term and short-term goals. The Effective Communication Module describes techniques and strategies for effectively communicating feelings, wants, and needs and for dealing with stressful interpersonal situations that may impede goal attainment. The Stress Management Module describes the role of perceptions, negative self-talk, and mistaken beliefs in producing stress and presents a number of generalizeable strategies for managing stress. Finally, the Problem Solving Module provides a summary of the skill-training package by pointing out that students have been using a problem solving approach throughout this training and by providing a general model for systematically working through and solving personal and technical training problems.

Design of CAI Enhancements

The objectives of the design of CAI enhancements for the Motivational Skills Training Package were to identify those components of the training that were enhanced by instructor and/or group experiences (McCombs & Lockhart, 1983). An analysis of the instructor's functions in facilitating student acquisition of strategies and skills taught in the package indicated that the instructor was instrumental in establishing a good relationship or personal rapport with the student, in serving as a model of personal responsibility and positive self-control, in helping the student understand what is expected of him or her in the training program, in introducing important concepts in each module in order to provide an advance organizer or meaningful structure for acquiring new concepts and skills, and in reinforcing the value of the skill training for positive self-development by explaining its application and benefits in military experiences. Group process components identified as facilitative included helping students identify with peers and open up to sharing personal feelings and experiences, providing opportunities for shared decision making and friendships, helping students reinforce mastery of new skills by group rehearsal and feedback, and assisting students in behavioral assignments and contracts that promote skill maintenance after the training is over.

Based on this analysis of facilitative instructor and group process functions, elements that could be simulated by specific CAI interactions were identified. In the area of instructor functions, three primary roles that could be provided by the computer were defined: modeler, facilitator, and motivator. To provide these roles, a character named "PC" was created to serve as an instructor/guide and to interactively perform each role by demonstrating the use of new strategies and skills, providing introductory concepts in a meainingful context, and coaching students in the application of new concepts and skills via personalized feedback and encouragement. In the area of group process functions, a set of military trainee characters was created to represent specific personal responsibility/self-control problems related to each module's content area. That is, a male or female character and accompanying problem scenario was defined to exemplify typical student problems with personal responsibility in general, with knowing who they are and what's important to them, with knowing their career interests and goals, with knowing how to set goals, with knowing how to manage stress, with knowing how to communicate effectively, and with knowing how to solve problems. These characters were designed to "grow" as a result of their skill training from their initial inability to solve particular problems to competent problem solvers and self-managers. This transition was designed to occur between PC's guided CAI introductions and CAI practice sessions for each module. CAI segments were therefore designed to incorporate these instructor and group process elements by providing introductions to each printed module as well as practice sessions following student reading of each module.

To achieve the high degree of personalization required to make PC and the seven student characters highly realistic and easily identifiable necessitated the use of a rich training medium that could provide both interactive visual and auditory capabilities. Although videodisc technology is available to provide these capabilities, it was beyond the scope of the contracted effort to interface a videodisc to the project-purchased Apple IIe systems, nor was this level of sophistication deemed necessary to provide the type of personalization desired. A search was thus begun to locate a less costly audio cassette player that could be interfaced to the Apple IIe microcomputer. The search revealed no such product yet on the market and work then began on the design and development of a computer-controlled audio capability.

The resulting capability consists of a specially designed interface card which plugs into the Apple IIe game I/O port. The interface receives pulses from a standard slide-sync audio cassette player. These pulses are used to trigger screen changes and, in turn, to allow the CAI software (in this case, the Apple SuperPILOT Authoring System) to control the on/off function of the audio player. This capability allows for computer control of a linear sequence of audio messages that coincide with particular CAI frame sequences, as well as provides for the personalization of skill training introductions and practices, at about one-eighth the cost of videodisc technology. In this particular application, audio is integrated with screen information in the following ways: (1) CAI screen reinforcement of audio information, (2) audio instruction preceding a CAI segment, (3) audio feedback following a CAI segment, and (4) audio as an integral part of a CAI segment.

Implications of the Computer-Controlled Audio Technology

Preliminary evaluation results at Ft. Sill from the implementation of the computer-controlled audio enhancements to CAI segments which accompany the Motivational Skills Training Package indicate that this technology is being positively received by both students and instructors and is reducing instructor and group interaction requirements. Although final evaluation results comparing the effectiveness of the CAI enhancements with actual instructor-led introductions and group practice sessions are still forthcoming, it is possible to speculate about several important implications of this technology for providing a cost-effective approach to the personalization of CAI training.

First, the benefits of the technology for this type of skill training are that it can increase personalization, allow simulation of instructor and group process functions, introduce novelty to enhance student motivation, encourage students to maintain attention to relevant screen information, boost skill levels regardless of reading ability, reduce reading demands as well as potentially improve reading skills directly, enable training by example (e.g., in the communication skills area), provide consistency in training, and save production time compared to other media. Many of these benefits are applicable to skill training domains outside the motivational area, thus suggesting the application of this technology in the training of cognitive and metacognitive learning strategies (e.g., reasoning and memory skills, self-assessment and self-monitoring skills) and in the training of specific cognitive and procedural skills required in technical training.

Second, in order to fully capitalize on the potential benefits of the technology in other training areas, a programmatic research effort is suggested. The research questions to be addressed in such a program include first assessing the instructional benefits of audio enhancements to CAI in the preceding areas (i.e., does audio improve training effectiveness?). Once the benefits are established for each area, the degree of complexity and/or individualization required to maximize training effectiveness can be addressed (i.e., what degree of complexity/individualization is most beneficial in each training area?).

After answers to the preceding research questions have been obtained, a third area to be explored is the technological advancements that can improve the computer-controlled audio capabilities currently developed. Areas where improvements are needed include the speed of use and ease of use for the user, the complexity of the training strategies and/or individualization that can be supported by the technology, and the ease of audio production possible with more sophisticated addressable and random access capabilities. For example, it may be desirable for some skill training applications to have a forward or backward branching capability, to have increased timing accuracy and precision for screen/audio information sequences, and to increase the audio quality by eliminating pulse sounds. The important thing to keep in mind, however, is that the instructional need for technological advancements be established prior to investing in the necessary development work.

In summary, there appear to be many skill training areas in which a computer-controlled audio capability can enhance both the personalization and individualization of training, thereby also enhancing student motivation. This technology is seen as a more cost effective approach than videodisc technology, particularly because a wide range of training applications do not require the use of both the CAI and video media in conjunction with audio. Further exploration of the technology thus promises to expand the range of options available to us for individualizing with CAI using currently available microcomputers.

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A STUDY OF LEARNING STRATEGIES WITH STUDENTS OF ENGLISH AS A SECOND LANGUAGE

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A STUDY OF LEARNING STRATEGIES WITH STUDENTS OF ENGLISH AS A SECOND LANGUAGE

Research and theory in second language learning strongly suggest that good language learners use a variety of strategies to assist them in gaining command over new language skills. Learning strategies are operations or steps used by a learner that will facilitate the acquisition, storage, or retrieval of information (Dansereau, in press; Rigney, 1978). Language learning strategies, once identified and successfully taught to less competent learners, could have considerable potential for enhancing the development of new language skills. Teachers can play an active and valuable role by training students in the application of learning strategies to different language skills and assisting in the extension of the strategies to new tasks in order to provide learners additional support in acquiring a new language.

Investigations of learning strategies in the second language acquisition literature have focused on describing strategies used by successful second language learners. Research efforts concentrating on the "good language learner" by Rubin (1975) and others (Naiman, Frohlich, Stern, & Todesco, 1978) have identified strategies reported by students or observed in language learning situations that appear to contribute to learning. These efforts demonstrate that students do apply learning strategies while learning a second language, and that these strategies can be described and classified. For example, Rubin proposed a classification scheme that subsumes learning strategies under two broad groupings: strategies that directly affect learning (clarification/verification, monitoring, memorization, guessing/inductive reasoning, deductive reasoning, and practice), and those which contribute indirectly to learning (creating practice opportunities, and using production tricks such as communication strategies). An alternative scheme proposed by Naiman et al. (1978) contained five broad categories of learning strategies: an active task approach, realization of a language as a system, realization of language as a means of communication and interaction, management of affective demands, and monitoring of second language performance.

Studies of learning strategy applications in the literature on cognitive psychology extend beyond purely descriptive studies and concentrate on determining the effects of strategy training for different kinds of tasks and learners. Findings from these studies generally indicate that strategy training is effective in improving the performance of students on a wide range of reading and problem solving tasks (e.g., Brown, Bransford, Ferrara, & Campione, 1983; Chipman, Seigel, and Glaser, in press; Dansereau, in press; Wittrock, Marks, & Doctrow, 1975). One of the more important findings from these studies is the distinction drawn between metacognitive and cognitive learning strategies. Metacognitive strategies involve thinking about the learning process, planning for learning, monitoring of comprehension or production while it is taking place, and self-evaluation of learning after the language activity is completed. Cognitive strategies are more directly related to individual learning tasks and entail direct manipulation or transformation of the learning materials (Brown & Palincsar, 1982). This line of research suggests that transfer of strategy training to new tasks can be maximized by pairing cognitive strategies with appropriate metacognitive strategies. Students without metacognitive approaches are essentially learners without direction or opportunity to review their progress, accomplishments, and future learning directions.

Training research on learning strategies to second languages has been limited almost exclusively to cognitive strategy applications with vocabulary tasks. The typical approach in this research has been either to encourage students to develop their own association linking a vocabulary word with its equivalent in the second language (Cohen & Aphek, 1980; 1981), or to train students to use specific types of linking associations that cue the target word, such as the keyword method (e.g., Atkinson & Raugh, 1975; Levin, in press; Pressley, Levin, Nakamura, Hope, Bisko, & Toye, 1980). Generally, the strategy training is given individually or is provided by special instructional presentations to a group. Dramatic improvements in individually presented vocabulary learning have been reported consistently in these studies.

The present study departs from the prior descriptive and training research on learning strategies in second language acquisition in a number of important ways. Overall, the study included both a descriptive and a training component to refine the strategy definitions and ensure that strategies on which students were trained could be applied reasonably to the learning tasks. The descriptive study extended prior work by classifying strategies as either metacognitive or cognitive and by identifying strategies used with language learning tasks that typically occur either within or outside the classroom. The descriptive study also analyzed strategy uses by beginning and intermediate level second language learners. The training study, most importantly, used natural classroom instruction to introduce applications of learning strategies to a range of language tasks that included listening skills and oral production as well as vocabulary practice. Metacognitive and cognitive strategies were presented either alone or in combination, and were presented with fading cues for strategy use over successive days of practice to determine if the transfer of the strategy occurred to similar activities. Rather than repeat prior demonstrations of associational techniques with vocabulary learning, this study attempted to pair strategies in a novel way based on reported uses during interviews with expert language learners. With the listening and speaking tasks, strategies were selected that were designed to maximize learning gains.

Specifically, the study addressed the following major questions: (1) What is the range of learning strategies in second language learning and acquisition, how can the strategies be classified, and with what frequency do the respective strategy groupings occur for individual language tasks by beginning and intermediate level language leaners; and (2) Can metacognitive and cognitive learning strategies be taught successfully to second language learners in a natural teaching environment with tasks of varying complexity including vocabulary, speaking, and understanding.

The study was conducted in two phases corresponding to each major question. The first phase was descriptive and involved interviews with high school level students of English as a second language (ESL) and their teachers in order to identify the range and type of strategies used by students at beginning and intermediate levels of English proficiency. The second phase of the study was experimental in design and involved random assignment of high school ESL students to one of two treatment groups instructed on strategies associated with vocabulary, listening, and speaking tasks. The treatment groups were a metacognitive/cognitive strategy group, and a cognitive strategy only group. A random control group received the same tasks but with no strategy training.

PHASE I: THE DESCRIPTIVE STUDY

Method

Subjects. The subjects were 70 high school students enrolled in ESL classes and 22 teachers providing instruction to these students. Students participating in the study were classified by their school as either beginning or intermediate level in ESL and were all from Spanish language countries, except for five Vietnamese intermediate level students. Students judged by their ESL teachers to be high in academic ability were selected on the assumption that higher ability students would use a greater range of strategies. The teachers who volunteered to participate in the study all held secondary teaching certificates and had a minimum of two years of teaching experience. Although most were ESL teachers, content area teachers also participated to identify learning strategies used by students after they began participation in mainstream classes.

Procedures. Students were interviewed in 19 small groups of 3-5 and requested to supply information on learning strategy uses with specific language learning activities. The interview was open-ended but followed a list of learning activities as a guide: pronunciation, oral grammar drills, vocabulary, following directions, listening comprehension, presenting an oral report, social communication outside the classroom, and operational communication outside the classroom (job interviews, answering the telephone, etc.). Students were asked to identify special techniques, helpful hints, or tricks they used in learning each activity in turn.

interviews were conducted in Spanish were necessary with beginning level students but were otherwise conducted in English. Teachers were interviewed individually and requested to supply information on their students' learning strategy uses with the same specific language learning tasks. In addition, observations were conducted in classrooms to determine whether learning strategy use could be observed in overt student behavior.

Results

Students in the 19 groups interviewed identified a total of 638 different strategy applications for a total of 33.6 strategies per interview. Teachers identified 25.4 individual learning strategies per interview. In general, the strategies identified in teacher interviews tended to be teaching strategies since most teachers were unacquainted with learning strategies. The classroom observations yielded only 3.7 strategies per observation. Because the teacher interviews were of questionable value, and the observations yielded such sparse data, the remaining discussion of results is based on student interviews only.

The 638 strategies identified by students were classified into 26 distinct strategies based on strategy definitions that appeared in a comprehensive literature review (O'Mally, Russo, & Chamot, 1983) and new strategy definitions that were suggested from student interviews. The 26 strategies were then differentiated into 9 metacognitive and 17 cognitive strategies using definitions prevalent in the cognitive psychology literature (Brown & Palincsar, 1982). The resultant strategy definitions are presented in Table 1. Additional analyses of the results were based on the reported frequency of metacognitive and cognitive strategy usage by student proficiency level, by task, and aggregated across tasks.

TABLE 1

Learning Strategy Definitions

LEARNING STRATEGY	DESCRIPTION
A. Metacognitive Strategies	
Advance Organizers	Making a general but comprehensive preview of the organizing concept or principle in an anticipated learning activity.
Directed Attention	Deciding in advance to attend in general to a learning task and to ignore irrelevant distractors.
Selective Attention	Deciding in advance to attend to specific aspects of language input or situational details that will cue the retention of language input.
Self-Management	Understanding the conditions that help one learn and arranging for the presence of those conditions.
Functional Planning	Hypothesizing, identifying, and organizing functional components necessary to carry out an upcoming language task.
Self-monitoring	Correcting one's speech for accuracy in pronunciation, grammar, vocabulary, or for appropriateness related to the setting or to the people who are present.
Delayed Production	Consciously deciding to postpone speaking to learn initially through listening comprehension.
Self-evaluation	Checking the outcomes of one's own language learning against an internal measure of completeness and accuracy.
Self-reinforcement	Arranging rewards for oneself when a language learning activitiy has been accomplished successfully.

B. Cognitive Strategies

Repetition	Imitating a language model, including overt practice and silent rehearsal.
Resourcing	Using target language reference materials.
Directed physical response	Relating new information to physical actions, as with directives.
Translation	Using the first language as a base for understanding and/or producing the second language.
Grouping	Reordering or reclassifying and perhaps labeling the material to be learned based on common attributes.
Notetaking	Writing down the main idea, important points, outline, or summary of information presented orally or in writing.
Deduction	Consciously applying rules to produce or understand the second language.
Recombination	Constructing a meaningful sentence or larger language sequence by combining known elements in a new way.
Imagery	Relating new information to visual concepts in memory via familiar, easily retrievable visualizations, phrases, or locations.
Auditory representation	Retention of the sound or similar sound for a word, phrase, or longer language sequence.
Key word	Remembering a new word in the second language by (1) identifying a familiar word in the first language that sounds like or otherwise resembles the new word, and (2) generating easily recalled images of some relationship between the two words that cues the meaning of the new word.
Contextualization	Placing a word or phrase in a meaningful language sequence.
Elaboration	Relating new information to other concepts in memory.

Transfer	Using previously acquired linguistic and/or conceptual knowledge to facilitate a new language learning task.
Inferencing	Using available information to guess meanings of new items, predict outcomes, or fill in missing information.
Cooperation	Working with one or more peers to obtain feedback, pool information, or model a language activity.
Question for clarification	Asking a teacher or other native speaker for repetition, paraphrasing, explanation and/or examples.

Metacognitive strategies accounted for approximately 30 percent of all strategy use, as shown in Table 2. Results presented in Table 3 indicate that intermediate level students tended to use self-management, advanced preparation, and self-monitoring, whereas beginning level students relied more on selective attention and delayed production. Metacognitive strategies were rarely reported in direct combination with cognitive strategies (about 7.0 percent), although strategy combinations were reported overall in 20.9 percent of all strategies. Cognitive strategies accounted for the majority of strategy uses, as shown in Table 4. Students at both levels of proficiency applied such regularly used strategies as repetition, note-taking, questioning for clarification, and cooperation. However, translation and imagery were used less often by intermediate than beginning students. Intermediate level students preferred strategies such as contexualization, resourcing, and transfer.

Applications of strategies varied depending on the learning activity, as shown in Table 5. By far the most strategies were reported for vocabulary learning, virtually twice as many as for other activities such as making an oral presentation and listening, and substantially more than for operational communication and analysis in listening comprehension. The other activity for which students reported numerous strategies was pronunciation. Thus, strategies were most frequently mentioned with relatively less conceptually complex activities such as vocabulary in comparison to the more complex activities such as listening and making an oral presentation. Part of this is no doubt due to the fact that students are seldom provided opportunities in classrooms for performing the more complex language activities.

Table 2

Number of Metacognitive and Cognitive Strategies Used by Students in Acquiring English as a Second Language

Type of Learning Strategy	Level of English Proficiency: Beginning Level N	%	Intermediate Level N	%	Total N	%
Metacognitive	112	27.4	80	34.9	192	30.0
Cognitive	297	72.6	149	65.1	446	69.9
Total	409	100.0	229	100.0	638	100.0

Table 3

Number of Metacognitive Learning Strategy Uses by Beginning and Intermediate Level Students in Acquiring English as a Second Language

Metacognitive Learning Strategies	English Proficiency: Beginning Level N	%	Intermediate Level N	%	Total N	%
Planning						
Self-management	22	19.6	18	22.5	40	20.8
Advance preparation	24	21.4	20	25.0	44	22.9
Advance organizers	1	0.9	0	0.0	1	0.5
Directed attention	15	13.4	10	12.5	25	13.0
Selective attention	25	22.3	13	16.3	38	19.8
Delayed production	8	7.1	2	2.5	10	5.2
Subtotal	95	84.8	63	78.8	158	82.3
Monitoring						
Self-monitoring	8	7.1	10	12.5	18	9.4
Evaluation						
Self-evaluation	9	8.0	7	8.8	16	8.3
Self-reinforcement	0	0.0	0	0.0	0	0.0
Total	112	100.0	80	100.0	192	100.0

Table 4

Number of Cognitive Learning Strategy Uses by Beginning and Intermediate Level Students in Acquiring English as a Second Language

Cognitive Learning Strategies	English Proficiency: Beginning Level N	%	Intermediate Level N	%	Total N	%
Directed physical resp.	0	0.0	0	0.0	0	0.0
Key word	0	0.0	1	0.7	1	0.2
Deduction	1	0.3	1	0.7	2	0.4
Recombination	1	0.3	1	0.7	2	0.4
Grouping	1	0.3	3	2.0	4	0.9
Auditory representation	3	1.0	2	1.3	5	1.1
Elaboration	9	3.0	2	1.3	11	2.5
Contextualization	7	2.4	11	7.4	18	4.0
Resourcing	11	3.7	7	4.7	18	4.0
Inferencing	21	7.1	11	7.4	32	7.2
Transfer	23	7.7	12	8.1	35	7.8
Translation	29	9.8	9	6.0	38	8.5
Imagery	31	10.4	11	7.4	42	9.4
Cooperation	34	11.4	18	12.1	52	11.7
Question for clarif.	38	12.8	19	12.8	57	12.8
Note-taking	43	14.5	20	13.4	63	14.1
Repetition	45	15.2	21	14.1	66	14.8
Total	297	100.0	149	100.0	446	100.0

Table 5

Number of Learning Strategy Uses Among Beginning and Intermediate Level Students for Different Learning Activities

Learning Activity	English Proficiency: Beginning Level N	%	Intermediate Level N	%	Total N	%
Listening Comp:Inference	34	8.3	12	5.2	46	7.2
Oral Presentation	22	5.4	30	13.1	52	8.2
Operational Communicat.	46	11.2	17	7.4	63	9.9
Instructions	42	10.3	25	10.9	67	10.5
Social Communication	42	10.3	28	12.2	70	11.0
Listening Comp:Analyzing	49	12.0	24	10.5	73	11.4
Oral Drills	52	12.7	21	9.2	73	11.4
Pronunciation	51	12.5	37	16.2	88	13.8
Vocabulary Learning	71	17.4	35	15.3	106	16.6
Total	409	100.0%	229	100.0%	638	100.0%

These findings suggest that students rarely use strategies with more complex language learning tasks. However, about one in five strategy uses involved two or more strategies in combination for both beginning and intermediate level students. Further, the use of metacognitive strategies indicates that students were reflecting on and analyzing the process of language learning. The findings also indicate that teachers have little or no familiarity with learning strategies and need more information to become a good source of strategy instruction.

PHASE II: STRATEGY TRAINING IN SECOND LANGUAGE LEARNING

The results of Phase I suggest that special instruction on strategy applications with language learning tasks should be useful for higher level language activities such as listening and speaking. The results also suggest that students use interesting strategy combinations requiring active manipulation of input that have considerable potential to contribute to language learning. The following discussion identifies metacognitive and cognitive strategy combinations possible with vocabulary, listening, and speaking tasks and presents the rationale for strategies used in the training phase of this study.

In vocabulary tasks, there is reason to believe that grouping and imagery combined would provide a useful mechanism for recalling new terms. Research evidence indicates that grouped objects in one's native language are easier to remember than lists of objects presented individually (Weinstein, 1978), and considerable data support the use of imagery in forming second language associations, as reviewed above. To the expert second language learner, grouping the objects provides a context which can be imagined -- such as objects used in sports or in sailing -- thereby permitting multiple associations between a single group label and the individual objects in the group, apparently faciliating recall of the second language labels for the objects (Stewner-Manzanares, 1983). By combining a metacognitive strategy such as self-evaluation with the vocabulary task, even more effective learning could result due to the added opportunities for review and analysis of the cognitive strategy learning effects.

Listening tasks have proven responsive to strategy training in first languages and there would be every reason to believe them to be equally responsive to strategy training in second languages. One cognitive strategy that has proven effective with first language listening skills is note-taking (Dansereau, Atckinson, Long, & McDonald, 1974; DiVesta & Gray, 1972; Wieland & Kingsbury, 1979). One of the ways to enhance note-taking skills with a metacognitive strategy would be to provide students with specific types of information to attend to in lectures, i.e., to use selective attention for specific linguistic terms. Linguistics items often used for emphasis in a lecture or that reflect the organization of the lecture are appropriate for this purpose, e.g., "first," "the most important point is...," and "in conclusion." It is possible that note-taking skills can be enhanced even further by encouraging students to cooperate in identifying omissions, errors, or in interpreting information worth remembering from the lecture.

Strategies to assist second language students in learning how to speak more effectively in an academic setting should be effective if they provide a way to analyze essential purposes or functions in the communication, and generate appropriate language to accomplish those functions. This type of functional analysis is similar in some respects to having a schema (Dansereau, in press) or an advanced organizer (Ausubel, 1960; 1978) in that a set of basic superordinate principles is available to serve as an organizing framework for new information. The student must first analyze the functional requirements of the task, e.g., what must be accomplished. Then they must examine their capability to provide specific language fulfulling those requirements and identify language elements needed beyond those presently available in their language repertoire. After retreiving the needed language elements, students should be able to accomplish all the functions required in a language task. The main additional requirement would be an opportunity to rehearse the language and receive feedback in a cooperative setting, using the superordinate principles to organize the communication, and appropriate markers to signal the shift from one organizing function to the next or to highlight other information.

The intent of the training study was to determine whether the unique combinations of strategies selected for the three language tasks would facilitate learning. Students presented metacognitive and cognitive strategies together were predicted to perform better than the group receiving cognitive strategies only, and these were expected to perform better than controls. The use of language tasks at different levels of complexity had the advantage or representing a realistic range of learning tasks from second language classrooms. Higher order tasks were also included to evaluate recent claims that classroom instruction is ineffective for the type of language "acquisition" tasks required for effective communication (Bialystok, 1979; 1983; Krashen, 1982). If it is possible to demonstrate gains on listening and speaking tasks with relatively brief learning strategy instruction, the validity of these claims should be questioned. Finally, a natural teaching setting was used to increase the likelihood that the results would have immediate application for instruction.

Method

Subjects. The subjects were 75 high school students enrolled in ESL classes during the Fall 1983 semester in an Eastern suburban high school. The students were all intermediate level, were of both sexes, and were about a third each from Spanish language countries, South East Asian countries, or a mix of other language backgrounds. Intermediate level proficiency was defined in all participating schools as students with limited proficiency in understanding and speaking English, and with little or no skill in reading and writing English.

Procedures. Students were randomly assigned to one of three instructional groups roughly proportional to ethnicity and sex within each of three schools. The treatments were as follows: a metacognitive group, which received training in the use of one metacognitive strategy and up to two cognitive strategies, depending on the language task; a cognitive group, which received only the cognitive strategies; and a control group, which was instructed to work on the tasks as they ordinarily would. Three project staff alternated presenting the three treatment conditions at the three school participating in the study to control for teacher effects. An overview of the treatment conditions is presented in Table 6.

Students received instruction and practice in the use of learning strategies 50 minutes daily for 8 days plus a full 50-minute period each for pretesting and posttesting. On any single day, students typically received two of the following three language learning activities: vocabulary, listening, or speaking. For the treatment groups, the same learning strategies were always repeated with each language activity, although new content was presented each time a language activity recurred. Students therefore could practice strategy applications with new materials. Explicit directions and cues for using the strategies were faded on successive days of treatment for each activity, until at the posttest only a reminder was given to use the same strategies they had rehearsed before. A detailed description of each language learning task and related treatment conditions is provided below.

Vocabulary Instruction. Lists of 20 new vocabulary words were presented in two cycles of two successive days each for a total of four days during the 8 days of instruction. The two cycles were essentially identical in presentation except for the content. Five commonly missed words from the first day of each cycle were repeated once. The vocabulary presentation lasted about 6 minutes each day for a total of 24 minutes exposure to practice with learning strategies. A short test followed each practice session. For the pretest, there was no prior training on the vocabulary words, whereas on the posttest, students were presented words on which they had received prior training but were given no opportunity to review and only a brief reminder to use the strategies. Pretests, posttests, and interim tests were a combination of recognition and recall items.

TABLE 6

Language Learning Activities and Learning Strategies
Presented for Each Treatment Condition

Treatment Condition	Strategy Type	Language Learning Activities		
		Vocabulary	Listening	Speaking
Metacognitive	Metacognitive Cognitive	Self-evaluation Grouping Imagery	Selective attention Note-taking Cooperation	Functional planning Cooperation
Cognitive	Cognitive only	Grouping Imagery	Note-taking Cooperation	Cooperation
Control	Activity only with no strategy training	———	———	———

The metacognitive group received instruction on the use of a metacognitive strategy (self-evaluation) and two cognitive strategies (grouping and imagery) accompanying their vocabulary presentation. For the grouping strategy, students were taught that a long list of words often can be separated into parts that share semantic or other features. Students were instructed to scan through a list and group the words that to them had common features. For the imagery strategy, students were instructed to close their eyes and vividly create a mental image that incorporated all of the key words they had grouped together. Recall was to be facilitated by the student imagining that they were reentering the scene and extracting the required word. The metacognitive strategy, self-evaluation, was implemented by having students keep journals which recorded the number of words they had learned that day, the words they found to be difficult, the method they used to remember the words, and a comment about their progress in learning vocabulary.

Students assigned to the cognitive group received instruction in grouping and imagery that was identical to that given in the metacognitive group. What differentiated this group's approach to vocabulary learning was the absence of the metacognitive self-evaluation.

The control group received no strategy instruction but instead were told to learn the words in whatever way they normally did. The time they were given to study the words equaled the time the other groups spent grouping and making images.

Listening Instruction. The listening task that students were requested to perform was to remember information presented in four, five-minute videotapes on academic subjects such as history or geography. The videotapes were designed to simulate a lecture experience the students might encounter in school. A short listening comprehension test following each lecture contained items designed to assess Bloom's knowledge, comprehension, and analysis levels. Videotapes were presented sequentially in order of judged difficulty of the content based on the pilot test. Two different videotapes were used for pretesting and posttesting. All pretests, posttests, and interim assessments were multiple choice recognition items.

The metacognitive group received instruction on one metacognitive strategy (selective attention) and two cognitive strategies (note-taking and cooperation). For selective attention, students were instructed to listen selectively for key words typically used in lectures to present an overview, a main topic, main points, examples, and a conclusion or summary. The videotapes had been designed specifically to include these and other markers. Students were instructed on note-taking by means of a T-list in which main points are entered on the left side of a page and corresponding examples or details are entered on the right. Thus, by selectively attending to phrases or keywords that often preceded important lecture points, students were able to facilitate note-taking. As a final step, students were instructed to use cooperation as a strategy to verify the accuracy of their notes, enabling them to fill in gaps in information or clarify areas of confusion by using their peers as a resource.

The strategies taught to the cognitive group for the listening activity were note-taking and cooperation. Instruction in these strategies was identical to that received by the metacognitive group. However, these students did not receive any information regarding selective attention or markers that often occur in lectures to highlight important information.

Students in the control group received no strategy instruction. They were simply told to listen to the videotapes and do whatever they normally did to help them understand and remember a lecture.

Speaking Instruction. Students were asked to present a brief oral report on one of six subjects that had personal or cultural significance. Four separate oral presentations were made on four separate days. Report preparation was completed in class to ensure comparable time on task across treatment groups. In presenting the report, students sat in a small group and spoke or read into a tape recorder from written notes. Taped oral presentations at pretest and posttest were scored blind by five judges who rated the speeches on a 1-5 scale reflecting delivery (volume and pace), appropriateness (choice of words and phrases for a class presentation), accuracy (phonological, syntactic, and semantic), and organization (coherence and cohesion). Interjudge reliability was about 85 percent.

The metacognitive group received instruction on one metacognitive strategy, functional planning, and one cognitive strategy, cooperation. Functional planning involves having the learner analyze the requirements of a communication task, and determine if he or she has the language skills necessary to fulfill those requirements. During instruction on the use of this strategy, students were led by the teacher through an analysis of the purposes language serves in a oral report. For example, the topic should be introduced and a brief overview presented, followed by the main points and details, and finally by a conclusion and summary. Throughout, use of relevant markers was encouraged to highlight important information and transitions. Having familiarity with what needs to be communicated once the main topic idea has been selected, students could then examine their language repertoires to determine whether they possessed the language required for the communication, and proceed to learn new language as required for the task. For the cooperation strategy, students practiced presenting their reports to a small group of other students. The other students were responsible for providing corrective feedback on volume, pace, organization, and comprehensibility. Using the group's advice after one practice session, the students then tape recorded the report.

The cognitive group received instruction using cooperation as a strategy for improving their reports. They were not offered any other strategies in conjunction with the speaking activity.

The control group received no strategy instruction but was given the list of topic possibilities and told to prepare an oral report on the topic of their choice in whatever manner they normally prepared for such an activity. This group also tape recorded their reports in the presence of a small group of students during practice sessions, but was not instructed to provide systematic feedback to their peers.

Results

Results are presented comparing the treatment groups on the vocabulary, listening, and speaking posttests using an analysis of covariance with the pretest as covariate. Results also show covariance analyses for the four daily listening tests, again with the pretest as a covariate. These data are shown in Table 7.

For the vocabulary test, it is evident that the results of training are not statistically significant, shown by the p-value of .349, and that the mean score for the control group is slightly higher than the mean for the

Table 7

The Effect of Learning Strategy Training on Selected Language Skills Controlling for Pretest Score

Variable	Metacognitive (n=27) Adj Mn	SD	Cognitive (n=26) Adj Mn	SD	Control (n=22) Adj Mn	SD	p-value	R^2
Posttests								
Vocabulary	22.66	4.76	21.41	4.23	23.21	4.90	.349	.17
Listening	8.25	2.12	8.18	2.00	7.30	2.31	.162	.30
Speaking	3.60	N/A	3.04	N/A	2.88	N/A	.008	.20

N/A = Not available

Variable	Metacognitive Adj Mn	SD	Cognitive Adj Mn	SD	Control Adj Mn	SD	p-value	R^2
Daily Tests on Listening								
Listening 1	6.03	1.29	5.91	1.45	5.46	1.47	.096	.26
Listening 2	6.45	1.48	6.54	1.22	5.45	1.50	.004	.36
Listening 3	6.27	2.33	6.95	1.61	5.17	2.31	.043	.29
Listening 4	5.25	1.32	5.10	1.68	5.09	1.57	.626	.10

treatment groups. Students trained to use learning strategies not only had difficulty in implementing the strategy, but sometimes resisted using them and were somewhat less efficient in their learning than students using their customary strategies. This is consistent with the experiences of other investigators who have tried to train students to use strategies that compete with techniques to which the students have become accustomed (Brown, Bransford, Ferarra, & Campione, 1983). One explanation for these results is that the key to enhancing memory for vocabulary, as Levin (in press) suggests, may be exclusively one-to-one verbal associations rather than in imagery. However, it could also be that combining grouping and imagery is sufficiently difficult for most persons that only individuals with high imagery can make use of the unified strategy, suggesting differences in cognitive styles. The difficulty of using the combined strategy might make it advisable to present the training individually, as has been discussed with other associational strategies (Hall, Wilson, & Patterson, 1981; Levin, Pressley, McCormick, Miller, & Shriberg, 1979; Pressley, Levin, Digdon, Bryante, McGivern, & Ray, 1982). Analysis of the daily vocabulary tests did not show any significant differences between the treatment groups.

Analyses of posttest scores on listening approached but failed to reach significance, although the scores fell in the predicted direction. To explore this finding further, analyses of the daily tests on listening are presented in the lower portion of Table 7. To understand these results, it is important to know that Listening Tests 1 and 2 had 8 items, and Listening Tests 3 and 4 had 9 items. In contrast, there were 13 items used on the posttest. The approximate difficulty level of the daily tests can be seen from inspecting the mean scores for the control group, bearing in mind the differences in numbers of items on which these scores are based. The pattern is one of increasing difficulty across successive days. It is evident from the results presented in Table 7 that significant effects were obtained on Listening Test 1 beyond the .10 level, on Listening Test 2 beyond the .01 level, and on Listening Test 3 beyond the .05 level. In each case, the treatment groups significantly outperformed the control group, although for Test 2 and 3 the levels for the metacognitive and cognitive groups were reversed from the predicted direction. There are at least two possible explanations for the poor performance of the treatment groups on the fourth listening test and on the posttest. One is that the cues were faded too quickly so that students failed to use the strategies on which they had been trained. A second is that there was an interaction between the strategy effectiveness and the difficulty of the task. Additional analyses are underway to explore these possibilities.

Posttest analyses for the speaking test were significant in the predicted direction beyond the .01 level. The adjusted mean scores shown can be converted into a 1-5 scale of the type used by the Foreign Service Institute to reveal that the metacognitive students scored on the average close to the 2+ level, whereas the control group scores were just below the 2 level. This amount of difference represents a substantial increment in language skills over the control group. The principle differences between a 2 level and a 2+ level on the scoring system we used were that a 2+ person has more organization, as suggested by clear subordination and sequencing of parts of the report, and greater comprehensibility.

DISCUSSION

Phase One of this study revealed that both beginning and intermediate level high school ESL students were able to describe their use of a wide range of learning strategies with specific language tasks. These strategies proved readily classifiable using the distinction between metacognitive and cognitive strategies. Analyses of the ESL student interview data using this distinction revealed that there were nearly twice as many cognitive as metacognitive strategies, and that students in general reported using the cognitive strategies far more regularly than the metacognitive strategies. There were nevertheless differences between beginning and intermediate level ESL students in the types of specific strategies of either type that were used. Also, roughly one strategy in five involved two or more strategies in combination, although generally these were cognitive strategies [redacted] rather than metacognitive and cognitive strategies together. Analyses of the strategy combinations is still underway, but selected combinations were sufficiently interesting to warrant using multiple strategies during the training phase of the study.

Analyses of the effects of metacognitive and cognitive learning strategies training with second language learners in a natural classroom setting showed mixed findings depending on the language strategies and task. Our data suggest that there is a tendency for students trained to use grouping and imagery on a vocabulary task, with or without self-evaluation, to learn less effectively than a control group using its customary approach to vocabulary learning. A number of factors could account for the poorer performance of the groups trained to use strategies, including the failure to use a specific verbal mediator linking the words to be associated, or an interaction between the imagery strategy and cognitive style of the learners. Informal observations indicated that Asian students, who otherwise were highly efficient rote learners of vocabulary lists, may have been particularly negatively affected by the introduction of grouping and imagery. Further, as noted in the descriptive study, vocabulary learning is an activity on which many students already have habitual strategies. We believe that more detailed interviews with expert learners as a prelude to individual strategy training are warranted before additional efforts are made to train students to use this combined strategy approach in group settings.

In the listening skills tasks, there were indications that the difficulty of the task or the explicitness of directions to perform the strategies may be both important determinants of performance. Students presented a listening task that is too difficult may find little assistance in using learning strategies because the initial communication is so unfamiliar that comprehension and learning fail to occur. The transfer of strategies which did occur to new learning activities may be extremely sensitive, requiring continued prompts and structured directions until the strategies become autonomous. There was little evidence that metacognitive strategies were uniquely instrumental in aiding this transfer. However, the metacognitive strategy used--selective attention, a planning strategy--was not the type that would afford students the opportunity to reflect on the learning, analyze the relevance of strategy applications, and forsee the potential for future use of strategies with similar activities. This suggests that metacognitive strategies should be selected carefully to allow for both planning and evaluation in learning.

Skills in speaking a second language were clearly improved through learning strategies training relative to a control group. The metacognitive group mean scores were higher than the cognitive group and these in turn were higher than the controls. Students were extremely adept in learning and applying functional planning, the metacognitive strategy, and gained in judged organization and comprehensibility. The cognitive strategy, cooperation, involved an evaluation process which students conveyed to each other through feedback on their speeches. The fact that evaluation as used in this study was represented in the form of cooperation indicates that metacognitive components were involved. This could have contributed to the improved performance of the cognitive group relative to the controls. In the cognitive group, however, the feedback was not linked to organizational elements entailed in planning, as was true in the metacognitive group. Thus, both a planning and an evaluation strategy seem advisable in future oral production activities.

The successful demonstration of strategies training in a natural teaching environment with second language listening and speaking tasks indicates that classroom instruction of learning strategies with higher level language skills can facilitate learning. Given these findings, suggestions that classrooms are effective primarily for vocabulary and grammar but not for communication skills should be questioned. The results do not show dramatic increases in scores relative to controls but, with relatively brief instruction, nevertheless produced statistically significant findings that would be accepted as educationally significant in terms of standard deviations units on the outcome measures. This should be meaningful to teachers, who have students for a much longer period of time than was used for presenting the treatment in this study. We suggest that future research be directed to refining the strategy training approaches, to targeting evaluative metacognitive strategies with specific language tasks, and to strengthening the effects of the training on student learning and strategy transfer.

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Teaching Reading Comprehension to Adults in Basic Skills Courses

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Teaching Reading Comprehension to Adults in Basic Skills Courses

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Over the last decade of research in cognition, human learning, and teaching, my students and I have conducted a series of studies whose data consistently indicate that reading with comprehension is a generative process. From these research studies we have learned several important lessons about the teaching of reading and about the nature, variety, and development of the generative processes of comprehension.

In several experiments (e.g., Doctorow, Wittrock, & Marks, 1978; Linden & Wittrock, 1981; Wittrock, Marks, & Doctorow, 1975) we have consistently improved reading comprehension among public elementary secondary school students by 25 to 100% with our instructional strategies. In these studies, time across the control and experimental treatments was always held constant, a variety of commonly employed commercially published reading materials was used, and our learning and instructional strategies were practical for use in the classroom.

In several studies we asked the learners to compose and to write a summary sentence for each paragraph they read. In other experiments we asked them to write paragraph headings, to draw simple diagrams, to relate the parts of the text to one another, to relate the text to their knowledge, or to think of and to write examples of the text, as they read it. These generative learning strategies regularly enhanced reading comprehension or retention by sizable amounts, without increasing the time given to the reading.

In one study of reading comprehension among sixth graders (Marks, Doctorow, & Wittrock, 1974), we hypothesized and found that sentence comprehension was markedly improved by substituting one high-frequency synonym per sentence for its low-frequency counterpart in the commercially published text. The effect occurred across all three levels of reading ability and with all different stories and tests used in the experiments.

In another study (Wittrock, Marks, & Doctorow, 1975) of reading as a generative process, we predicted and found that a familiar story context sizably increased reading comprehension and the learning of undefined new vocabulary words. The students apparently generated the meanings of the words from the familiar story context, in accord with the model of generative learning. Again, the results occurred with all three levels of reading ability and with all stories and tests used in the experiment.

In a study of the effects of generating pictures upon vocabulary, Bull and Wittrock (1973) found that the drawing of simple diagrams by fifth graders facilitated their learning and retaining of the meanings of the vocabulary words, when compared with the copying of the verbal definitions of the words. When children are mature enough to construct imaginal representations of the words they read, these representations can facilitate their vocabulary learning.

A related effect occurs with verbal generations, and the size of the effect is sometimes large. In one set of three classroom experiments, Doctorow, Wittrock, and Marks (1978) asked 400 sixth graders to read stories from commercially published reading materials. Some groups of children were also given headings for the paragraphs of the stories. Other groups were asked to generate summary sentences for the paragraphs after they read them. Other groups were given paragraph headings and were asked to generate summary sentences for each paragraph. The model of generative learning predicted that the groups given the paragraph headings and asked to construct summaries should produce the highest comprehension followed, in turn, by the groups asked to generate summaries, the groups given the paragraph headings, and last, the control groups given only the same commercially published stories read by all the groups. The data closely agreed with these predictions. The group given the generative instructions and the paragraph headings doubled the comprehension and retention attained by the control groups. Time to learn was held constant across all experimental and control groups.

Linden and Wittrock (1981) developed an instructional sequence designed to teach reading comprehension according to Wittrock's model of generative learning. In the study, 58 ten-year-old school children were taught to construct imaginal and verbal elaborations as they read texts in their reading classes. Compared with a control group of school children given the same amount of time to learn and given the same texts, the verbal and imaginal generations constructed by the children in the experimental group increased reading comprehension.

From these classroom studies there is support for the hypothesis that reading comprehension and retention can be improved by inducing low- or high-ability learners to generate relations among the parts of the text or between the text and their experience and knowledge. Either the characteristics of the text, such as the frequency value of the words, its headings, or its familiarity, or the generative activities children are asked to perform upon it, such as to summarize it, construct a heading for it, or draw a picture of it, can be used to induce children to construct meaning as they read. The result is often an enhancement of reading comprehension and retention.

To facilitate reading comprehension, the model of generative reading implies that we stimulate the learners to construct relations among the parts of the text and between the text, on the one hand, and the reader's knowledge and experience on the other hand. To faciliate comprehension, these constructed relations should have the following characteristics. First, they must be relations which the reader would not equally well construct without our intervention. Second, the relations must not trivialize comprehension. They must involve more than the learner's short-term memory and more than the surface structure of the text. They should involve the learner's long-term memory of experience, or the learner's knowledge, or both of these. They should involve the text's deep significance in the construction of one or more of its legitimate meanings.

We can stimulate the construction of relations having these two characteristics by designing the reading materials appropriately for the interests and abilities of the learners and by directing them to generate meaning for the text as they read. Whether we should make the relevant relations explicit or ask the learners to construct them is not the central issue. In either case, so long as we do not trivialize learning, the learners can and should be actively engaged in the understanding of the relations and in the text's meaning. When the learners can attend to the task and can construct the text's meaning or meanings, then they should be given the instructions and the directions appropriate for their developmental level, knowledge, and background. When the learners cannot adequately attend to the task or cannot construct important meanings from it, then they should be given the relations to be learned, which they can elaborate upon in an attempt to understand and to remember them.

These concepts were explored in the series of studies reported in the following paragraphs. The series began with a pilot study in which the first drafts of three sets of curriculum materials were used to teach three different strategies of reading comprehension. The series continued with a study using revised curriculum materials designed to teach different generative reading comprehension strategies. The last study presented the third revision in both curricular materials and in reading comprehension strategies. Army enlisted personnel in Basic Skills classes were the sole participants in all three studies.

Pilot Study

Design. The participants were assigned individually at random to three reading comprehension self-instructional treatments. The dependent measure was a reading comprehension posttest.

Subjects. The participants were 25 Army enlisted personnel enrolled in two Basic Skills Education Program classes taught at an Army Base in California.

Treatments and materials. The experimental materials consisted of three self-instructional booklets. One booklet was used in each treatment. The first treatment instructed learners in the use of generative verbal comprehension strategies. The second treatment instructed learners in the use of generative verbal comprehension strategies and metacognitive monitoring strategies. The third treatment provided learners with the practice readings only. Practice readings included technical military material from Army manuals and excerpts from newspapers and short stories. The practice readings were held constant across all three treatments.

The Generative Verbal Strategies treatment concentrated on instructing learners to find the main ideas and topic sentences and to construct metaphors and analogies, orders, sequences, hierarchy diagrams, and summaries. The first part of the 98-page booklet included 48 pages of instruction in the various skills. Each of the skills was taught as a discrete unit with accompanying examples of skill application followed by practice readings and exercises. The second part of the booklet was composed of 50 pages of practice readings and exercises designed to demonstrate how certain skills could be used in conjunction with others. Instruction and practice were self-paced.

The second treatment, the Metacognitive and Generative Verbal Strategies, involved the same instruction in skills acquisition and utilization as the Generative Verbal Strategies booklet, but also included training in metacognitive skills for self-monitoring procedures. All practice readings and exercises were identical to the first treatment, with the exception that all practice exercises also included a series of "reading manager" questions. Because of the addition of the metacognitive skills instructional unit and the expanded response categories in the practice section, the booklet for the second treatment was 125 pages in length.

The third treatment, the Control Treatment, which was presented in a booklet 48-pages in length, consisted of only the readings used in the first and second treatments. The only instructions in the booklet asked students to read the passages.

Procedures. Prior to individual random assignment of learners to treatments, the students were given a 45-minute reading comprehension test developed for this experiment. Questions in this test were typical of most standardized tests of reading comprehension, involving both literal and inferential reading comprehension multiple-choice items based on one or two paragraph readings. A total of 35 items was used in the test.

Immediately after the pretest, and for the eight class days following it, students were given approximately 45 minutes to an hour per day to work on the treatment booklet they had been assigned. Instruction by the Basic Skills teacher was limited to answering questions about procedures. Teachers were instructed not to provide instruction beyond what was included in the booklets.

On the 10th class day, students were given a posttest, an identical copy of the pretest, except for the addition of questions following each reading that asked participants to record what skill(s) they used in answering the questions. Following the administration of the posttest, participants were asked to fill out a two-page questionnaire which included questions on ease or difficulty level of instruction and readings. The questionnaire also asked participants to evaluate their performance and understanding of the materials. Lastly, the questionnaire asked participants to evaluate how well, or poorly, they had learned each of the skills.

Results

The pilot study provided significant information for the extensive revisions implemented for the first study. It was clear through both personal interviews and the qualitative data generated in the questionnaire that the self-instructional format of the booklets would not best serve the needs of the soldiers in the Basic Skills program. Much-needed classroom interaction among learners and between the teacher and the students was hindered by this approach. The soldiers generally felt ineffective in their learning efforts because of the self-instructional model. Teachers also felt encumbered by this change in classroom format.

Some of the soldiers found the booklets overwhelming in length, which created initial negative feelings toward the materials. Few participants were able to complete their treatments in the allotted time. In addition, the reading and vocabulary levels of the treatments were too difficult for a number of the participants.

There were mixed reactions about the relative usefulness of the comprehension strategies. Most positive responses favored the "Topic Sentences," "Summaries," and "Getting the Main Idea" sections, although several soldiers commented favorably about the "Analogy and Metaphor" strategies. Many soldiers perceived the learning of particular strategies as informative and beneficial to their reading proficiency.

Though this small sample size did not permit the effective use of statistical analyses, gain in comprehension occurred in some treatments. One basic skills class showed sizable gains in both the Generative Verbal Strategies and in the Metacognitive and Generative Verbal Strategies treatments, while the other BSEP class showed no consistent pattern of changes across the three treatments.

Study One

From the findings of the pilot study we made several decisions about the design, materials, and procedures to be used in the first of three studies on the teaching of generative reading comprehension techniques to young adults in basic skills courses. First, we decided to retain group instruction, with experienced and supportive basic skills teachers instructing intact classes of learners with comparable reading abilities. Intact groups and reading teachers provide a familiar and relatively secure environment that enhances motivation and minimizes anxiety and fear of failure. Intact groups and reading teachers also introduce variance across treatments that complicates data analysis. However, intact groups and live reading teachers also add the important elements of practical and representative actual teaching and learning environments that exist in basic skills classes. As a result, our results gain some utility and meaning from the natural and realistic environments used in the study.

Second, reading materials were selected because of their utility to the Army, interest to the participants, and because of the appropriate grading level. Because the participants in Study One, unlike the participants in the Pilot Study, were either largely new recruits or were people wishing to reenlist in the Army, a majority of the reading selections were taken from the recently revised Army Manual of Common Tasks. To add variety and generality to the reading passages, the remaining selections were taken from general references other than Army materials.

Third, the instructional materials were completely rewritten, greatly shortened, and centrally focused upon the generative reading comprehension skills that the research literature and the pilot study indicated held the greatest promise of success--summaries, inferences, main ideas, and examples. The written instructional materials were given one lesson at a time to the participants. These brief lessons of 5-10 pages each seemed more manageable than the entire 100-page books given to the learners in the pilot study.

Design. Within the constraints of time and the number of classes available at any one time, intact classes were assigned, at random, to three treatments, two experimental and one control condition.

Participants. A total of 98 participants in basic skills classes on three Army bases in California were included in the data analyses in the study. In addition, several participants were dropped from the data analyses because they failed to complete the instruction, often because they were reassigned during instruction to other duty.

Treatments and materials. The instruction in all three treatments lasted for a total of nine 45-minute class sessions. A Generative Verbal Strategy treatment, a Generative Imagery Strategy, and a Control condition were the three treatments used in the first study. The Generative Verbal Strategy treatment consisted of three main sections which taught, respectively, how to compose (1) Headings and Subheadings, (2) Inferences, and (3) Summaries. Throughout each of the nine lessons, the learners were required to generate these three types of verbal elaborations for each reading passage they encountered. Group work was included in each lesson. The Basic Skills teachers were free to work with any and all students throughout each class session.

The Generative Imagery treatment consisted of the same basic set of materials and the same general procedure. However, instead of constructing the three types of verbal elaborations mentioned in the discussion of the Generative Verbal treatment, the learners were asked quickly to construct interactive "stick figures," simple diagrams, or pictures to summarize relations across sentences and paragraphs in the text.

The Control treatment was given the same amount of time as was given to each of the two experimental treatments. However, the teacher of each intact Control treatment class provided her customary reading instruction in class, without use of the experimental treatments.

Tests. A 36-item test of literal and inferential comprehension was given before and after instruction in each of the three conditions in Study One. The posttest was an exact repeat of the pretest. In addition, TABE scores were obtained on the participants in all of the treatments.

Results and Discussion

(Only preliminary data analyses are available now. The analyses of variance, planned comparison tests, and correlational analyses will not be completed for several weeks.)

Table 1 presents the means of the experimental and control groups. The first and most central finding is that each of the two experimental groups shows a gain from pretest to posttest of approximately 14% to 17% of the posttest score, or about 16% to 20% of the pretest score. At the same time, the control group given the pretest and the posttest showed no gain from the pretest to the posttest.

Insert Table 1 about here

The second central finding is that without experimental instruction the intact classroom groups vary in their scores, ranging from a mean of 18 to 22. This range of scores probably reflects the different reading abilities encountered in the different intact groups on the three Army bases, and the difference in the year their scores were obtained. Because of commitments to Army training needs, the base Education Services Staff could allow us access to only one Basic Skills class at a time, as the opportunities and enrollment occurred. Some Basic Skills classes enrolled only 5 or 6 personnel, and sometimes classes were not in session. As a result, these data were gathered in small numbers over about 1½ years, during which time the reading ability of the participants varied from one intact class to another.

If further statistical analyses support the results presented in Table 1, the findings in Study One imply that in nine class sessions (45 minutes each), generative reading strategies can enhance reading comprehension about 13% to 20% compared with control procedures that teach reading and basic skills without using these generative comprehension procedures.

Study Two

Purpose. Based on the results of the first study, we decided to retain the verbal generative strategies materials and to develop two new verbal generative strategies that included metacognitive strategies.

Design. Within each of three reading class difficulty levels, classes were assigned at random to one of four treatments. The dependent measure was the reading comprehension test used in the first study.

Participants. Twelve reading classes in the Basic Skills program at Schofield Barracks, Hawaii, participated in the study. A total of 149 enlisted personnel were included in the pretest and initial instruction. A total of 115 participants completed the instruction and posttest. Due to Army procedures, a number of participants were absent for a large part of the study (two days or more) and were deleted from consideration in data analyses.

Materials. Three experimental reading comprehension strategy training treatments were used in this study, in addition to the control treatment. The first of the treatments, the Verbal Generative Strategy, attempted to teach three specific generative verbal strategies--headings and subheadings (including topic sentences), inferences, and summaries.

The second treatment, the Metacognitive Generative Strategy, attempted to teach several specific strategies for constructing a summary. The third treatment, the Metacognitive Generative Strategy with examples, attempted to teach the same specific summary construction skills as the second treatment, but, in addition, also taught participants to relate reading content to their own past experience.

The Verbal Generative Strategy was presented to participants in nine discrete lessons, averaging four pages each in length. Learners were instructed in understanding reading as a building process (1 lesson); generating headings and subheadings (2 lessons); creating summaries using headings, subheadings, topic sentences, and main idea skills (3 lessons); generating inferences (1 lesson); synthesizing all of the strategies in summary building (1 lesson); and review and practical application of the skills (2 lessons).

The Metacognitive Generative Treatments were also presented to participants in nine discrete lessons, averaging four pages each in length. In both Metacognitive treatments, the major emphasis was on the sequential presentation of three basic questions useful for formulating a summary. The instruction again concentrated on teaching the learner to understand reading as a cognitive generative process. Unique to the Megacognitive Generative Treatment with examples was the inclusion of training in the use of the learner's past experience in facilitating reading comprehension. This training was introduced in the initial lesson and prompted throughout the rest of the booklet in all practice sessions.

The skills training sections in the two Metacognitive treatments were identical to each other. Rather than training skills discretely and then instructing learners in how they could be used in conjunction with one another, as was done in the Verbal Generative Treatment, the Metacognitive treatments followed a sequential process of teaching learners summary building through a three-question process. The second and third lesson instructed learners in establishing "Who" or "What" a reading was about. Within the context of these lessons, participants were taught to identify and use a topic sentence to answer these two questions. Lessons four and five taught participants to answer the second of three questions in summary building--"What Happened" in the reading. In conjunction with this skill, learners were taught to identify the important parts of a technical military reading and to use order and sequence where applicable. Lesson six instructed learners in the use of the last of the three questions--"Why" did the events in the reading transpire and/or "Why" did the author write what he did. Within this lesson, the use of inference was explained, and learners were asked to apply this skill to answering the "Why" question. Lesson seven reviewed all of the material that the learners had been taught previously and demonstrated the use of the three-question summary building technique. Lessons eight and nine were used for practice, in which learners applied the summary building strategies to more difficult readings. Deliberate emphasis was placed on technical and military readings throughout instructional and practice lessons.

The control treatment subjects participated in their normal reading classes in the basic skills program and used the materials that are currently in general use in that program.

Procedures. Where it was possible, each of the experimental treatments was assigned randomly to a class at each of three reading levels of BSEP classes.

Three experienced reading teachers participated in the project as instructors for the nine experimental treatment classes.

The pretest consisted of 36 literal and inferential reading comprehension multiple-choice items and was administered by the regular basic skills instructors the day before the instruction began. Participants were allowed 45 minutes to complete the instrument.

For four consecutive class days, participants in the experimental groups received two lessons per class period. Each lesson was taught in approximately 45-minutes. Participants were usually given a short break between lessons. On the fifth class day, the ninth lesson was taught during the first half of the class, and the posttest was administered during the second half of the class period. The posttest was a repeat measure of the pretest. Participants had 45 minutes to complete the instrument. After the posttest, the participants were asked to fill out a questionnaire evaluating their own performance, and also evaluating the materials.

Results and Discussion

Table 2 presents the means of the three experimental treatments of Study Two. See Table 1 for control group scores. The same control treatment group used in Study One is also used in Study Two, because, as mentioned earlier, the Control group in Study Two contained a large contingent of experienced non-commissioned officers. No non-commissioned officers were in any of the experimental groups in Studies One or Two. As a result, the data from the control group in Study Two were not analyzed.

Insert Table 2 about here

As Table 2 indicates, the three generative strategies each showed sizable gains from the pretest to the posttest, while the control group (Table 1) showed no gain from the pretest to the posttest. The Verbal Generative Strategy produced a gain of about 14% to 16% of the pretest score. The two Metacognitive Strategies each produced a gain of about 19% to 24%. The Verbal Generative Strategy produced a gain nearly identical to the gain its predecessor produced in Study One, while the two new Metacognitive Strategies each produced a higher gain.

These data indicate that the Verbal Generative Strategy effect of Study One was replicated with a second sample of participants. The data also indicate that the two Metacognitive Strategies consistently produced a sizable, 19% to 24%, gain. Whether these differences in gain among the experimental strategies is statistically significant is not yet known.

However, the sizable gains occurring in all experimental groups, especially the Metacognitive groups, indicates some support for the practical utility of generative teaching procedures for facilitating reading comprehension in nine 45 minute sessions of basic skills classes taught in realistic Army training settings enrolling representative Army students.

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Table 1

Means and Standard Deviations of the Experimental and Control Groups of Study One (Preliminary Findings)*

Treatments	Pretest	Posttest	Gain: Post -Pre	Gain: % of Post	Gain: % of Pre
Experimental Groups					
Imagery Generative Strategy (N = 23)	22.2 (4.6)	26.7 (2.7)	+4.5	16.9%	20.3%
Verbal Generative Strategy (N = 24)	20.6 (3.5)	23.8 (4.1)	+3.2	13.2%	15.6%
Imagery Generative Strategy, Posttest Only (N = 19)		24.2			
Control Groups					
Control: Conventional Instruction and Posttest Only (N = 19)		18.2 (7.4)			
Control: Pretest, Conventional Instruction, and Posttest Only (N = 15)	21.1 (5.4)	20.8 (5.4)	-0.3	0%	0%

*Data include all subjects.

Table 2

Means and Standard Deviations of the Experimental and Control Groups of Study Two (Preliminary Findings)

Treatments	Pretest	Posttest	Gain: Post -Pre	Gain: % of Post	Gain: % of Pre
Experimental Groups					
Verbal Generative Strategy (N = 28)*	18.9 (4.1)	22.0 (3.9)	+3.1	14.1%	16.4%
Metacognitive Generative Strategy (N = 24)*	18.7 (3.6)	23.1 (4.2)	+4.4	19.0%	23.5%
Metacognitive Generative Strategy Plus Examples (N = 28)*	17.4 (5.6)	21.4 (4.7)	+4.0	18.7%	22.9%
Control Group		(Data Not Analyzed)			
Control: Pretest, Conventional Instruction, and Posttest Only (N = 15)					

* Data from subjects scoring 75% or higher on the pretest are not included in these analyses.