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ABSTRACT

This working paper, which reviews the experimental literature on learning skills to provide background information to the staff of the Skills Essential to Learning Television Project (a multi-level series of video and print resources for classroom use), covers four areas: study skills, instructional development and design, cognitive psychology, and adjunct aids. The focus is on the processes that learners bring with them into instructional settings. A summary of research related to adjunct aids is presented in a table covering advanced organizers, typographical cues, directions, objectives, quizzes, interspersed questions, interspersed directions, and directions to draw pictures. The following possible dimensions for adjunct aids are also displayed in a table: verbal versus nonverbal, active response versus no active response, location (pre-instructional, interspersed, or post-instructional), concrete versus abstract, thematic versus formal, and factual versus higher order memory. A set of general recommendations based on the literature review is offered. Thirty-nine references are listed (LMM)

LEARNING SKILLS AND INSTRUCTION

The Agency for Instructional Television is a nonprofit American-Canadian organization established in 1973 to strengthen education through television and other technologies. AIT develops joint program projects involving state and provincial agencies, and acquires and distributes a wide variety of television and related printed materials for use as major learning resources. It makes many of the television materials available in audiovisual formats. AIT's predecessor organization, National Instructional Television, was founded in 1962. The AIT main offices and Midwestern office are in Bloomington, Indiana; there also are regional offices in the Washington, D.C., Atlanta, and San Francisco areas.

The working paper reported here was written by Donald J. Cunningham of the Institute for Child Study, Indiana University, for the Skills Essential to Learning Television Project, of the Agency for Instructional Television.

LEARNING SKILLS AND INSTRUCTION

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LEARNING SKILLS AND INSTRUCTION

For the last several decades, educators have been mostly concerned with what students know and with devising ways to increase the amount of student learning. The instructional development movement that has dominated education is an approach largely concerned with efficient and effective acquisition of instructional content. Recently, however, educators have become increasingly interested in how students learn. The shift in emphasis within psychology from a largely behavioristic model to a largely cognitive model has no doubt influenced this change in education. The skills that learners use in learning are now becoming more adequately studied, and deliberate attempts are being made to introduce training in learning skills into school curricula.

One such attempt is The Essential Learning Skills Television Project being developed by the Agency for Instructional Television. The purpose of this paper is to selectively review the experimental literature that pertains to learning skills and that will offer useful insights to the developers of the project. The author, from his survey of this field, has identified four areas to review: (1) study skills, (2) instructional development, (3) cognitive psychology, and (4) adjunct aids. These four areas are not distinct or discrete, but they are identifiable approaches bearing upon the topic of learning skills. Each of these will be reviewed in turn and will be followed by a set of summary recommendations.

Study Skills

Numerous publications have appeared over the years purporting to teach skills that are important to learning, starting, of course, with the Greeks (see Yates, 1966). Some of these more "ancient" methods have been rediscovered by modern cognitive psychologists and will be discussed later in this paper. By far the bulk of the literature on study skills has been aimed at the college age learner in the form of manuals or guidelines. In these "how to study" guides, recommendations are made to students as to how to read textbooks, listen to lectures, watch films, organize for study, take notes, underline, write papers, etc. Although aimed primarily at college age learners, these recommendations do offer important insights for learners of various ages. The expertise of the authors and the empirical validation used as a basis for these recommendations does vary widely, of course, so the consumer of this literature needs to be discriminating.

Browning (1976) summarized the recommendations of authors concerning five frequently mentioned reading study skills: recitation (active practice), underlining, marginal note-taking, outlining, and "combined methods" such as the SQ3R (survey, question, read, review, recite). This table is reproduced below.

Table 1

Recommendations of Authors

Ratings	Key
1 = Recommended with few or no reservations	R = Recitation, self-testing
2 = Recommended, but secondarily	U = Underlining
0 = Not mentioned	MN = Marginal notes
X = Recommended against use	OND = Outlining, note-taking, diagramming
	SQ3R, etc. = SQ3R and similar combined methods

Sources (in Chronological Order)	Date	R	U	MN	OND	SQ3R
Morgan & Deese (1st ed.)	1957	1	2	0	1	1
Fedde	1961	1	x	1	1	0
Robinson	1961	1	2	0	1	1
Smith et al.	1961	1	0	0	1	1
Pauk (1st ed.)	1962	1	1	1	1	1
Resnick & Heller	1963	1	1	1	0	1
Hill & Eller	1964	1	0	0	0	0
Austin et al.	1966	2	0	0	1	0
Gilbert	1966	0	0	0	1	0
Stanton	1966	1	0	1	0	0
Libaw & Martinson	1967	1	2	2	1	1
Anderson	1969	1	0	2	2	1
Kalish	1969	1	1	1	1	1
Morgan & Deese (2nd ed.)	1969	1	1	0	1	1
Raygor & Wark	1970	1	1	0	1	1
Baker	1974	0	1	1	1	0
Pauk (2nd ed.)	1974	1	1	1	1	1
Preston & Botel	1974	1	1	0	1	1
Policastro	1975	1	2	2	1	1

(From Browning, 1976)

Even a cursory glance reveals disagreement among the authors as to the value of these five techniques. These authors also seem to follow the philosophy that the more techniques you employ the better. Is there any empirical substantiation for these recommendations? While it is beyond the scope of this paper to review in detail the many recommended techniques, evidence for two will be presented: underlining for the reading mode, note-taking for the listening mode.

If you've ever bought a used text book, you are aware that students frequently underline the text. Is this an effective study skill? How much of the material should be underlined? Should only main ideas be underlined? Is the effect of underlining to aid the student in encoding the material or in facilitating review? The literature addresses some of these questions but provides conclusive support for few answers.

One theoretical advantage is that the underlined material exploits the well-known "von Restorff effect" -- information that is somehow isolated from a homogeneous background is better remembered. Thus, the underlined information, being isolated from the rest of the text, should be better remembered. Research has shown, however, that while the isolated information is learned more rapidly, it is at the expense of the other material.

When this reasoning has been applied to written textual material, the results have not been encouraging. A review of literature by Browning (1976) shows that the majority of the research is badly conceived and poorly conducted. Researchers do not agree among themselves concerning

a standard technique for underlining, thus making generalizations difficult. Nevertheless some tentative conclusions can be drawn. First, underlining done by the producer or author of the instruction and keyed to the criterion test is superior to student-generated underlining. When students do the underlining, the results vary according to the degree of training or expertise of the students in underlining. Too many students underline too much and do not use their underlining to differentiate main ideas from supporting facts. Second, it would appear that underlining facilitates the process of reviewing the material rather than the initial learning of the material; that is, underlining does not aid the initial encoding of material (it may, in fact, interfere with it) but, rather, assists the student in reviewing the material quickly.

Should students underline? My assessment of this literature leads me to conclude that underlining should probably be done by the author and keyed to the main ideas of the text. Students should be instructed in how to use the underlining in an efficient manner. For example, the SQ3R method mentioned above seems to have received support from recent research and theory about skilled reading, which has shown that prior expectations play an important role in the reading process. Surveying the chapter, reading the summary, looking over the subheadings, and reading underlined portions are all techniques which enable the reader to develop expectancies about the topic, and to familiarize him/herself with the sequence of information, the format, and the sentence complexity. Such prefamiliarization has been shown to dramatically increase speed of reading and comprehension (see Smith, 1971, for a review of this area). Thus, underlining, or any of the

techniques commonly recommended by study skills experts for reading, are useful but only if used properly. If students do underline for themselves, I would recommend that they do it after giving the chapter a quick survey and a quick reading. At that time they will be better able to distinguish important content from unimportant and to create an underlined version that will make their later review of the material more efficient.

When replay of instruction is not possible, note-taking is a recommended procedure. Like underlining, the literature on note-taking is inconsistent and difficult to summarize. Recently, however, two major theoretical explanations of the functions of notes have emerged (the reader should note the parallel with the discussion of underlining). First, notes may aid the learner to encode the material, to personalize it and make it more meaningful. Second, notes may serve an external memory function, where a summary of the content of the lecture is written down for later review. Most research on note-taking has confounded these two factors so that any advantage for note-taking could not be accounted for by one or the other factor alone.

A recent study by Carter and Van Matre (1975) has partially resolved this issue. They divided 172 college undergraduates into four treatment groups: (1) subjects were allowed to take notes during a tape recorded lecture and review their notes during a five-minute period; (2) subjects took notes but could only mentally review during the five-minute review period; (3) subjects listened without taking notes and then mentally reviewed the lecture during the review period; (4) subjects listened without taking notes and then engaged in a letter cancellation task during the review period that was designed

to prevent mental review. The results showed group one outperformed all other groups and that groups two and three did not differ. These results suggest that the act of taking notes did not seem to influence immediate or delayed recall but the opportunity to review notes did. Thus it seems from these data that having notes is more important than taking notes.

This study does leave certain issues unanswered, however, and several studies are underway in my laboratory to resolve such issues as: (1) are a subject's personal notes better than notes prepared by the author? (2) will pre-information such as a list of instructional objectives increase the efficiency of note-taking and show an advantage for note-taking over and above the advantage for note having? (3) are certain strategies for note-taking more effective than others? and, (4) can students be trained in such strategies? The amount of good information available on even such simple questions as these is disappointingly small and only general guidelines can be offered at this time:

1. Where possible, students should be provided with notes developed by the author/lecturer that emphasize the main points contained in the lectures. My own personal experience is that these notes should be prepared in "outline form" only, requiring that students "flesh" out the notes by filling in the details. Such a procedure combines the virtues of both the encoding and external storage functions of notes.
2. Students should be provided with training in how to take notes early in their academic careers. Grades four through six would not be too soon to begin such training. Children's encoding skills

at this age are less well developed than those of adults, so external storage in the form of notes would be helpful. Training should emphasize how identify main points, appropriate level of detail, when to review, etc.

In summary, almost no literature is available on study skills with younger learners. Underlining, note-taking, outlining, and so on may not be efficient strategies for young readers and listeners whose organization and communication skills are not fully developed. But perhaps this is the very age where training in the use of efficient study skills should begin. Children as young as three have been shown to be capable of powerful elaborative or organizational strategies, but they do not spontaneously use such strategies. In fact, many of our present instructional strategies discourage their use. For instance, skilled readers pay minimal attention to the printed word and often make semantic errors when reading out loud (e.g., reading grocery store when the text says market), but much of our early reading training over-emphasizes letter perfect reading. In fact, such errors should be regarded as evidence of progress in reading ability. Students should be encouraged to read quickly, to elaborate on the story being read, to use memory "tricks" to remember the content. A systematic cataloging of these skills and recommendations for training students to use them is beyond the scope of this paper but should probably be a part of The Essential Learning Skills Television Project (see summary for specific recommendations).

Instructional Development

Research on school learning can be roughly divided into two approaches. The first, here called the instructional development

approach, is largely concerned with the characteristics of instructional materials or environments that are associated with efficient and effective learning. Should the materials be presented in a discovery sequence or an expository sequence, be designed to include active responding, be written at a particular reading level, be presented in color or black and white? Resolution of these issues through research and theory should, it is felt, lead to optimally designed instruction.

The second approach centers on the strategies or processes that learners bring to an instructional setting. The instructional materials and environments are given secondary attention; they are important only to the extent that they encourage or make more likely particular cognitive processes that have been shown to be important for learning. This section will deal with the first approach while the next two, "Cognitive Psychology" and "Adjunct Aids" (and the previous section, "Study Skills") will deal with the second.

Rather than attempt to review the vast literature on instructional development, I will pull out what I consider to be some "enduring truths," principles that seem to be well substantiated. It will not be possible to adequately document these principles in this paper, but I will provide a source or two in which the literature is discussed more completely. One further caveat is that the principles I list are not intended to be exhaustive or comprehensive. Another observer might list quite different principles. I have attempted to extract those that will be of most benefit to The Essential Learning Skills Television Project.

1. Active responses made for the right reasons facilitate learning (see Anderson and Faust, 1973, for a more complete discussion). One of the most well-documented principles from the psychology of learning is that requiring overt responses increases learning. It came as a surprise, therefore, when the early literature in instructional development (learning from films, programmed instruction) showed no consistent advantage for active responding. But further refinements in the experiments and in the theoretical conceptions underlying them led to a clarification of the conditions under which active responding is important. In brief, these studies showed that active responding was effective only when the response required of the student was relevant to the instructional objectives, and when the response could only be made if the student actually read or watched or paid attention to the instruction. An active response itself is of no value. An active response that causes or influences the student's behavior in directions supportive of the instructional goals is useful. In much of the early research, the responses required were irrelevant to instructional goals or were made on bases other than the author intended. Relevant responses made for the right reasons do facilitate learning.

A corollary to this principle is that the requirement to make an overt response is most important when the responses required are difficult or unfamiliar. Technical terminology or new motor responses are situations where frequent overt responses are especially important. In situations calling for highly familiar responses, covert active

responses ("thinking" the answer rather than writing it) are as effective as overt responses and have the additional advantage of taking less time.

A second corollary concerns the frequency of responding. Overt responses by students are somewhat disruptive to the lesson flow and should not be allowed to interfere. Literature on the part versus whole learning issue (see Cunningham, 1971) indicates that learners should practice or make responses after that amount of material when they are capable of making most (e.g., 75 percent) of the responses being taught. The size of this unit will vary somewhat from learner to learner but can be estimated for the target population. The size of this unit also depends upon the "natural parts" of the task. In many tasks, there are natural points where it makes sense to interrupt and practice. These should be identified and taken into account along with the learner variables.

2. Knowledge of results will facilitate learning. When the learners make active responses, should they be provided with information concerning the adequacy of their performance? Early research on this issue tended to be very confusing and contradictory, (see Anderson and Faust, 1973, and Anderson et al., 1973). As conceived originally by operant researchers, knowledge of results was supposed to serve as a reinforcer to learners, strengthening their responses in the same manner that the pellet of food strengthens the behavior of the rat in a Skinner box. Early research with programmed instruction failed to support this

position and, in fact, often showed that no knowledge of results was actually superior to providing knowledge of results.

Again, however, recent research has clarified the conditions under which knowledge of results aids learning. First, it appears that if knowledge of results functions as a reinforcer, it is a weak one. Second, an important function of knowledge of results is to provide the learner with information concerning the adequacy of his response. If this information is necessary, as it is when the student's response is incorrect or when the response is so difficult that the learner is uncertain about his response, then knowledge of results is very important. Under these circumstances, the learner is being provided with additional information that he needs to correct himself or learn the response. When the instruction is easy or familiar, knowledge of results is less important. It is also critical that the learner not be allowed to see the knowledge of results before he fully formulates his answer. Many programmed texts have the correct answer in sight of the learner. This proves too tempting to even the most conscientious learner, and the students will often make their responses by copying answers; that is, they make the correct response but for the wrong reason. Under these circumstances, knowledge of results actually can interfere with learning.

3. Frequent testing facilitates retention. Under principle 1 above, it was argued that active responding facilitates learning. But what of retention? How can we insure that the information once learned will be retained? One of the most reliable principles from the psychology

of learning is that information not used is quickly forgotten. Frequent use of the knowledge or skill either on "tests" or in performance "on the job" will prevent this forgetting. In many circles, tests are not very popular these days. The misuse of tests is well known and will not be documented here. But it has been known at least since Spitzer (1939) that testing as soon as possible after instruction is completed reduces substantially the amount forgotten (see Anderson and Faust, 1973). For instance, Spitzer's (1939) data showed a very typical retention curve: 40% recalled when the test was given immediately after learning but only 10% recalled when testing was delayed fourteen days. But when subjects were tested immediately and then again fourteen days later, scores had only dropped to 35%. The immediate test seemed to have solidified the information, making it less susceptible to forgetting. Testing is a powerful tool for the educator. The role of a test as an evaluator should not obscure its role in retention.

The remaining principles all concern the learning of concepts. In my opinion, the bulk of the learning that goes on in the schools is the learning of concepts. At times we are seeking to teach students new concepts (concept learning) while at other times we are teaching students to use already familiar concepts in new ways (concept utilization). A substantial literature exists on concept learning but relatively little on concept teaching. A thorough summary by Clark (1971) is probably the most comprehensive source. I will pick out only a few principles from this literature to summarize.

4. <u>During initial concept teaching, eliminate or hold constant irrelevant features and magnify critical features</u>. Concepts can be analyzed into subcomponents called features. Some features of the concept BALL, for instance, are size, shape, color, and use. Only some of these features are critical for defining the concept; other features are irrelevant. Shape and use are critical features for the concept BALL, but color is irrelevant. Research has shown that one way to speed concept learning is to eliminate or hold constant irrelevant features when presenting examples or non-examples of the concept. For instance, Dwyer (1967) showed that students learn the anatomy of the heart faster from simple line drawings than from realistic photographs. The line drawings had the advantage of eliminating irrelevant detail from the instructional stimuli. Concept learning may also be speeded by highlighting or pointing out the critical features to the student. In sum, both magnifying critical features and eliminating irrelevant features simplify concept learning in its initial stages. But obviously one is not presented with such simplified examples in real life. One would hope surgeons would be able to deal with realistic hearts and not line drawings when performing open heart surgery. It is necessary, therefore, in the later stages of concept learning to withdraw emphasis of critical features and to introduce irrelevant features like those likely to be encountered in the real world.

5. Introduce concepts using highly familiar examples. Research has shown that concepts are most easily induced from highly familiar examples. The concept of fruit is more easily induced from examples such as banana, orange, and apple than from examples such as mango, avocado, and paw-paw. Again, however, it is necessary to introduce unfamiliar instances in the later stages if the student is to have a broad understanding of the concept.

6. Group together examples of each concept when teaching several simultaneously. Often the instructional situation calls for teaching several concepts simultaneously (e.g., several architectural types). Under these conditions, it is best to present several examples of the same concept together before presenting examples of the other concepts. Such a procedure allows the subject to induce and remember the critical features of one concept before moving to the next, thus reducing the likelihood of interference between concepts.

7. Test concepts with novel examples. To test for the acquisition of a concept, it is necessary to use examples of the concept that the student has not seen during instruction. If during instruction, the subject is told that city hall is an example of a certain style of architecture, this building would not be a suitable example to use in testing the concept since the student might just remember the example. In verbal concept learning, such as learning from text, it is necessary to test using language and/or verbally described examples that are different from those used in instruction. For instance, "intermittent reinforcement" might be described verbally during instruction as leading

to increased resistance to extinction and illustrated by a rat performing in a Skinner box. Testing for understanding of these concepts requires that different language (e.g., rewarding some but not all acceptable responses increases persistence) and examples (e.g., a faulty cigarette lighter) be used. Anderson (1972) presents a useful discussion on the testing of concepts and rules.

The literature on the approach here labeled as instructional development is vast indeed and this section has only touched upon it. Other useful references include Anderson and Faust (1973), Gagné (1970), Gagné and Briggs (1974), and Davies (1973).

Cognitive Psychology

A revolution has recently overtaken psychology: a shift in emphasis from a predominantly behavioristic view to a predominantly cognitive view. Whereas psychology used to be defined as "the study of behavior," now it is more commonly defined as the "study of human behavior and mental processes." Psychologists now view human beings and other organisms as seekers of information who code, organize, store, retrieve, and use information functionally. The day of the "empty organism" is past.

Again confronted with the task of reviewing a vast body of theory and research in a finite paper, I have chosen instead to present a highly personalized account of the more important principles that seem to be emerging from this area. Of necessity, the review will be

selective, but I believe it will be of use to The Essential Learning Skills Television Project. This area is still too new for highly generalized principles of the sort stated in the previous section. Instead, competing viewpoints will be presented and the instructional implications derived.

Cognition has been defined by Neisser (1966) as referring to "all the processes by which sensory input is transformed, reduced, elaborated, stored, recovered, and used." Each of the terms in the definition is important. All that we know about the world has been mediated by the sense organs and by the cognitive manipulations that we perform on this information. We transform information into forms compatible with our information processing system. We reduce information by selecting those aspects which interest us or to which we are attuned. We elaborate information by personalizing it or relating it to what we already know. We have memory systems for holding information, either for short periods of time or permanently. We recover information as we need it, and it is this previous knowledge that determines in large part how (and how well) we learn new information. And we use information, both recent information and information from our knowledge structure, as a guide for our actions.

Within this general orientation, a number of different approaches to the study of cognition have emerged. These are not completely distinct approaches, and each borrows heavily from others, but they are sufficiently different in their implications to warrant separate treatment. One group of cognitive psychologists is very concerned with structural characteristics of the information processing system. I call this the memory models approach since these theorists love to sketch flow charts of the various memory systems that they have identified. To illustrate,

Atkinson and Shiffrin (1969) have proposed an information processing system consisting of three main memory stores: a sensory register for holding incoming sensory information briefly; a short-term memory where we operate on the information by rehearsing, elaborating, and making decisions about it; and a long-term memory where we store information for extended periods of time (perhaps permanently). Much research has been done to demonstrate the validity of such structural formulations. Although much useful information was gained from an investigation of these models, they have not, in my opinion, generated the sort of instructional implications that The Essential Learning Skills Television Project needs.

A more recent formulation offers more promise. Craik and Lockhart (1973) recently proposed a model of cognition that they labeled the "levels of processing" approach. This view emphasizes the extent and nature of processing that learners give to incoming sensory information. Learning is regarded as a rather automatic by-product of operations that are carried out on the incoming information. A number of levels are proposed, such as sensory processing, phonemic processing, pattern recognition, and semantic processing. Surface levels such as semantic analysis are not as elaborate as the deeper semantic levels, and memory for the information is determined largely by the

depth of processing. Thus the deeper a stimulus is processed, the more likely it is to be remembered. Within each level, two types of processing are proposed: Type 1, which maintains the information at that level, and Type 2, which transfers the information to a "deeper level."

This approach, while still relatively crude, has the advantage of focusing attention upon the processes that learners employ while learning. Developers of instructional materials often make the assumption that learners will automatically understand. The "levels of processing" view suggests that understanding comes only with deeper levels of processing and seeks to elaborate the nature of these deeper levels. A large number of processes have been investigated, including mental imagery, verbal elaboration, and mnemonic strategies. Several of these will now be described in more detail.

Paivio (1971) has been particularly influential in bringing imagery back from the outcast state to which it was banished by behaviorally oriented psychologists. Mental imagery has been known as a powerful memory technique since at least the early Greeks. One such use of imagery, the method of loci, is illustrated by the following anecdote about the Greek poet Simonides. Simonides was invited to chant a poem at a banquet. He left the banquet for a moment, and during his absence the roof of the banquet hall fell in, killing all. The relatives of the deceased guests could not identify any of the corpses because they were so mangled, but Simonides was able to visually recreate where each guest sat and to identify them. He was impressed by his feat, and later "invented" the method of loci, a memory device in which the learner visualizes in his mind a highly familiar place (e.g., the Parthenon) and

imagines himself walking through it. As he walks, he associates various parts of what he is trying to remember (e.g., a speech) with parts of the place. When remembering, the learner mentally walks through the place again and recalls his associations.

Paivio's (1971) research has shown imagery to be a powerful mediation technique but has argued that it is most useful for concrete stimuli. He has theorized that meaning derives from two mediational systems: visual and verbal. Most people are capable of imagery, but few use it in the powerful ways suggested by Simonides. Recent research has shown, however, that readers who employ imagery while reading concrete materials do remember more than those who do not (Anderson & Kulhavy, 1972). Specific training for students on using imagery while reading or listening may be useful. There is some evidence to suggest that imagery may be more effective in listening than in reading because reading and imagery, as visual activities, may compete and interfere with one another.

For years mnemonic strategies were regarded as carnival tricks unworthy of attention by serious psychologists. We can no longer ignore the powerful effects on memory of these devices, however, and many psychologists have recently investigated their nature. Popular books such as that of Lorayne and Lucas (1975) have also stimulated interest in this area. The basic principle underlying all mnemonic strategies is that the learner uses something that he knows well to learn something new. For instance, the method of analytic substitutions requires that the subject first learn, indeed overlearn, a rather complicated set of rules by means of which he can translate numbers into meaningful words.

For instance, the telephone number of a friend of mine translates into "crispy", a description I have associated with my friend, with the result that I always remember this number even though I call it infrequently. The same principle underlies the effectiveness of the commonly known rhyme "one is a bun, two is a shoe,...etc." in learning short lists. Lorayne and Lucas (1976) have strongly advocated the teaching of these techniques in schools, and I agree. Their effectiveness is beyond question. I urge The Essential Learning Skills Television Project to incorporate instruction in these techniques in their materials. Specific mnemonics can be taught (e.g., "Thirty days has September...") as well as techniques for developing personal mnemonics using such well-known principles as grouping, rhyming, or peg words. (See Norman, 1976, for more details.)

A third emphasis in cognitive psychology is represented by theorists who are attempting to describe how humans acquire, organize, and use the large bodies of information they possess. The details of the various theoretical approaches (e.g., Kintsch, 1974; Anderson & Bower, 1973) need not concern us here -- just the fact that these approaches point out the importance of our existing knowledge in new learning. Of course, theorists like Ausubel (1963) have been arguing for years that the most significant variable for new learning is the adequacy of our existing knowledge structure, but recently theorists have been more specific as to the process. What relationships should exist between new and old knowledge in order for learning to proceed most efficiently? Does prior knowledge actually influence what we get from new information or even how we perceive that information?

Several lines of research are contributing to our understanding of these issues. Anderson and his colleagues (1974) have shown that learners with different subject matter specializations will interpret ambiguous passages consistently with their background knowledge. One passage, which could be interpreted either as a description of a bridge game or of four people rehearsing for a woodwind ensemble, was interpreted the first way by most physical education majors, the second way by most music majors. The term schema has been resurrected from early cognitive theory to describe these consistent, organized ways of viewing the world. Some schemata are very specific, such as your specific knowledge of President Carter. All new information that is received about Carter is said to be viewed from the perspective of the individual's previous knowledge of him. Other schemata are very generalizable such as the schema for "give." This schema defines a set of relationships between the one who gives and the one who receives, the nature of the entity given, the type of exchange that takes place, etc. The schema for "give" is related to but different from the schemata for "donate," "loan," or "bestow." According to these theorists, a large part of our knowledge of the world is organized into such schemata, and a major task confronting the young child is the learning, not of specific bits of information, but of a set of consistent and generalizable schemata. Further discussion of the concept of schema may be found in Anderson (in press) and Rummelhart and Ortony (in press).

The concept of schema is useful in several direct ways. The existence of organized cognitive structures suggests a much greater role for the student in learning and instruction. This view suggests that the student contributes his/her previous knowledge in instructional

tasks by developing a set of expectancies as to the content and form of the nominal instruction. For example, Frank Smith (1971) has estimated that skilled reading is not primarily a visual task; he estimates that only about 40% of the information used in reading comes from the printed page. The rest is constructed by the reader. Studies of reading behavior reveal that skilled readers fixate only about twice a line, too infrequently and too rapidly to possibly process every letter on the page. Reading has come to be regarded as a guessing game where readers develop expectancies as to what will appear on the printed page (content, syntactic style, spelling patterns, etc.). The readers then sample selectively from the printed page to confirm these expectancies. Only when the sample drawn fails to confirm expectations or the material is very difficult or unfamiliar does the reader slow down his reading and take in more of the visual stimulus. ·lated processes are presumed to operate in listening or learning from ,_ctures and films.

One interesting consequence of such a view is that readers, listeners, and viewers will sometimes make errors (read, hear, or see things that are not actually present), but skilled readers will make primarily errors that are semantically consistent (e.g., reading "supermarket" for "grocery store"). Reading teachers traditionally get upset over reading errors, but semantically consistent reading errors should be regarded as signs of reading progress, not problems. The above considerations strengthen the proposition that children should be deliberately taught reading strategies that are consistent with what we know about reading:

to read quickly, to employ methods such as SQ3R to facilitate the development of prior expectancies in reading, etc. To my knowledge, such skills are not systematically taught in the schools.

Another way in which the concept of schema may prove useful is in terms of describing the relationship between the structure of instruction and the subject's already existing knowledge. Several researchers (Meyer, 1975; Fredrickson, 1975) have provided methods for analyzing the structure of discourse, the relationships between items of content in a prose passage that is read or listened to. The details of these systems are too complicated to be discussed here, but the essence of the systems is to provide a means for describing the schema that the author is using in communicating his message. Meyer and Freedle (in press) have investigated four structures: adversative, covariance, attribution, and response. Meyer (1976) has argued that identification of the structure of schemata employed by the author to organize his content can be of great assistance to the reader in processing information from the text. She now has research under way to determine if training readers or listeners in identifying such structures will influence such measures as reading comprehension and retention. I personally know of no comparable analysis system available for pictorial or film materials, but see no reason why the same considerations would not hold for that medium. As a personal anecdote, my own appreciation and, I believe, understanding of films benefited from being involved in the filming of a movie. Perhaps involving children in the process of developing television programs or making films will have a similar effect and should be incorporated in The Essential Learning Skills Television Project.

Adjunct Aids

The last area to be reviewed in this paper will be called adjunct aids. The focus of this approach is on the processes which learners bring with them into instructional situations. Since processing is also the concern of cognitive approaches, it is not surprising that adjunct aids theory and research draws heavily upon cognitive theory. The concept of adjunct aids is derived from the work of Rothkopf (e.g., Rothkopf, 1968). Rothkopf proposes the term mathemagenic activities to encompass behaviors and mental processes that are relevant to the attainment of instructional objectives. Careful reading and close attention are mathemagenic activities that usually contribute in a positive way to the attainment of instructional objectives. Going to sleep and doodling are also mathemagenic activities since they are also relevant, albeit in a negative sense. Rothkopf feels that the discovery of classes of activities or behavior that are relevant to the attainment of certain instructional outcomes and the discovery of means of controlling, maintaining, or altering these behaviors, offer a viable alternative to the instructional development approach. Instead of determining the best form of instruction for everyone and rewriting all existing instruction in those formats (the instructional development approach), the adjunct aids approach proposes to identify behaviors and cognitive processes that can be manipulated so as to maximize learning from all types of existing instruction (good or bad).

Adjunct aids (AAs) are a class of stimuli that are presumed to alter the character and frequency of mathemagenic behaviors. They are stimuli that are added to instructional materials or instructional environments in order to influence learning in (usually) desirable ways. A number of adjunct aids have been extensively investigated, including

inserted questions (Rothkopf, 1966), advanced organizers (Ausubel, 1960), and typographical cuing (Hershberger, 1964).

The reader may be tiring of disclaimers, but once again it must be noted that AA research is replete with inconsistent results and lacks a firm theoretical basis. There is no specific, widely recognized taxonomy of the types of adjunct aids available nor any specification of the dimensions of learning that particular adjunct aids are likely to affect. For instance, inserted questions are presumed to facilitate the retention of content directly tested by the questions (a direct practice effect) and, in some cases, to increase attention to and hence retention of content not directly covered by the questions. Contrast those functions with that presumed to be served by an advanced organizer. Advanced organizers are, theoretically at least, to serve an organizational function, to provide "ideational scaffolding" for the instructional content. Neither a direct practice function nor any attentional function is usually ascribed to advanced organizers. Yet both inserted questions and advanced organizers are usually included in a discussion of adjunct aids. Obviously some framework for organizing and classifying existing types of adjunct aids is sorely needed.

A further advantage for constructing such a classification system is that it is very likely to suggest <u>new</u> types of adjunct aids. For instance, I have previously noted (Snowman and Cunningham, 1975) that adjunct aids are mostly verbal. Considering that verbal adjunct aids were only one pole of a continuum, we began exploring nonverbal or

pictorial adjunct aids. Snowman and Cunningham (1975) have confirmed that pictorial adjunct aids (reader-generated pictures) are also feasible and as effective as interspersed questions. This study is a good example of the type of desirable effect that a conceptual system can have on a field.

It may assist The Essential Learning Skills Television Project to review a preliminary and incomplete taxonomy that I recently developed for adjunct aids (Cunningham, 1975). Table 2 contains a partial listing of AAs along with some brief definitions. The most striking thing about this listing to me is the diversity of AAs listed. Is there some compelling reason, other than convenience, to group them under the single heading of adjunct aid? Is there some set of dimensions that will show the relationships existing between these diverse AAs? I believe there are, and in Table 3 I have presented a tentative listing of some of the important dimensions along which I believe AAs might vary.

Table 2

A Partial Listing of Adjunct Aids

1. Advanced Organizers	1. Ausubel (1963) defines advanced organizers as verbal discourse written at a higher level of inclusiveness and abstraction than the instructional materials themselves. Not designed to teach per se, they are supposed to provide "ideational scaffolding," to provide concepts around which the instructional materials can be organized. A considerable but somewhat inconsistent literature exists concerning advanced organizers (see Barnes & Clawson, 1975, Hartley & Davies, 1976).
2. Typographical Cues	2. Italics, underlining, and other such devices are included in this category (see dicussion in "Study Skills" section).
3. Directions	3. Communications of the intents and purposes of various instructional treatments to students has produced interesting results (e.g., Rothkopf's, 1966, finding that brief exhortations to study hard produced significant gains in post-test performance).

Table 2 (Continued)

4. Objectives	4. A number of studies have investigated the effects of providing learners with statement of instructional objectives. The literature, while inconsistent, shows few instances where this practice decreases learning (see Duchastal & Merrill, 1972).
5. Quizzes	5. Aside from some rather old research on the topic, only a few studies have directly tested the effects of quizzes upon learning (see discussion under "Instructional Development").
6. Interspersed questions	6. By far the majority of the research on AAs has centered here. Research shows a strong direct practice effect for questions and an indirect attentional effect when the interspersed questions are placed after the content to which they are relevant (Anderson & Biddle, 1975).
7. Interspersed directions to draw pictures	7. This new type of AA was devised by Snowman and Cunningham (1974) and proved to be as effective as interspersed questions for providing mathemagenic positive behavior.

Table 3

Possible Dimensions for Adjunct Aids

1. Verbal vs. Nonverbal	1. Some AAs, such as interspersed questions, appear to control mathemagenic processes that are largely verbal, while others, such as interspersed directions to sketch pictures, may control nonverbal mathemagenic processes such as imagery.
2. Active Response vs. No Active Response	2. Some AAs, such as interspersed questions, typically require an active response on the part of the reader, whereas other AAs, such as typographical cuing (e.g., italics, underlining), do not.
3. Location (Preinstructional, Interspersed, or Post instructional)	3. AAs such as advanced organizers or behavioral objectives typically precede instruction; adjunct questions or typograhical cuing occur during instruction; summaries, reviews, study questions, quizzes and the like are most frequently found after instruction.

Table 3 (Continued)

4. Concrete vs. Abstract	4. AAs such as advanced organizers are constructed at a higher level of abstraction than summaries or statements of instructional objectives.
5. Thematic vs. Formal	5. AAs such as objectives and interspersed questions are usually designed to aid the reader by increasing his comprehension of the meaning of particular content in the instructional passage, whereas AAs such as typographical cuing, outlines, and to some extent, advanced organizers are designed to facilitate learning by highlighting the formal structure of the passage.
6. Factual vs. Higher Order Memory	6. Some AAs (e.g., questions) are presumed to induce "comprehension" at "deeper levels of processing" than others (Craik & Lockhart, 1972).

My hope is to eventually be able to produce a more adequate listing of dimensions and to use them as a multiple dimensional category system -- a system that allows the consideration of all dimensions simultaneously rather than a system of more or less discrete dimensions. Such a multiple dimensional system would have the advantage of integrating several dimensions and clarifying the parameters that determine the effectiveness of AAs. For instance, an AA that is mostly verbal, requires active responses, is postinstructional, concrete, and thematic (e.g., a verbal postquiz) can be operationalized much more accurately in an experimental test between it and another AA similarly located on the model. The advantages of such precision in operationalization can hardly be overemphasized.

The invention of new and interesting types of AAs might also be a by-product of such a classification system. Imagine, if you will, what a nonverbal, preinstructional, active response, concrete, thematic AA might look like. I'm not sure either, but one possibility might be an incomplete line drawing of one aspect of the content to be described, in which the subject predicts and completes the drawing (e.g., the student predicts Red Ridinghood's path to Grandma's house). What would be the effects of such an AA on comprehension or memory? Again I'm not sure because I'm not aware of the use of such AAs. It might be interesting to see! The point is that the classification system may be generative as well as summative.

This preliminary model of adjunct aids may be of use to The Essential Learning Skills Television Project by suggesting specific AAs to incorporate into the television programs themselves or to

supply along with the programs. This analysis will have to be derived from a precise specification of the goals and objectives of the programs themselves and a good deal of "tinkering" to determine the most effective use of AAs. For instance, suppose it is the intent of this series to present the programs in a hierarchical sequence (i.e., later programs build upon information presented in earlier programs) and to have the students practice the concepts presented in the programs. These intents would suggest the use of adjunct aids that integrate the programs and that require active responses on the part of the learners. Assuming that these features would not be built directly into the programs themselves, AAs could be provided through such materials as workbooks. To assist the students in integrating the programs, advance organizers, summaries, prequestions, and the like could be read by students prior to viewing. Such techniques would greatly assist the students in generating the prior expectancies that cognitive researchers have identified as being so important in new learning. Keeping students active requires the use of devices like quizzes or class projects that could also be presented to students in a workbook.

Development of these devices should be assigned to educators/ producers thoroughly familiar with the intents of the project and with the development of adjunct aids themselves. There is no more frustrating activity than reviewing the literature on a particular adjunct aid (e.g., advance organizers) and discovering that the majority of authors do not agree on its operationalization. The inconsistencies in findings is largely due to this factor. In an informal experiment with one of my classes, I had my students read everything Ausubel had ever

written about advanced organizers, then asked them to construct one for a particular passage. The diversity in the organizers produced was incredible. The point is that consistency in the production of stable results from the use of advanced organizers will only come from those well trained in the theory underlying these techniques. Constructing AAs most likely to assist learners is a job for professionals, not amateurs!

Recommendations

In the preceding sections I have reviewed four different areas that offer insights into the skills that learners employ while learning. In this section I hope to bring these diverse areas together in a set of general recommendations to the producers of The Essential Learning Skills Television Project.

The literature reviewed indicates strongly that effective learners are active learners. Whether this activity is overt or covert seems less important than whether this activity occurs. But the literature from the instructional development field indicates strongly that active responses must be made for the right reasons -- the responses must be relevant to the instructional objectives, or it must be possible to make the responses correctly only when the appropriate cognitive processes have been employed. Incorrect responses must be corrected since responses tend to be learned whether correct or incorrect. Responses that the learner is not able to make must be prompted and strengthened when they occur by, perhaps, simplifying at first, then gradually introducing the desired level of complexity.

How may learners be active? One obvious way is repetition of the criterion responses. Surely many learning activities profit

from repetition: motor skills like tennis, golf, driving a car, piano playing, and painting. Memorizing verbal information such as poems, speeches, or mnemonics, is also facilitated by repetition. Repetition is a powerful learning skill and should be systematically taught to children. Unfortunately this skill has fallen into disrepute in many educational settings because of an unwarranted association of it with "rote" learning. But repetition is a principle easily incorporated into the television programs and a skill easily taught to children in grades four through six.

Repetition is not always the most economical way to learn, however. Learning the sequence 149162536496481 can be accomplished through repetition but is still easier if mnemonic principles such as grouping analytic substitutions, rhyming, and the like are employed. The sequence is still easier to learn if the learner discovers or is told that the numbers are really the squares of the well-known sequence 1,2,3,4,5,6,7,8,and 9. Mnemonics represent a powerful memory tool that any learner is capable of learning. The basic principle underlying all mnemonics is that the learner uses something he/she already knows very well to learn something new. The memory tricks seen on television and in the movies are based directly on this principle. Feats of this sort are possible only after a substantial investment of time and effort (perhaps years) in learning the system. But simpler mnemonics are easily taught to children in grades four through seven. The simple rhyme "one is a bun, two is a shoe, ...ten is a hen" is easily taught to

children and can be used to demonstrate the use of mnemonics to learn lists. Grouping and rhyming are natural behaviors to many children, and my own experience (a son in cub scouts) is that with a little instruction and encouragement they can use these techniques to learn.

The study skills reviewed earlier in this paper likewise reflect the recommendations already made: students should be active learners, and they should learn by actively relating the new material to what they already know. Notes, outlines, summaries, and underlining, all operate to highlight the important points of a presentation so that they can be actively practiced. If students are to do the note-taking or outlining, they should be well trained to identify the important points of the presentation, the cues to look for (e.g., topic sentences, section headings in prose, intonation patterns in speech). The goal of these notes or outlines is, in my opinion, to produce a situation where active practice is more easily accomplished by, for instance, reviewing notes or underlining, re-reading summaries or overviews. Study skills are really organizational skills, preliminary steps that allow a more systematic study of the material. Such skills are vitally important if students are not to be overwhelmed by the amount of material they are expected to learn. For younger learners, we may have to do a good deal of this preorganizing for them, but grades four through six are not too early to begin to teach these skills.

Especially important skills to teach at this age are those associated with skilled reading or listening. The vast majority of the information we wish to communicate to students is provided

through the medium of connected discourse. Efficient decoders of verbal information are efficient learners. Recent cognitive theory has provided many insights in the processes of skilled reading and listening. Reading speed is increased, and reading and listening comprehension are improved if the learner exploits his already existing knowledge of the topic and his knowledge of how information is normally communicated. The first type of knowledge suggests that information should be presented in contexts familiar to the children. If the topic to be communicated is care of animals, the discussion should probably use familiar examples like dogs and cats rather than sharks or boa constrictors. Later in the presentation more exotic animals can be introduced. Children should be reminded or urged to remember what they already know about the topic and try to relate the new information to this preknowledge. Imagine the following experiment. Two groups of subjects are tested over a particular topic, say, the anthropology of New Guinea tribesman. Neither group reads anything about the topic, but one group is instructed to imagine going to the library, getting a book off the shelf, and reading a book about New Guinea tribesman. Invariably, when I have informally conducted this experiment, the "imaginary" group scores slightly but significantly higher than the control group. The point is that everybody knows a little something about most any topic and this knowledge can be used as a basis for new learning.

The second type of knowledge important for reading and listening is knowledge of how such communication ordinarily takes place. In this category would be included knowledge of grammar, syntax, spelling patterns, and phrase structure. Also included would be such knowledge as:

the first sentence in a paragraph is often the topic sentence, section headings are often clues to the organization of the passage, when a speaker raises his voice he is often making an important point, and so on. Knowledge of these conventions could aid students immeasurably in learning from discourse. A similar argument could probably be made for pictorial communication, although my personal knowledge of the conventions in such media is limited.

Steps can be taken quite early to teach students to employ the first type of knowledge. Students can be asked to think or write down or say aloud all they already know about a topic. Sometimes erroneous information that the child already has will need to be corrected, but such a case would only be apparent when the child verbalizes. In the ideal situation, the instruction should be individualized to the state of the child's existing knowledge, but such ideals are seldom practical. It will often be sufficient that the child establishes some context for the information, often, indirect ones such as by analogy.

The second category of knowledge is more subtle. The conventions of communication modes are often best taught indirectly by exposing the children to numerous examples. In a sense, the child's job is to discover the structure that exists in communications. For example, very young children need to know the conventions of the convers ion mode, such as a question requires an answer, directions are to be followed, and so forth. These connections may be regarded as the structure of the conversation mode and must be acquired if the child is to be socialized. Older children must likewise acquire the structure of verbal and visual modes. Abstract descriptions of the conventions may not be easily taught to students in grades four through

six. I honestly don't know. But children are excellent at perceiving and using the structure present in situations even when they can not verbalize it, which suggests providing them with multiple experiences with these media.

The section on adjunct aids suggested numerous types of stimuli that can be added to materials to facilitate learning. My view of this literature leads me to regard adjunct aids primarily as remediation devices. Bright students who have good organization and information processing skills have little need for adjunct aids unless the learning materials are unfamiliar or difficult for them. Such students learn no matter what we do to them. But the less able and younger student will profit from adjunct aids that are carefully designed to support the lesson objectives. But, and this is critical, students must be instructed in the use of these aids. The best adjunct aid is useless unless the student makes proper use of it. For example, a majority of the studies on behavioral objectives have failed to test whether students paid attention to them at all, let alone whether the students use them efficiently. Such training should be an integral part of The Essential Learning Skills Television Project.

In summary, the literature on learning skills offers much promise to those interested in increasing these skills in students. It is hoped that this review points out those areas most likely to be productive in the development of materials for The Essential Learning Skills Project.

Reference List

Anderson, J. R. & Bower, G. H. Human associative memory. Washington, D.C.: Winston, 1973.

Anderson, R. C. How to construct achievement tests to assess comprehension. Review of Educational Research, 1972, 42, 145-170.

Anderson, R. C. The notion of schemata and the educational enterprise. In R. C. Anderson, R. J. Spiro, & W. E. Montugue (Eds.), Schooling and the acquisition of knowledge. Hillsdale, N. J.: Lawrence Erlbaum Associates, in press.

Anderson, R. C. & Biddle, W. B. On asking people questions about what they are reading. In G. Bower (Ed.), Psychology of learning and motivation (Vol. 9). New York: Academic Press, 1975.

Anderson, R. C. & Faust, G. W. Educational psychology. New York: Dodd Mead, 1973.

Anderson, R. C. & Kulhavy, R. W. Imagery and prose learning. Journal of Educational Psychology, 1972, 63, 242-243.

Anderson, R. C., Kulhavy, R. W., & Audre, T. Conditions under which feedback facilitates learning from programmed instruction. Journal of Educational Psychology, 1972, 63, 186-188.

Anderson, R. C., Reynolds, R. E., Schallert, D. L., & Goetz, E. T. Frameworks for comprehending discourse (Tech. Rep. No. 12). Urbana, Ill.: University of Illinois, Laboratory for Cognitive Studies in Education, 1976.

Atkinson, R. C. & Shiffrin, R. M. Human memory: A proposed system and its control processes. In K. W. Spence & J. T. Spence (Eds.) The psychology of learning and motivation (Vol. 2). New York: Academic Press, 1968.

Ausubel, D. P. The psychology of meaningful verbal learning. New York: Grune and Stratton, 1963.

Barnes, B. R. & Clawson, E. V. Do advanced organizers facilitate learning? Recommendations for further research based on an analysis of 32 studies. Review of Educational Research, 1975, 45, 637-660.

Begg, I. & Paivio, A. Concreteness and imagery in sentence meaning. Journal of Verbal Learning and Verbal Behavior, 1969, 8, 821-827.

Browning, W. G. A critical review of research and expert opinion on the underlining study aid. In Wallace D. Miller and George McNinch (Eds.), Reflections and investigations on reading. Twenty-fifth yearbook of the National Reading Conference. Clemson, S. C.: National Reading Conference, Inc., 1976.

Carter, J. F. & VanMatre, M. H. Note-taking versus note having. Journal of Educational Psychology, 1975, 67, 900-404.

Clark, D. C. Teaching concepts in the classroom: A set of teaching prescriptions derived from experimental research. Journal of Educational Psychology, 1971, 62, 253-278.

Craik, F. I. M., & Lockhart, M. Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 671-684.

Cunningham, D. J. Task analysis and part versus whole learning methods. AV Communication Review, 1971, 19, 365-398.

Cunningham, D. J. The development of a theory of adjunct aids. Paper presented at the annual meeting of the National Reading Conference. Tampa, Fla. Dec., 1975.

Davies, I. K. Competency based learning: Technology, management, and design. New York: McGraw-Hill, 1973.

Duchastel, P. C. & Merril, P. F. The effects of behavioral objectives on learning: A review of empirical studies. Review of Educational Research, 1973, 75, 250-266.

Dwyer, F. M. Adapting visual illustrations for effective learning. Harvard Educational Review, 1967, 37, 250-263.

Fredrickson, C. H. Representing logical and semantic structure of knowledge acquired from discourse. Cognitive Psychology, 1975, 7, 371-455.

Gagne, R. M. The conditions of learning (2nd ed.). New York: Holt, Rinehart, and Winston, 1970.

Hartley, N. & Davies, I. K. Pre-instructional strategies: The role of pre-tests, behavioral objectives, overviews and advanced organizers. Review of Educational Research, 1976, 46, 267-292.

Hershberger, W. H. Self-evaluation responding and typographical cuing: Techniques for programming self-instructional reading materials. Journal of Educational Psychology, 1964, 55, 288-296.

Kintsch, W. The representation of meaning in memory. Hillsdale, N.J.: Lawrence Erlbaum, 1974.

Lorayne, H. & Lucas, J. The memory book. New York: Stein & Day, 1974.

Meyer, B. J. F. The organization of prose and its effects on memory. Amsterdam: North-Holland Publishing Co., 1975.

Meyer, B. J. F. Organization in prose and memory: Research with application to reading comprehension. Paper presented at the Annual Meeting of the National Reading Conference, Atlanta, Ga., December, 1976.

Meyer, B. J. F. & Freedle, R. The effects of different discourse types on recall. Princeton, N.J.: Educational Testing Service, in press.

Neisser, U. Cognitive psychology. New York: Appleton, 1967.

Norman, D. H. Memory & attention. (2nd ed.). New York: Wiley, 1976.

Paivio, A. Imagery and verbal processes. New York: Holt Rinehart, and Winston, 1971.

Rothkopf, E. Z. Learning from written materials: An exploration of the control of inspection behavior by test-like events. American Educational Research Journal, 1966, 3, 241-249.

Rummelhart, D. E. & Ortony, A. The representation of knowledge in memory. In R. C. Anderson, R. J. Spiro, & W. E. Montagur (Eds.), Schooling and the acquisition of knowledge. Hillsdale, N.J.: Lawrence Erlbaum Association, in press.

Smith, F. Understanding reading. New York: Holt, Rinehart, and Winston, 1971.

Snowman, J. & Cunningham, D. J. A comparison of pictorial and written adjunct material in learning from text. Journal of Educational Psychology, 1975, 67, 307-311.

Spitzer, H. F. Studies in retention. Journal of Educational Psychology, 1937, 30, 641-656.

Yates, F. A. The art of memory. Chicago: University of Chicago Press, 1966.

Selected AIT Research Publications

This list includes research reports from AIT and its predecessor organizations, NITL, NCSCT, and NIT. Most of these reports have been distributed widely and may be obtained from AIT (cost, if any, is indicated) and from the ERIC system. For a complete list of AIT research publications write to: Research Department, AIT, Box A, Bloomington, Indiana 47401.

AIT RESEARCH REPORTS

Report of "Ripples" Evaluation Activities to the Consortium Members. NITC, July 1970.

"Images & Things" Evaluation Report to Consortium Members. NITC. September 1971.

The "Inside/Out" Evaluation: The First Five Programs, Parts I and II. Bureau of Public Discussion, Indiana University, July 1972. $5 (ED 070 250 and ED 070 251)

"Ripples" A Third-Year Survey. AIT, December 1973.

Report on Evaluation Activities of the "bread & butterflies" Project. Educational Testing Service and AIT, October 1974. $3 (ED 097 921)

Formative Evaluation of "Self Incorporated" Programs (Research Report 30) AIT. January 1976. $5 (ED 119 712) Summary. (ED 119 711)

"Inside/Out" Teacher's Guide Survey (Research Report 31). February 1976

A Compilation of Instructional Television Series for Secondary School Use (Research Report 38). June 1976.

AITATTN: The AIT Attention Plotting Program (Research Report 45) January 1977

Affective Films for the Hearing Impaired Child: A Test of Captioned "Inside/Out" Programs (Research Report 46). April 1977.

A Challenging Picture: The Status of ITV Utilization in Secondary Schools (Research Report 47). June 1977.

Research on the Use of Television in Secondary Schools (Research Report 48) June 1977.

School Television in the Archdiocese of New York (Research Report 51) July 1977

The ITV Experience at Evanston Township High School (Research Report 52). July 1977. No Charge.

An Experiment in Autonomy: Secondary School Television Use in Two Coastal Georgia Schools (Research Report 53). July 1977.

The Allegheny Educational Broadcast Council: Instructional Television in Central Pennsylvania (Research Report 54). July 1977.

Field Test of Trade-offs Program #4: Trade-offs Among Goals (Research Report 55) December 1977.

MeasureMetric Test Development (Research Report 56). December 1977.

A Responsive Evaluation of Inside/Out (Research Report 58). November 1977

Field Test of Four Versions of Trade-offs Program #2: Malcolm Decides (Research Report 59) December 1977.

Testing of Trade-offs Four-Program Cluster (Research Report 60) December 1977

Trade-offs #4. Effects of Lessons by Trained and Untrained Teachers (Research Report 61) December 1977.

The Status of Arts Education in the Public Schools (Research Report 62) January 1978

A Compilation of Instructional Television Series in the Arts (Research Report 63) January 1978

Guidelines to Media Utilization Lessons from Project Discovery (Research Report 64) July 1978

Survey of Library Facilities at Telecommunications and Educational Research Organizations (Research Report 65). August 1978.

ESSENTIAL LEARNING SKILLS RESEARCH REPORTS AND PAPERS

Background Papers

Byron G. Massialas. *Coping in the 1980's: Inquiry Skills and Participation in Decision-Making for Fifth and Sixth Graders.* 1976.

Karen P. Middleton, *Library Skills Instruction in the Fifth and Sixth Grades.* 1977.

John J. Patrick and Richard C. Remy, *Essential Learning Skills in the Education of Citizens.* 1977.

Philip Peak, *Teaching Mathematics: An Integration of Skill and Knowledge.* 1977.

Mary Lou Ray, *Communication, Fifth and Sixth Graders, and The Essential Learning Skills Television Project.* 1977.

Wilbur Schramm, *Some Notes on Research, Theory, and Production in Instructional Television.* 1977.

Research Reports

Review of State and National Assessment Information. March 1977.

Responses to the Essential Learning Skills Experimental Bulletin. April 1977.

A Program Evaluation Concept and Methodology—The Video Storyboard: An Evaluation of "The Public Library." May 1977.

Skills Review. June 1977.

Summary of Goals Sort Verification Activity. June 1977.

Surveys of Time Spent in Instructional Activities, of Instructional Resources, and of Instructional Themes. June 1977.

Preliminary Findings of Evaluation Data for the First Three Experimental Programs and the Hey Wait! Think, See, So Show Excerpt. November 1977.

Final Report of the Field Research on the First Three Experimental Programs. February 1978.

Summary Report of Experimental Phase Field Testing. February 1978.

Working Papers

Janet Alexander and Candace Garrett, *Fifth and Sixth Graders: Their Attitudes about Parents, Peers, School, and Themselves.* September 1976.

Candace S. Garrett and Patricia M. Marshall, *Cognition in Fifth and Sixth Grade Children.* February 1977.

James G. Greeno, *Solving Problems.* February 1977.

Donald J. Cunningham, *Learning Skills and Instruction.* June 1977.

Fred L. Perry, Jr., *Memory: As it Relates to Children Ages 9 to 12 Years.* June 1977

Nancy Malacek Neubert, *Self-management as an Essential Skill: What the Business Literature Suggests.* July 1978