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THE EFFECTS OF DIFFERENT TYPES OF ORGANIZERS

ON STUDENT LEARNING FROM TEXT

by

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B.Sc.. University of Toronto. 1967

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF

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THE EFFECTS OF DIFFERENT TYPES OF ORGANIZERS ON STUDENT

LEARNING FROM TEXT

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ABSTRACT

Advance organizers are hypothesized to enhance learning by promoting learners to link new information to information the learner already knows. No research, however, empirically demonstrates that linking actually occurs. Also, advance organizers are poorly operationalized in most previous research and there are many apparently contradictory findings. This study addresses these weaknesses by operationally defining different types of organizers in terms of a hierarchical map of new information and by collecting evidence of whether learners actually link new information to information in an advance organizer.

Prior to reading a 30-paragraph article about computer crime and prevention, Grade 8 students read one of four types of organizers. Two were conceptual advance organizers, abstract concept and analogy, and two were pseudo-organizers, outline or dummy. While reading the article, students traced connections between paragraphs of the article and sections of the organizer. After reading, students answered short-answer questions, categorized technical terms introduced in the article, and completed two multiple-choice tests.

A multiple linear regression analysis with backward rejection of statistically non-reliable predictors tested for main effects of tracing and types of organizers and trace-treatment interactions. Tracing correlated positively with both multiple-choice tests but students reading conceptual organizers had low average tracing scores (29% and 37%). Apparently, making connections between a conceptual organizer and new information is difficult. The failure to find main effects due to different organizers suggests that students have difficulty productively using conceptual organizers.

Several disordinal interactions were found. Tracing was generally uncorrelated with achievement for students reading pseudo-organizers but correlated positively with achievement for students reading a conceptual organizer. Better tracers reading a conceptual organizer outperformed better tracers reading a pseudo-organizer on all three achievement tasks. This suggests that conceptual advance organizers do enhance learning when students actually connect them to information to be learned.

Further research needs to explore how students' use of organizers, operationalized by traces, relates to achievement. An important focus in this research is to specify the cognitive processes students use while tracing to connect information in advance organizers to new information.

ACKNOWLEDGEMENTS

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INTRODUCTION

Students in schools are daily faced with the task of absorbing new and often complex material. A reading assignment is a common task given to students in schools. The text material contains content that the teacher wants students to learn. Explicitly or implicitly, the teacher sees the text as a collection of propositions that students must master. In the best case, the teacher will have a clear, written plan of the propositions and their relations. At worst, the implied structure may be a random list of facts. In either case, the text material that the student is given to read will typically contain content that the teacher believes is important and some that the teacher perceives to be extraneous to the goal of the lesson.

By the time they reach high school, students have been trained to understand that text materials that they are given to read are not meant to be memorized verbatim. They interpret an instruction like "Learn Chapter 3" to mean "Learn the important points in Chapter 3", or "Be sure you understand what Chapter 3 is about", or "You will probably be tested on the ideas in Chapter 3". Their learning task is twofold. As they read, they must sift out the "important" propositions. And, they must learn them. The selection process, by which important propositions are

distinguished from less important ones, implies that a
student is organizing information as it is being read.

When the assigned task is reading, teachers use a
variety of techniques to help students select and learn the
desired material from the text. Some techniques primarily
aid students in organizing the information. Students may
be instructed to make notes following an outline. They
may be told to underline important points. The teacher may
introduce the new topic by giving a preview of the new
material or by relating it to a topic previously covered.
Other techniques are used mainly to help students memorize
the information. Students may be asked to copy out
definitions of key terms or summaries from the text. Some
techniques are motivational. For example, students may be
told that they will be tested on the new material.

Another way to categorize these techniques is to say
that they include activities that occur BEFORE students
start to read (e.g. read over the assignment, listen to the
teacher's introduction), DURING their reading (e.g. write
notes, answer questions), and AFTER the reading (e.g. an
oral or written test).

This sequence can be viewed more formally as

1. the presentation of an introduction (BEFORE)
   that provides criteria for selecting important
   points

2. assimilation of the new material by the
   students, often through elaboration activities
   (DURING) that may re-organize the information,
   and

3. practice and testing (AFTER)

The study carried out here is concerned with the first
step in this sequence. Teachers use introductory
activities to motivate students and to prepare them for the
new learning task. One way to prepare students for
selecting and then learning new material is to review
prerequisite knowledge and skills. Another way is to
provide a meaningful context for the new material. The
underlying assumption in this method is that students will
learn better if they are able to connect the new
information that they are studying to some previous
knowledge.

Advance organizer model of instruction

The importance of providing or introducing a context
to which new material could be related was formally
proposed by Ausubel (1963) as the advance organizer model
of instruction and is derived from his assimilation theory
of learning. During the past 23 years, the model has been
applauded, attacked, extended and refined.

Ausubel's instructional prescriptions are so closely bound up with his learning theory that it is difficult to separate the two. An examination of the advance organizer model must necessarily begin with a description, albeit abbreviated, of Ausubel's ideas about learning. While acknowledging that schools are concerned with developing a variety of skills like problem-solving and critical thinking, he sees transmission of knowledge as schools' principal function.

> "The learner is merely required to comprehend the material meaningfully, and to incorporate it or make it available or functionally reproducible for future use." (1963, p.1)

The particular target of the advance organizer model is the acquisition of a body of knowledge.

Ausubel distinguishes between meaningful and rote learning. Rote learning is verbatim memorization; materials learned this way are stored in memory as relatively isolated facts with few or no connections to a larger ideational structure. Meaningful learning is incorporation of new information into an existing cognitive structure; materials learned this way are connected to ideational structures already in memory. While Ausubel does not define operationally the cognitive processes that make incorporation different from verbatim memorization, he implies that students who learn "meaningfully" will be able to successfully apply their knowledge to new situations,

but that students who learn in a rote fashion will not be able to apply their knowledge to new situations so readily.

Ausubel assumes that cognitive structures are organized in a hierarchical way. At the top are abstract and highly inclusive concepts. At lower levels are progressively less abstract and less inclusive concepts which are subsumed, or absorbed, by concepts in the upper levels. At the bottom are specific informational data (Ausubel, 1963).

Assimilation theory says that students learn by linking new propositions to an existing cognitive structure. Therefore, students who have an appropriate existing cognitive structure will learn more successfully than those who don't. An instructional technique designed to promote the development of appropriate cognitive structures is the advance organizer. Advance organizers are presumed to provide students with an appropriate cognitive structure to which new material can be assimilated meaningfully. The purpose of an advance organizer is to provide "ideational scaffolding" (Ausubel, 1963) for the new material, a means of anchoring new ideas to existing ones.

Rossner (1982) criticizes Ausubel's work for theoretical ambiguities and for the lack of operational definitions of learning variables. She points out that Ausubel does not define theoretical terms clearly, does not make clear distinctions between assumptions, preconditions

for learning. learning theory. and instructional techniques, and does not always maintain logical consistency between his assumptions and theory. The lack of operational definitions, both for instructional techniques and measures of learning, make empirical research into his work difficult.

Information-processing model of cognitive structure

Nevertheless, advance organizer research has occupied many researchers over a period of over twenty years. The information-processing model of cognitive structure that is generally accepted by the current generation of educational researchers (Anderson, 1980: Mayer, 1979b) is an extension of Ausubel's strict hierarchy of concepts. In spite of the weaknesses in the fleshing out of Ausubel's theory. assimilation theory. modified by other researchers, has remained a powerful explanatory tool in educational research. While the theoretical background for this study has its roots in Ausubel's work, this study will rely more on later versions of assimilation theory. particularly Mayer's (Mayer 1979b).

The basic unit of declarative. or factual, knowledge is the proposition (Anderson. 1980) which represents a single idea. Propositions are not stored in memory independently but form a network linked by relations. A cognitive structure can be modelled as a propositional network. The network may be hierarchical. with abstract and highly inclusive concepts at the top, and progressively

less abstract and more specific concepts at lower levels,
as in Ausubel's theory. Or, it may be a more diffuse
network with many lateral as well as vertical links (Mayer,
1980). Networks may be complex webs of relationships or
have few links. This propositional network model for
cognitive structure is quite popular in current research,
and does have some empirical support (Mckeithen et al.,
1981).

Research on advance organizers has been hampered by
the lack of an operational definition of an advance
organizer. Ausubel defines an advance organizer as
introductory material, presented before the new learning
task, at a higher level of abstraction, generality, and
inclusiveness than the new task. The content of an
organizer is selected to be suitable for explaining,
integrating and interrelating the new material (Ausubel,
1963). In practice, almost any type of activity that
precedes a learning task has been called an advance
organizer - for example, written passages, overviews,
diagrams, presentations of behavioural objectives.

Operational definitions of advance organizers

Four "organizers" are investigated in this study.
They will be called the abstract concept, the analogy, the
outline, and the dummy. Each can be defined in terms of
its relation to a propositional map of the new material.

Let us examine the structure of some hypothetical content to be learned, that can be organized in a hierarchical fashion as shown in Figure 1.

X represents an abstract, general concept, say the idea that new crimes arising from new inventions require the development of new methods of control and prevention. This idea is one that the learner would likely already know. A, B, C, etc. are more specific elaborations of the general concept. These might be examples of new crimes and methods of prevention related to particular inventions - for instance, computers, photocopiers, video cassette recorders. A1, A2, A3, A4 are still more specific elaborations of idea A. They may include descriptions of ways of committing computer crimes, examples of computer crime, methods of protecting computer machinery from abuse, methods of protecting information stored in computers from abuse. The pattern continues similarly for B, C, etc. In this example, the portions of the map representing ideas A and B are congruent, while the portion representing C is different, to illustrate that a cognitive structure is not necessarily a symmetrical structure.

2

FIGURE 1

Example of Hierarchical Content Map
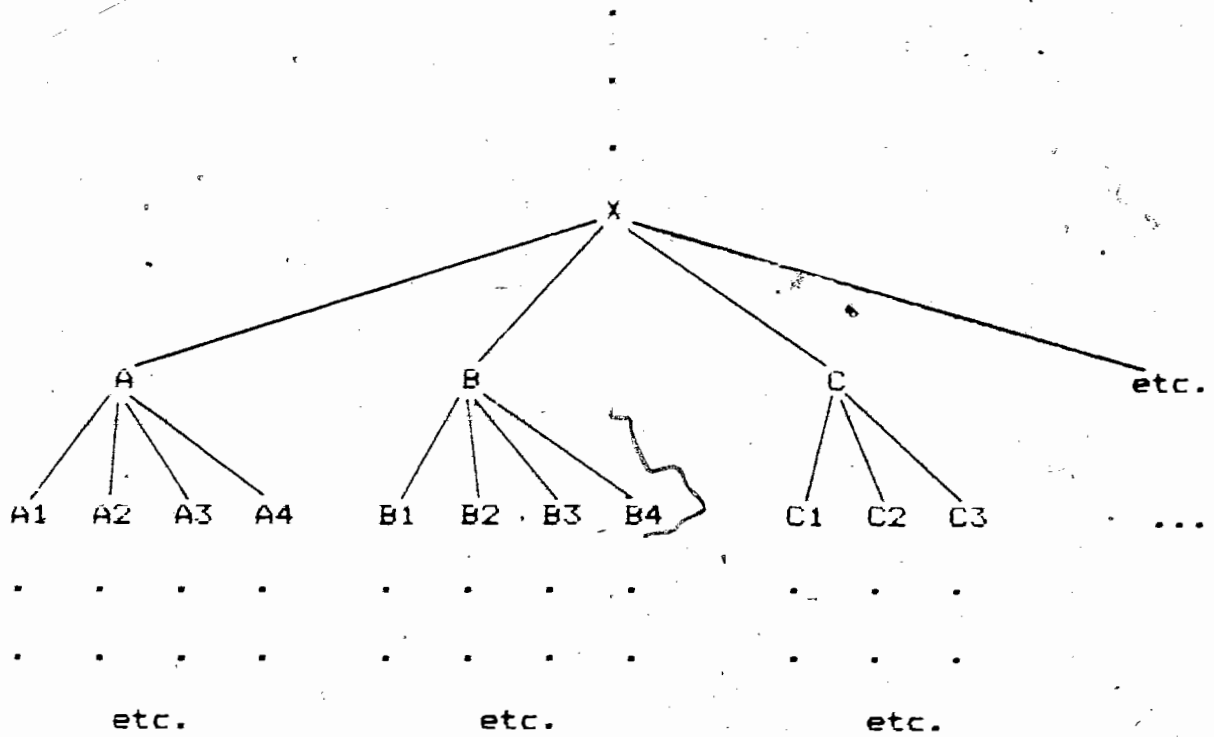
This structure is highly idealized. In real new material taught in schools, we would expect hierarchical structures like this to be obscured by cross-connections. In the previous example, the idea "theft of stored data" is connected to "ways of committing computer crimes" by the relation "is one instance of". The same "theft of stored data" idea is connected to "locking computer programs" by the relation "can be prevented by". These are but two simple examples of connections. Even so, this idealized structure can serve to illustrate the differences among the four "organizers" used in this study as shown in Figure 2.

In Figure 2, concept A and its cascading nodes and sub-nodes, represent the body of new information that is to be learned.

The abstract concept organizer is Ausubel's classic expository advance organizer (Ausubel. 1963). It is found at a higher hierarchical level than the part of the map that represents the new material. It corresponds to the portion of Figure 2 that includes concept X, a concept which the learner likely already knows. In terms of the hierarchical map, a learner would make connections vertically between specific points in the new material and the more general information in the organizer. These connections can also be classified as external, linking new information to previously known information.

FIGURE 2

Different Types of Organizers Defined in Relation to

a Hierarchical Content Map of New Material to be Learned
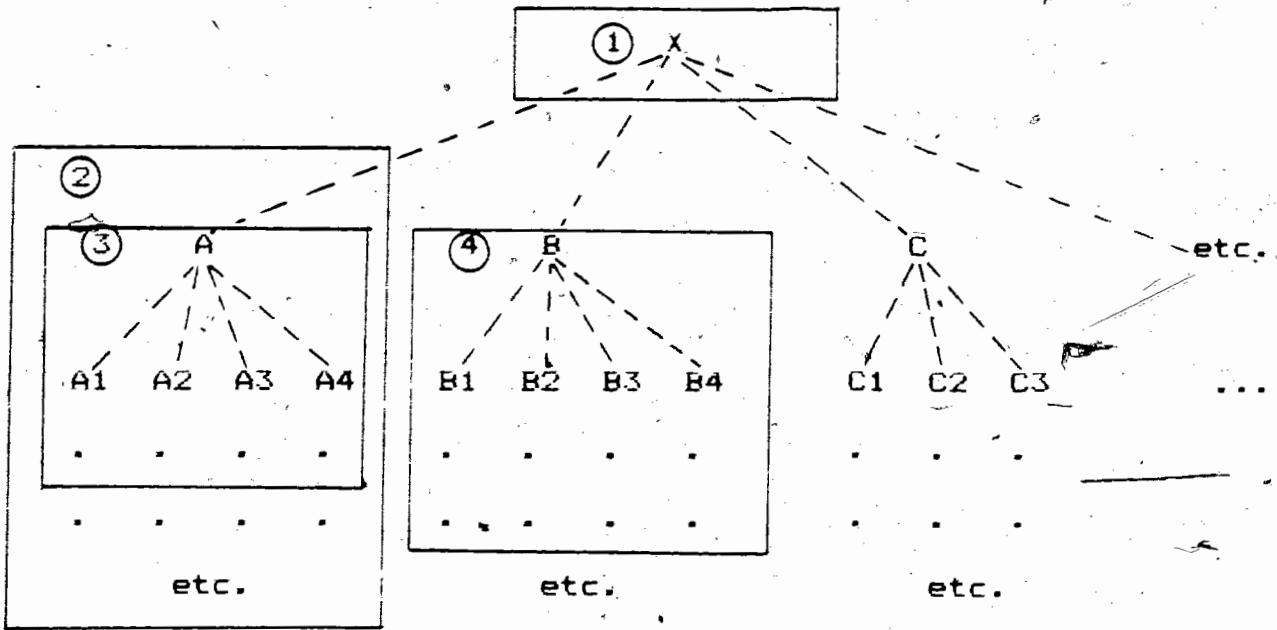
1 = abstract concept organizer

2 = new material

3 = outline organizer

4 = analogy organizer

The analogy organizer is a structure of information that is congruent to that of the material to be learned. However, the topic of the analogy is different from the material to be learned. In Figure 2, this organizer consists of concept B and its related nodes and sub-nodes. Concept B, the topic of the analogy, is assumed to be already familiar to the learner. In terms of the hierarchical map, the learner would make predominantly lateral connections between particular points in the new material and associated points in the analogy. These connections are also external; they link new information to previously known information. The analogy organizer has some similarities to Ausubel's comparative organizer (Ausubel, 1963) and to Mayer's concrete model (Mayer, 1975b) but is not identical to either.

The abstract and analogy organizers will be classed as conceptual organizers. In using them, students are encouraged to relate the new material to previously known information. In other words, both of these organizers encourage connections to information external to the new material. The remaining two organizers will be classed as psuedo-organizers because they do not foster the making of connections to external information.

The outline organizer is actually a part of the map of the new material. It consists of one or several levels of the hierarchical map of the material to be learned. In other words, it is a subset of the new material. As such,

it does not fit Ausubel's definition of an advance
organizer. Instead, it approximates the rote-learning
situation. In terms of the hierarchical map, the learner
would make vertical connections between data in the new
material and points in the outline. Unlike what is
presumed to happen with the abstract concept, however,
these vertical connections would be internal, relating
points in the new material only to other new points. There
would be no connection to previously learned information.
The outline organizer is included in this study for
comparison purposes.

The dummy organizer is a body of information that is
unrelated to the new material. It does not even appear in
the hierarchical map given in Figure 2. The information in
the dummy is of no assistance to the learner in organizing
and learning the new material. It is included in the study
to control for the effects of the rehearsal of material
that would take place in the effort to make connections,
regardless of whether there were any connections to be
found.

While these definitions are far from being
operational, they do provide the beginnings of a scheme for
classifying advance organizers. It is reasonable to
suppose that the use of structurally different advance
organizers might lead to differences in the ways that
students assimilate the new material. Table 1 compares

TABLE 1

A Comparison of the Structure and Predicted Effects
of Different Types of Organizers

Type of Organizer / Characteristic	abstract concept	analogy	outline	dummy
level	higher	same	same but subset	outside content map
topic	same	different	same	different
linking	vertical	lateral	vertical	---
external connections	strong	strong	weak	---
internal connections	weak	weak	strong	---
effect on near transfer	negative	neutral	positive	neutral
effect on far transfer	positive	positive	negative	neutral

Explanation of Characteristics

level - hierarchical level of organizer in relation to new
        material
topic - topic of organizer in relation to new material
linking - main direction of concept linking
        new material--->organizer
external connections - new material--->previous knowledge
internal connections between propositions in new material
effect on near transfer - effect on recall of factual data
effect on far transfer - effect on transfer of information
        to new situations

some of the characteristics of the different types of
advance organizers and their possible effects.

Previous research

Advance organizer research has explored the effects of
advance organizers on a variety of dependent variables.
There are many apparently contradictory results. Early
studies in the 1960's and early 1970's mostly looked for
evidence of a main effect, namely, whether advance
organizers facilitated learning or not. Many of these
studies produced conflicting results and no reliable
conclusions could be generalized from them. Later studies
examined the effects of advance organizers at a finer level
of detail and were often concerned with interaction
effects. In other words, what are the combined effects of
advance organizer and some other variable, like student's
ability, amount of practice, type of learning? While there
are still apparent contradictions in more recent research,
the picture that seems to emerge from the majority of
studies is that advance organizers have a facilitative
effect on transfer of learning to new situations, but
little or no effect on simple recall of the material read
by students following exposure to the advance organizer.
The major weakness in all the studies is that the learner's
use of the advance organizer is largely ASSUMED. Little
empirical evidence is offered to show what use, if any,
learners actually make of the advance organizer. Winne
(1984) shows that it is possible to obtain empirical

evidence of student cognitive processing and describes methods by which such evidence can be collected.

Purpose

This study attempts to rectify this flaw about assuming students' use of the advance organizer by having learners leave behind a concrete trace of their efforts to relate the new material being learned to the advance organizer. Thus, the goal of this study is to trace and compare the effects of the different types of organizers described earlier.

The next chapter reviews a selection of the copious literature in this field, concentrating particularly on the work of Richard Mayer, and focussing on the issues to be addressed in this study. It also presents the hypotheses of this study. Chapter 3 describes the experimental design developed to test the hypotheses and to rectify some of the flaws evident in previous research. Chapters 4 and 5 present and interpret the findings of the experiment, and the conclusions drawn from it. Finally, the appendix contains the actual materials used in the experiment and more detailed descriptions of some scoring procedures.

CHAPTER 2

REVIEW OF THE LITERATURE

Summary of previous reviews

Studies carried out during the 1960's and early 1970's generally tested the effects of advance organizers on student achievement, measured by a posttest. Barnes and Clawson (1975) reviewed 32 such studies, finding that 12 reported that advance organizers facilitate learning and 20 reported that they do not. From this review, they concluded that "advance organizers, as presently constructed, generally do not facilitate learning" (p.651).

The studies in Barnes and Clawson's sample were very diverse. They classified them according to the following variables.

variable	range
duration of study	20 minutes - 20 weeks
students' ability	educable mentally retarded
	- intellectually gifted
students' grade level	Grade 5 - graduate school
subject matter	religion, mathematics,
	science, social studies
type of organizer	written passage, graph,
	simulation game, diagram

There was a variation in the types of learning measured. However, descriptions of posttests are generally so skimpy

that it is unclear what precise achievements they are measuring.

Barnes and Clawson tried to summarize the impact of each of these variables on the efficacy of advance organizers. In all cases, they concluded that there was no particular effect. Since the studies that were similar in any one variable, also exhibited wide differences in several others, this result is not particularly surprising. With so many variations in the studies, a tally of the yes/no "votes" based on statistically reliable differences seems simplistic and inappropriate.

Barnes and Clawson offer nine recommendations for further research. Essentially they suggest that good research techniques should be followed, including the use of operationally-defined advance organizers, and that research should continue to explore all the variables, listed earlier, that they used to classify the studies.

Lawton and Wanska (1977) criticize Barnes and Clawson's review on several points, including inconsistencies in presenting the findings and misinterpretations of Ausubel's theory. Lawton and Wanska point out that it is unreasonable to generalize from a group of studies that differ in terms of a large group of variables, even though they may be similar in one. They also stress that Ausubel's theory does not require that meaningful learning occur ONLY when an advance organizer is presented. Meaningful learning requires a relevant

assimilative set. A relevant assimilative set is a cognitive structure to which a learner can link propositions contained in the new material. Only in the case where the student does not already possess a suitable assimilative set, are advance organizers predicted to be effective.

> "Most of the apparent contradictions in the related research data are consistent with the view that all meaningful learning (according to Ausubel's theory) occurs either as a result of spontaneously concerned subsumers or by acquiring relevant subsumers from the learning of an advance organizer." (Lawton and Wanska, 1977, p.240)

Moreover, West and Fensham (1976) point out that there is no guarantee that learners will use relevant subsumers.

In their recommendations, Lawton and Wanska continue the theme of the need for operationalizing definitions of advance organizers.

> "Before we ask whether organizers facilitate learning, more definitive and stringent tests of the structure of organizers are required." (p.243)

They also point out the need for more rigorous analysis of the subject matter, of pretests to measure the learner's initial state of knowledge, and of achievement tasks that can assess different types of learning.

Hartley and Davies (1976) reviewed fifteen years of research into the effects of four different pre-instructional strategies, namely pretests, behavioural objectives, overviews and advance organizers. Like the other reviewers, they found many instances of conflicting results and concluded that "at the present time, most of

the research seems confused". (p.256). They state strongly that the concept of advance organizer must be operationalized before additional experimentation will be worthwhile.

In a more comprehensive and penetrating review of advance organizer studies, Mayer (1979b) concludes that advance organizers can affect learning. Mayer divides advance organizer studies into two categories — standard, in which one group receives an advance organizer before instruction while the other receives either a control passage or nothing; and modified, in which one group receives an advance organizer before instruction while the other receives an organizer after instruction. He reviewed 27 standard studies and 17 modified studies.

Important features of Mayer's review, in comparison to Barnes and Clawson's and Lawton and Wanska's, are the larger number of studies considered, a more precise description of the conditions under which advance organizers are predicted to have an effect, and a broader evaluation of the studies. Mayer is critical of Barnes and Clawson's conclusions. He suggests that even negative results can be consistent with assimilation theory.

Mayer's review is guided by a model that describes three conditions for meaningful learning.

"Reception - the new material must be received by the
learner.
Availability - the learner must possess, prior to
learning, a meaningful assimilative context for
integrating the new material.
Activation - the learner must actively use this
context during learning to integrate the new
information with old." (p.134)

Mayer's assimilation theory predicts that advance
organizers will have an effect when the second and third
conditions, availability and activation, would not
otherwise occur. Mayer describes four situations in which
advance organizers are predicted to have an effect. They
are

1. when the material to be learned is unfamiliar to
   the learner and conceptual in nature

2. when the advance organizer provides or locates an
   assimilative context and encourages the learner to
   use that context during learning

3. when the learner would not have or use such an
   assimilative context if left to his or her own
   devices, and,

4. when the test measures breadth of learning rather
   than verbatim retention.

Advance organizers are predicted to have no effect under
the opposite of these four conditions. Mayer uses the term
"assimilative context" without definition. By it, he seems
to be referring to an existing set of concepts in the
learner's memory which can act as anchors for the new
material. In other words, Mayer's assimilative context

seems to be the same as Ausubel's conceptual anchors, or relevant subsumers.

Mayer judged the studies that he reviewed on three points - the familiarity of the new material, the likelihood of the the advance organizer serving as an assimilative context, and the results (test scores). He drew the following conclusions.

In standard advance organizer studies (advance organizer vs. control), there was a small but consistent advantage for the advance organizer group over the control group. In modified advance organizer studies (advance organizer vs. post organizer), there was some evidence that the advance organizer group outperformed the post organizer group. Advance organizers most strongly aided performance when new material was poorly organized, or when learners were inexperienced or of low ability. Advance organizers aided far transfer more than near transfer. Near and far transfer are presented as opposite ends of a continuum, with near transfer being equivalent to specific retention of details; far transfer is described as transfer to new situations. However, no operational definitions are given for transfer.

The evidence of the four reviews of early studies, Barnes and Clawson, Lawton and Wanska, Hartley and Davies, and Mayer, on the whole supports the advance organizer model. In a meta-analysis of 135 advance organizer studies, Luiten, Ames and Ackerson (1980) found that

advance organizers have a facilitative effect on learning and retention. Many of the apparent contradictions seem to have their roots in a poor interpretation of advance organizer theory or in poor methodology.

Results of the early studies gave indications of the conditions under which advance organizers can be expected to enhance learning (new or poorly organized material, inexperienced or low ability learners). They also pointed to differences in quality as well as amount of learning. However, many of these studies share some common weaknesses. Advance organizers are not defined operationally, and, in some cases, not even described adequately. Materials are often poorly described. This creates a problem particularly in trying to understand precisely what the posttests measure. Terms like "near and far transfer" and "broad learning outcomes" are used to categorize test items, but, no operational definitions are offered. This lack of operational definitions is a serious impediment to continued research in this area because Ausubel's and Mayer's assimilation theories predict that advance organizers will have different effects on different types of learning. This is a likely cause of the apparent confusion about interpretation of results of advance organizer studies. Another major weakness of these studies is the lack of any empirical support for the mechanism of action of the advance organizer. The advance organizer is assumed to PROVIDE a suitable assimilative context and to

ENCOURAGE the learner to use it. There is no guarantee
that the learner actually does use it (West and Fensham,
1976).

Pertinent studies

In a series of studies, Mayer explored issues related
to the mechanism of how advance organizers work.

An advance organizer is presumed to enhance learning
by the following mechanism. The advance organizer either
provides or activates a suitable "assimilative set" or
cognitive structure in the learner's mind. Subsequently,
while reading the new material, the learner links
propositions in the new text to propositions in the
assimilative set. The locus of effect of the advance
organizer may be at the encoding stage, when information is
being learned, or at the retrieval stage, when information
is being recalled. The new material may become integrated
with existing knowledge, producing a qualitatively
different cognitive structure as an end product, or it may
simply enlarge the existing cognitive structure by adding
information to it (Mayer 1979b).

Assimilative set. In one set of experiments (Mayer,
1975a), students were taught the concept of binomial
probability by two methods. One group was taught using a
formal statement of a rule and explanations that were
exressed only within the context of the formula. The other
group was taught by attempting to relate the variables in
the formula to the learner's experience. The first method

exemplifies the rote learning set; the second exemplifies
the meaningful learning set.

Results indicated no difference in amount of learning.
However, the first group excelled on near transfer (rote
learning), while the second group excelled on far transfer
(meaningful learning). Analysis of recall protocols
indicated that the "rule" group was adding more and more
isolated information to memory, while the "experience"
group was streamlining and integrating new material with
existing knowledge. Further, experimental results revealed
an aptitude X treatment interaction in which subjects who
had little intuitive knowledge about probability and
combinations fared better with the "rule" method, while
those who were high in these intuitions performed better
with the "experience" method. This interaction is
consistent with the idea that meaningful learning requires
that the learner have appropriate prerequisite concepts.
This sets the stage for the study of advance organizers,
which are presumed to provide an appropriate assimilative
set where one does not already exist.

A study (Mayer, 1976a) in which subjects memorized
links among nonsense letters, words, or cities was
undertaken to clarify the idea that meaningful learning
involves assimilation of new information to an existing
superordinate structure or schema. Three groups of
subjects memorized one-way links between pairs of
interlocking elements. Each group learned the same set of

associations - but in different contexts. One group
learned paired letter combinations that they were told
represented one-way paths between points in a forest, for
example, C to N. Another group learned paired-word
combinations that represented one-way message connections
between code-named spies, for example, CLERK to NEIGHBOR.
The third group learned paired city combinations that
represented one-way flight paths between US cities, for
example, CHICAGO to NEW YORK. The group that learned
flight connections between cities was given a map of the
involved cities to examine before learning. This third
treatment group is the group that is assumed to have a
relevant existing cognitive structure. The map is assumed
to function as an advance organizer, providing a meaningful
context for the new information to be learned. All groups
studied until they could reproduce the individual links of
pairs of elements (letters, words, or names of cities)
perfectly. They were then administered a transfer posttest
of problems that required them to determine the length or
cost of a path between a pair of elements. All groups
performed well on short problems, having one- or two-step
paths, but the "cities" group excelled on long, complex
problems, that had three-, four-, or five-step paths.

Mayer concluded that the map may have served as an
assimilative set. Again, support is demonstrated for the
idea that a meaningful learning set leads to a different
learning outcome.

Locus of effect. A supplemental study (Mayer, 1976a) was carried out to clarify two points. First, the effect may have been caused simply by the presence of a visual display of the connections (the map) for one group. To avoid this problem, no maps were used for any group in the supplemental study. Second, an advance organizer may have its locus of effect at the encoding stage or at the retrieval stage.

In this study, all subjects learned pairs of letters. The three treatment groups were a control group that received no further information about the letter pairs, an advance organizer group that received a list showing that the letters were abbreviations for the names of cities on airline flight paths before learning, and a post organizer group that received the letter-city list after learning. Results of the supplemental study showed that all three groups were similar in the solution of short problems, but the advance organizer group excelled on long, complex problems. Since the "before" group performed better than the "after" group, these results support the idea that the organizer functions as an encoding rather than as a retrieval aid. However, the use of the assimilative set during learning is ASSUMED. There is no direct empirical evidence of what use subjects made of the advance organizer while learning.

Learning outcomes. In a subsequent series of studies, Mayer (Mayer 1975b, 1976b, 1979a, 1980: Mayer and Bromage,

1980) explored the effect of advance organizers (among other instructional variables) on learning a computer language. The tasks in all the studies were similar - learning a computer language from a descriptive text. Evaluation of subjects' success was also similar in all the studies - a written test containing problems varying in type of activity, namely, interpreting or generating a program, and complexity. Three categories of complexity are described. The simplest type of problem involved a single programming statement. The next level used nonlooping programs. The most complex level used looping programs.

In the first experiment (1975b), the goal was to determine how different types of learning sets incorporated into instruction would influence learning. Twenty university students were the subjects in each cell of a 4X2 factorial design. The first factor was method of instruction - rule, model, rule-flow, and model-flow. The rule group received only a descriptive text describing the rules for FORTRAN statements. The model group received a diagrammatic model of a computer expressed in familiar terms, like ticket windows, scoreboards, and shopping lists, and a descriptive text that explained FORTRAN statements in terms of the model. The rule-flow and model-flow groups received flowchart representations of each of the FORTRAN statements as well as the corresponding rule or model group materials. The groups that received a

model of a computer prior to learning represent treatments that provide a meaningful assimilative set. The second factor was amount of practice. Some subjects were allowed to practice problems similar to those in the posttest after learning while others received no practice.

Subjects were first given an algebra pretest and questionnaire about previous programming experience. They were then allowed to read through the instructional booklet and learn the material at their own rates. On completion, those in the practice group were given a deck of practice cards, that presented problems similar to those in the instructional booklet, and were allowed to work through them at their own rates. All subjects were given a posttest of problems that varied by type, namely, interpretation and generation, and complexity, namely, statement, non-looping, and looping.

Mayer found no effect due to practice. He reasoned that there was no effect possibly because practice time was so short and the practice problems so simple and similar to those in the instructional booklet. There were no statistically reliable main effects due to method of instruction. However, several interesting interactions were found. A two-way interaction was found in which the model groups excelled in interpreting programs while the non-model groups were superior in generating programs. Mayer also found a 3-way interaction among method of instruction, type of problem and complexity of problem.

Superior performance was shown by the model group on

looping interpretation problems and by the non-model group

on non-looping generation problems. Use of the flowchart

resulted in better performance on generation and

non-looping problems, which Mayer classifies as problems

involving application of ideas very similar to those in the

text, but poorer performance on interpretation and looping

problems, which Mayer describes as problems requiring

extension of the material to novel situations.

The overall conclusion was that qualitative

differences in learning outcome resulted from the different

treatments. Mayer accounted for these results by

considering the model as an advance organizer.

> "Model instruction provides the learner with a rich
> set of prior experiences which are familiar to the
> learner and by which new information may be understood
> and organized; since the model is presented first and
> new material is then related to it, it shares some of
> the characteristics of Ausubel's 'advance organizer'"
> (p.732).

He proposed that model subjects had a meaningful

learning set active during learning and thus acquired a

cognitive structure with strong external connections

(connections to the assimilative set) and weak internal

ones (connections between propositions in the new

material). Nonmodel subjects learned by rote and acquired

a cognitive structure with strong internal connections and

weak external ones. We can speculate that the formation of

external connections places new information at the ends of

very long pathways in the learner's cognitive structure.

These pathways can be traversed to many other subsets of knowledge, thereby leading to transfer to new situations. On the other hand, internal connections place new information at the ends of short pathways that do not lead to previous knowledge, thereby inhibiting far transfer.
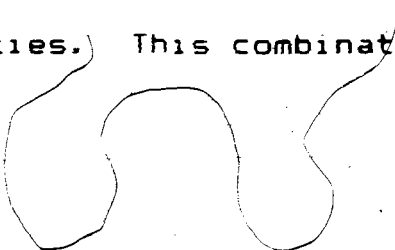
Advance organizer vs. post organizer. Another set of experiments (1976b) used the same model and a similar experimental design to test the prediction that pretraining with a concrete model of a computer will result in a different pattern of transfer than post-training with the same model. Pretraining means that the model is used as an advance organizer; post-training means that it is used as a post organizer. Results indicated that the advance organizer group performed better on problems requiring far transfer than the post organizer group. This conclusion is consistent with the interpretation that the locus of effect of the organizer is at the encoding (or learning) stage, not at the retrieval stage. In other words, it is consistent with assimilation theory that states that the meaningful learning set must be active during learning.

Activation of the assimilative set.   The studies examined so far address the issue of availability of a meaningful learning set.   Assimilation theory also suggests that the learner must actively use the assimilative context during learning.   In the previous studies, the activation of the meaningful learning set is taken for granted.   Mayer (1980) studied elaboration techniques as a means of effecting the activation.   He describes two common types of elaboration activities.   One is comparative elaboration in which a learner explains the relation between concepts in the text.   The other is integrative elaboration in which a learner explains the relation between a concept in the text and other concepts already in memory.   Integrative elaboration can be considered as a method to activate use of an assimilative set.

In the fourth experiment of the study reported in Mayer (1980) four treatments were compared - advance organizer without elaboration, model elaboration without advance organizer, elaboration without a model, and post organizer.   This experiment used the same model and a similar design as the other experiments in this study.   The post organizer group functioned as a control group.   The first group represents the typical advance organizer treatment group, where subjects are given an organizer to study BEFORE learning new information, but subjects' cognitive processing involving the organizer is ASSUMED to take place.   The model elaboration group represents the

case where there is empirical evidence that subjects did
engage in relating new information to previously known and
familiar concepts DURING learning. In other words, an
assimilative set was demonstrably activated during
learning. The comparative elaboration group approximates
the rote-learning situation in which learners relate new
propositions to each other but make no connections to an
existing cognitive structure.

Results indicated that all treatment groups performed
better than the control group. However, the treatment
groups could be ranked with respect to breadth of transfer,
which Mayer defines in terms of length of the posttest
problems. Long problems, involving a variety of
operations, are considered examples of far transfer, while
short problems, with few different operations, are
considered near transfer. The advance organizer promoted
the broadest transfer and comparative elaboration the
narrowest. The model elaboration group was in the middle.
These results show the separate effects of advance
organizers and elaboration activities. The logical next
step in research is to combine the two to examine the
effects of an advance organizer whose use can be
empirically guaranteed through the use of elaboration
activities. This combination is one of the features of my
study.

Student ability. A second factor examined in Mayer's experiment (1980) was the effect of mathematics ability. Separate analyses of results for high-ability subjects and for low-ability subjects showed no main or interaction effects for high-ability subjects. There was, however, a statistically reliable treatment x problem length interaction in the low-ability group. The interaction showed, that for low-ability subjects, the advance organizer promoted the broadest transfer and comparative elaboration the narrowest. The model elaboration group was in the middle. These results are consistent with the idea that low-ability subjects are least likely to have or activate a suitable assimilative context on their own. They are, therefore, most likely to be helped by activities that provide an assimilative context, such as an advance organizer, or activate an assimilative context, such as integrative elaboration.

Learning outcomes and advance organizer structure. In the final study in this series, Mayer and Bromage (1980) examined advance organizers in relation to assimilation theory at a much finer level of detail. Each programming language statement was broken down into a set of transactions, a transaction being an operation carried out on some object in some memory location of the computer. The same model of a computer as in previous studies was used as an advance organizer. Each type of "location" referred to in transactions - input, output, memory

locations for data, and pointer to program instructions,
was explicitly presented in concrete familiar terms in the
advance organizer. The four locations were called the
conceptual anchors. To aid analysis later, the text (new
material) was broken down into propositions, units of one
idea, which in turn were related to the conceptual anchors
in the advanced organizer. Idea units that were related to
conceptual anchors were called "concept idea units". There
were also "format idea units", that described the format of
the statements, and "technical idea units", that provided
technical information. Format and technical idea units
could not be directly related to the advance organizer.
One group read the organizer before reading the new text
(advance organizer); the other group read the organizer
after/reading the text (post organizer). Both groups were
then tested on the text using a modified recall test.

The recall protocols were broken down into
propositions. The propositions were classified into nine
categories - technical, format, or concept idea units;
novel, vague, or connective summaries; text appropriate,
text inappropriate, or model intrusions. Results supported
a pattern predicted by assimilation encoding theory. The
advance organizer group recalled more concept idea units,
novel summaries, and text-appropriate and model intrusions.
The post organizer group recalled more technical and format
units, vague and connective summaries, and
text-inappropriate intrusions. Again, there is empirical

support for the existence of qualitatively different
learning outcomes. Moreover, the different learning
outcomes are now described in a way that relates more
directly to the structure of the organizer and the new
information. This type of description of learning outcomes
improves on earlier studies, where learning outcomes are
described only in terms of near and far transfer.

Another study that related learning outcomes to the
structure of the organizer was carried out by Derry (1984).
Two treatment groups were used. One group received an
advance organizer, which was a prose passage describing
five themes that would later appear more specifically in
the text to be learned. The control group received a
placebo introduction. Subjects were instructed to use the
introductory material as an aid to learning. Subjects then
studied a text about Greek mythology. The advance
organizer and text material were broken down into idea
units which were organized into a hierarchical structure.
The idea units were classified as schema-implied,
schema-modifying, or schema-irrelevant. Schema-implied
ideas were ones that were easy to relate to the advance
organizer with little extension of the organizer ideas
required. Schema-modifying ideas were ones that could be
related to the advance organizer with a change,
modification or addition required to the organizer ideas.
Schema-irrelevant ideas were ones that were unrelated to
the organizer ideas.

After studying the text, subjects were given a posttest with three subscales, one for each of the three types of idea units. The advance organizer group scored highest on the schema-modifying subscale. The control group scored highest on the schema-implied subscale. Another analysis showed that, on the schema-modifying subscale, both advance organizer and control groups were able to avoid intrusion of advance organizer ideas. However, on the schema-implied subscale, the advance organizer group showed greater intrusion of advance organizer ideas than the control group. Derry concluded that the advance organizer "appeared simultaneously to depress recognition of schema-implied detail and improve recognition for schema modifications" (p.102).

Derry also found an interaction between treatment and reasoning ability. Within the advance organizer group, subjects with high reasoning ability performed better overall than those with low reasoning ability but reasoning ability was not a determiner of success in the control group. From this result, she concluded that learning with an advance organizer involved a logical reasoning process rather than reliance only on memorization. According to Derry, this result implies that the cognitive processing involved in using an advance organizer is deductive in nature.

Student ability revisited. The issue of the interaction of advance organizer and subject's "ability" is

a cloudy one. The "early" advance organizer studies (Mayer 1979b) indicated that advance organizers had their greatest effect for inexperienced or low-ability learners. Mayer's binomial probability study (1975a) showed that learners who were high in intuitions about probability fared better with the advance organizer than those who were low in such intuitions. In Mayer's elaboration study (1980), students with high mathematics ability showed no effect due to the advance organizer, but low ability students showed a positive effect. Derry (1984) found a positive interaction between advance organizer and good reasoning ability.

These results appear contradictory at first glance. There may be two important reasons for this situation. The obvious one is that there is a great variety of different measures used for "ability", so that there is no consistent operational definition of "ability" across the studies. Another possible reason is that the advance organizers themselves differ widely. For example, in much of his advance organizer research, Mayer uses a concrete model of a computer as an advance organizer. The subject matter of the organizer includes ideas like scoreboards and shopping lists, which act as analogies for low level details, in the hierarchical sense, for ideas in the new material. In contrast, Derry's advance organizer is more abstract and general than the ideas in the new material. Yet both organizers are described as functioning as comparative organizers. It may be that the differences in the types of

advance organizers are responsible for the different

interactions.

Summary of findings especially pertinent to this research

Many studies indicate that an appropriate assimilative

set facilitates learning of new material. While some

studies (Mayer,1976b; Derry, 1984) include instructions to

subjects to use the advance organizer as an aid to

learning, NONE includes any methods to ensure that subjects

actually are relating the new material to the advance

organizer. My study will include an activity in which

subjects will have to keep referring back to the advance

organizer and will leave a trace of the connections that

they made between paragraphs of the new material they are

reading and sections of the advance organizer.

Only poor operational definitions exist for advance

organizers. As a result, a variety of quite different

introductory activities are called advance organizers in

the research. This lack of operationalization leads to

inconsistency, which, in turn, makes it very difficult to

generalize across studies. This study will show that it is

possible to identify different types of advance organizers

by their relationship to a hierarchical map of content

presented in the material to be learned. It will also

compare different types of advance organizers in an attempt

to isolate effects that are caused by these differences.

While advance organizers do not seem to confer any

advantage when measures of total learning are used, they do

seem to affect the quality of learning. Advance organizers appear to promote the retention of conceptual rather than factual details. They appear to enhance the ability to solve problems that involve applying knowledge to new situations, but may retard the ability to remember specific details. This study will attempt to replicate some of these findings. It will also relate the learning outcomes not only to the structure of the advance organizer and the text (Mayer and Bromage, 1980; Derry, 1984) but also to the subject's success in relating the new material to the advance organizer.

Several advance organizer studies have looked at the interactive effects of a wide variety of measures of ability with conflicting results. Since all the studies essentially involve learning from text materials, one would expect that the subject's reading ability would be a factor in determining success. Yet, this measure has largely been ignored in advance organizer studies. This study will investigate the effect of reading ability.

HYPOTHESES

Consider how assimilation theory predicts that the
different types of advance organizers should work. The
abstract concept organizer activates an existing cognitive
structure in the learner's mind. Because this organizer is
at a higher level in the hierarchical map than the new
material (see Figure 2), the learner is encouraged to form
vertical links between the new material and the abstract
concept. These links can also be classified as external
connections, between the new material and other
information, namely, the organizer. Other connections,
both vertical and lateral, already exist in the student's
cognitive structure, relating the organizer to other
previous knowledge. Thus, the process of forming the
external vertical links between new material and organizer
completes a pathway that ultimately links new information
to a large body of previous knowledge.

One can imagine the association of one piece of
information with another as stepping from node to linked
node of the content map. The abstract organizer is
predicted to promote far transfer because it acts as a
node, or bridge, connected simultaneously to new
information and previously learned knowledge. For example.
a learner who was given an abstract organizer should be
able to draw analogies between the new material and similar
novel situations more successfully than a learner who was

given a different type of organizer. Assimilation theory suggests that in the process of making vertical connections, lower level details are absorbed, or subsumed, by higher order concepts. Therefore, learners given an abstract concept organizer would have difficulty with recall of items low in the hierarchy.

The abstract concept provides conceptual anchors to which ideas in the new material can be hooked, but other than that, does not give a learner an explicit structural map of the new material. The learners must deduce the structural map of the new material for themselves. Thus, given the task of organizing learned information, a group of learners would be expected to organize the new material in a variety of ways, depending on their success in detecting the structure of the material.

The analogy provides or activates an existing cognitive structure in the learner's mind which is at the same hierarchical level as the new material. This parallelism is expected to encourage the learner to forge lateral links between the new material and the already familiar analogy. These links could also be classified as external connections because they connect new material to content about an entirely different topic. Because of the formation of external connections, the analogy organizer is predicted to promote transfer to new situations. As with the abstract organizer, some loss of low level detail is expected. However, because lateral links would be forged

at several levels of the hierarchy, including the lowest
levels, students given the analogy organizer are expected
to have less difficulty with recall of details than
students given the abstract organizer.

The learner's organization of the new material should
reflect that of the analogy organizer. However, because
the learner is mostly forging lateral links, the
hierarchical structure of the analogy may be harder to
detect. Therefore, a variation in organizational patterns
would be expected as for the abstract concept.

The outline is at a lower level of the hierarchical
map than either the abstract concept or the analogy. A
learner given an outline is given part of the structural
content map for the new material. Additional ideas from
the new material can be linked to the outline, mostly by
vertical links. However, all the connections are internal.
There are no connections to knowledge structures about
other topics in the learner's memory. This situation is
predicted to promote near transfer but to inhibit far
transfer. Learners given an outline organizer are expected
to perform better on simple recall tasks than learners
given a conceptual organizer, but less well on tasks
requiring transfer to new situations. They are expected to
have difficulty relating the material to other things that
they know.

Because the outline explicity describes the
organization of the new material, the content map that

students in this group develop is expected to reflect the organization of the outline.

Learners in the dummy group are left to their own devices in learning the new material. Because the dummy organizer, having no relation to the new material, is of no use in organizing the content to be learned, it is expected that students will use their own learning strategies. It is difficult to predict the performance of this group in relation to the others. In a sense, the dummy group represents a mixture of learning strategies which may be more or less effective than the strategy of using an advance organizer.

Summary of hypotheses

On measures of near transfer, the conceptual organizer groups are expected to perform less well than the pseudo-organizer groups. On the same type of measure, the abstract concept group is expected to perform less well than the analogy group.

On measures of far transfer, the conceptual organizer groups are expected to perform better than, the pseudo-organizer groups. The abstract concept group is expected to perform better than the analogy group.

On measures of organization of information, the outline group is expected to match the content map of the new material more closely than the other three groups.

These patterns are expected to be most evident when students are able to correctly relate new material to the organizer.

CHAPTER 3

METHODS

Subjects

The subjects were 325 students in ten Grade 8 Mathematics classes taught by four different teachers at Burnaby North Secondary School. These ten classes represent the total enrollment in regular Grade 8 Mathematics in the school. Students participated in the study with school board and parental permission.

Materials

For each task in the experiment, students were given written instructions describing what they had to do and showing an example of a similar task. Classroom teachers clarified instructions for students who required extra help.

Text. The new material to be learned was a 2000-word article titled "Computer Crime and Prevention", part of a set of research materials developed by Dr. P. H. Winne (Winne and Carney, 1985). The article was written to be at Grade 7-8 reading level. The article discussed methods and examples of computer crimes, problems in controlling this type of crime, and methods of preventing computer crimes. Information in the article was organized in a hierarchical fashion, ranging from broad general concepts like "theft of software by thieves can be prevented" to very specific

technical details like "programs can be locked by writing extra information between tracks".

The text material was divided into 30 paragraphs and was presented to students as a booklet of eight double-spaced pages. A box was placed beside the end of each paragraph of the article. For each paragraph, students wrote down in the box, the number of the section in the organizer (described in the next section) that they believed related most closely to the paragraph. These numbers constituted the concrete trace of students' attempts to relate the paragraphs of the article to the organizer. The text is reproduced in Appendix A.

Organizers. Four different organizers were developed: abstract concept, analogy, outline, and dummy. Each organizer was approximately one double-spaced page in length and was divided into four numbered sections. The sections were numbered to give students a simple way of identifying them during tracing. Copies of the organizers are presented in Appendix B.

The abstract concept organizer was a passage describing the idea that new inventions give rise to new abuses, which in turn give rise to new methods of controlling the problems. The organizer dealt with general ideas; there was no mention of specific technologies or crimes. This organizer was operationally defined as abstract because its content would be found at a hierarchically higher level than the new material (see box

1 in Figure 2). Students would have to make vertical links to relate new material to the organizer.

The analogy organizer described the misuse of office photocopiers and efforts to control these abuses as an analogy to computer crime and prevention. The content map of this material is at the same hierarchical level as the new material (see box 4 in Figure 2). Students would have to make primarily lateral links to relate the new material to the analogy organizer.

The outline was a point-form list of topics covered in the new material. It was presented as four headings, each with three sub-headings. The outline was a summary of the spatial map that was used in the development of the text material. Its content map is part of the content map of the new material (see box 3 in Figure 2). Students would have to make mostly vertical links in relating the new material to the outline, but these links would not connect with any previous knowledge.

The dummy organizer was a general passage about computers and how they have become more common since their invention. It contained no mention of computer crime or prevention of computer crime.

Attitude questionnaire. This instrument consisted of 16 items to which students chose responses on a scale from 1 to 5. Nine of the items were questions about the students' opinions of the text and the reading tasks: the other seven items were various other questions about

computers. The questionnaire was used as an interpolated task between reading the text and administration of the first of the achievement measures. The results of the questionnaire were not analyzed. The questionnaire is reproduced in Appendix C.

Free recall. This measure of achievement consisted of five short-answer questions covering the spectrum of content in the text. The questions varied in their level of generality, that is, their reference to hierarchical level of the structure of the content. The questions were classified as being targeted at the top, middle, or lowest level of the hierarchical content map. The most general question asked students "What important points does the article give about computer crime?". The question at the most specific level of detail asked "Why do people commit computer crimes?". Students were instructed to write as many points as they could remember in answer to each question. The purpose for posing questions at different hierarchical levels is to shed light on the effects of the different advance organizers. The questions are reproduced in Appendix D.

Categorizing task. Students were given a set of fifteen index cards, each containing a term (word or phrase) taken verbatim from the text. Students were to organize the cards into groups and give each group a name plus a short description. Examples of the terms used are - data diddling, audit trail, fingerprints. Terms selected

were the most technical terms used in the article. It was
assumed that the ways in which students grouped the terms
would reflect the structure that they had imposed on the
material. The categorizing task is presented in Appendix
E.

Multiple-choice test. This measure of achievement was
divided into two parts. Both parts of this test are
reproduced in Appendix F. The first part was a
conventional test containing fifteen items, evenly sampled
from the entire text. In developing the items, the text
was first divided into 15 sections of approximately equal
length - generally two paragraphs. A question was written
for each section. Each item offered four answer choices
and had only one correct answer. These questions were used
to test the student's ability to remember particular
details.

The second part also contained fifteen multiple-choice
items addressing content spread over the entire text.
However the four options for each item contained three
correct alternatives and one wrong alternative. Each of
the correct alternatives was phrased in a way that
corresponded to one of the three advance organizers.
Specifically, one alternative was expressed in abstract
terms, one as an analogy, and the third as a paraphrase of
material in the text (outline). Here is an example of this
type of question.

One characteristic of many computer crimes is that they

    A. are like petty theft in factories.

    B. are a new type of crime.

    C. involve moving around information stored in

       computers.

    D. involve machines affecting other machines, not

       people.

Here is the classification of the alternatives.

    A - analogy

    B - abstract

    C - outline

    D - wrong

Students were asked to rank the alternatives from 1 to 4,

one corresponding to the best answer and four to the worst.

based on their idea of the correctness of each alternative.

Aptitude measures

    Two aptitude measures were used. One was reading

comprehension measured by the Gates-MacGinitie reading

test. The test had been administered to students by school

staff at the start of their Grade 8 year. Scores are

expressed as a grade equivalents. For example, a score of

8.5 indicates that a student's reading ability falls

between the average reading abilities of students in Grade

8 and Grade 9.

    The other aptitude was average school lettergrade.

The school uses a seven-point lettergrade scale, where A=7,

B=6, C+=5, C=4, C-=3, D=2, and E=1, to evaluate students in

each subject area. The average lettergrade for each student was computed by averaging the point values of lettergrades received in four core subjects, namely English, Social Studies, Mathematics and Science, taken from students' Spring report cards. These were the most recent lettergrades available.

Experiment design and procedure

Students in each classroom were randomly assigned to one of four treatment groups. Each treatment group received a different organizer - abstract concept, analogy, outline, or dummy; the same text material - the article about Computer Crime and Prevention; and the same evaluation instruments. Random assignment of students in each classroom to experimentally formed groups was done by arranging the different booklets in a random sequence prior to distribution, then having the classroom teachers distribute the papers by their usual method. Some teachers distributed the papers by placing one on each student's desk themselves. Others handed a group of papers to the first student in the row. The student then passed them out to classmates in the row. There were equal numbers of the four sets of materials given to each class. However, because some students dropped out of the study through absence or lack of parental permission, the actual numbers in the four groups within each classroom did not always equal 25% of the students in the room.

The treatments were administered by the students' regular classroom teachers. The procedures of the study were explained to the teachers by the researcher in a one-hour meeting. Teachers were also given a detailed set of instructions to follow while administering the treatment. These instructions are reproduced in Appendix G.

The experiment consisted of the following sequence of activities. On the first day, students were given instructions which explained how to record their assessments about how a paragraph in a text described or extended information provided in a section of introductory material. Classroom teachers handed out instructions and read the instructions out loud to the students, offering additional explanations as needed. They gave students additional individual explanations of the instructions when needed.

Classroom teachers then handed out the introduction plus text booklets. Students read the organizer first. Second, they read the text. As they read the text, they wrote a number in the box beside each paragraph of the text. The number corresponded to one of the numbered sections of the organizer. Students chose the numbered section of the organizer that they thought related most closely to each paragraph that they read. They were instructed to use a zero if they thought that there was no

relationship. The organizer was available during this activity.

The numbering activity was included for the following reasons. First, the activity forced the students to relate the text that they were reading to the organizer, thus guaranteeing that activation of the organizer actually did occur. Second, the activity left behind a simple trace of the students' cognitive processing of the text, that is, the process of students' attempts to relate the text to the organizer. This trace could subsequently be analyzed. Students were given 25-30 minutes to complete this task.

The questionnaire was administered next, after the text packages had been collected. Answering the questionnaire functioned as an interpolated activity between the presentation of the new material and the free recall task.

After the questionnaires were collected, classroom teachers handed out the free recall task. Students had 20-25 minutes to complete this task.

On the second day, classroom teachers handed out instructions for the categorizing task, and went over an example task with the students. Students were then given a set of 15 index cards with terms from the text printed on them to categorize. They were instructed to use two to five categories, to give each category a name and description, and to list the members of the group in rank

order, from best example to worst. Students were given 30 minutes for this task.

After the categorizing task was collected, classroom teachers gave out Part I of the multiple-choice test. As students completed the first part of the test, the classroom teacher collected it and issued Part II of the test, drawing the student's attention to the different task to be done in Part II. Part II of the test was printed on coloured paper to emphasize the difference from Part I. The classroom teacher collected the tests as students finished them.

Scoring

Trace of advance organizer use. The researcher produced a set of correct "traces" for each organizer by identifying the numbered section of the organizer that related most closely to each paragraph. Correct traces for the abstract concept, analogy, and outline organizers were numbers from one to four. All correct traces for the dummy organizer were zeros because the dummy organizer and the text were unrelated. Student traces were marked correct if they matched the researcher's traces. The trace score calculated for each student in the study was the number of correctly traced paragraphs.

Free recall task. For each of the five short-answer questions, a model answer was written listing idea units, either noun or verb phrases from the text that were judged to be correct points in answer to the question. Model

answers for these five questions are presented in Appendix H.

Phrases in students' answers were classified as follows. Phrases in students' answers that were required for good grammar or introductory phrases referring to the question (e.g. "the reasons why people commit computer crimes are...") were ignored in scoring. Substantive phrases were considered to match an idea unit in the model answer if they were a verbatim or paraphrased version of the model answer idea. The score for each question was the number of correct idea units contained in the student's answer. Additional phrases/clauses in the students' answers were classified as irrelevant, extraneous, or wrong. Irrelevant phrases were those that were contained in the text but were not part of the model answer, yet did not contradict the model answer. Extraneous phrases were those that were reasonable parts of answers to the given question, but contained information that was not in the text. Wrong phrases were those that contained incorrect information or inappropriate responses.

For example, one of the free recall questions was "According to the article, why do people commit computer crimes?". The model answer consists of the following idea units - for gain, for power, for money, out of spite, for information. Examples of correct idea units are - for personal profit, to have control, to get rich, for revenge, to find out things you shouldn't. Examples of irrelevant

points are - by changing information, to get a hotel room without making reservations, to get computer time. Examples of extraneous idea units are - for fun, because they are dishonest. Examples of wrong points are - so they can work in their business, 250,000.

Intrusions from the advance organizer were classified as extraneous points. It was intended to make these a separate category, but there were so few that it was decided to include them with other extraneous points.

In summary, the free recall scores consist of the number of correct idea units for each question and the total number of correct idea units for the entire task.

All marking was done by the experimenter. Each student's answers were marked twice, with a time interval of one or two days between markings. Answers that were classified differently on the second marking were set aside for a few days, and remarked again. Only about 5% of the answers had to be remarked.

Categorizing task. A model answer was constructed by using the main points of the outline organizer as suitable group names. The outline was used as the reference point for judging students' answers because it most directly describes the overall structure of the text. Three model category names were established - computer crime, preventing computer crime by protecting hardware, preventing computer crime by protecting software. A reading of students' answers showed that a large number did

not differentiate between hardware and software protection. Therefore, a category simply called prevention of computer crime was included in the list of acceptable names.

Category names plus descriptions chosen by students were classified as appropriate or inappropriate. Appropriate categories were those that matched categories in the model answer or were subsets of those categories according to the outline. For example, "ways of committing computer crime", and "examples of computer crime" are second-level entries in the outline. "How to stop computer crime" is an example of a paraphrase of a model category. Inappropriate categories were those that did not reflect any relation to the text, for example, "terms that start with 'c'", "words I don't know". A list of category names used by students is presented in Appendix I.

Students' placements of terms on the index cards into categories were classified as correct, incorrect, or inappropriate. An item was considered correct if the student placed it in an appropriate group, and the item belonged in the group according to the student's definition. An example is the placement of "data diddling" in a category called "computer crimes". An item was marked incorrect if it was placed in an appropriate category, but did not belong to that category according to the student's definition of the category. For example, placement of "data diddling" in a category called "ways to prevent computer crime" is incorrect. Data diddling is a type of

computer crime, not a method of preventing such crimes. An item was marked inappropriate if it was placed in an inappropriate category. An example would be the placement of "data diddling" in a category called "words I don't know".

Three scores were produced. The appropriate-category score was the percentage of total groups used by the student that were judged to be appropriate. The correct-items score was the number of terms that were placed correctly in appropriate categories. The perfect-categories score was the percentage of total groups used by the student that were appropriate and contained only correctly placed terms.

Each student's answers were marked twice, with a time interval of one or two days between markings. Answers that were classified differently on the second marking were set aside for a few days, and remarked again. About 5% of the papers had to be remarked.

Multiple-choice - part I. The score for this part of the test was the number of correct responses.

Multiple-choice - part II. Items that students ranked in the first and last positions were considered. Four scores were generated. The identify-wrong score was the number of incorrect alternatives that were ranked last. The abstract score was the number of times that the alternative expressed in abstract terms was ranked first. Similarly, the analogy and outline scores are the number of

times that each of those kinds of alternatives was ranked

first.

Table 2 shows the ranges of scores on all aptitude and

achievement measures.

TABLE 2

Range of Scores on Aptitude and Achievement Measures

Aptitude/ Achievement Measure	Highest Score Possible	Actual Range of Scores Minimum	Maximum
Reading Comprehension grade equivalent	12.7	3.3	12.7
Lettergrade points	7.0	1.0	7.0
Trace	30	0	30
Free Recall Task Short-answer questions			
#1	5	0	4
#2	11	0	6
#3	35	0	10
#4	17	0	4
#5	3	0	3
total	71	0	22
Categorizing Task appropriate- categories	1.00	0.00	1.00
correct-items	15	0	15
perfect- categories	1.00	0.00	1.00
Multiple-Choice Test			
part 1	15	0	15
part 2 - identify- wrong	15	1	14
- abstract	15	0	8
- analogy	15	0	9
- outline	15	1	15

NOTE - Lowest possible score is zero (0) in all cases
except reading comprehension, where lowest possible
score is 3.3, and lettergrade, where lowest possible
score is 1.0.

CHAPTER 4

RESULTS AND DISCUSSION

Description of sample

Of the 325 students who were the potential sample for this study, 227 actually participated; 98 were not included because they were absent on either one or both days of the treatment, or, did not receive parental permission to participate.

A one-way analysis of variance revealed that there was no statistically reliable difference among groups on either of the two aptitude measures ($p > .10$), reading comprehension and average lettergrade (see Table 3). Reading comprehension scores were unavailable for 20% of the students. These missing cases represent students who were not given the reading test at the start of the school year for a variety of reasons, including absence on the testing day and late registration. Lettergrades were unavailable for 6% of the students. These missing cases represent students whose report cards were not in the student record files to which the researcher had access.

The correlation between reading comprehension scores and average letter grade was .53 ($p < .01$) (see Table 4). The positive correlation verifies the expected relationship that better students are better readers and vice versa. The value of the correlation, however, indicates that each variable measures non-overlapping skills.

TABLE 3

Means, Standard Deviations, and Cell Sizes of Reading

Comprehension Scores and Average Lettergrade by Group

Treatment Group	Reading Comprehension			Average Lettergrade		
	mean	s.d.	n	mean	s.d.	n
abstract	8.35	2.22	43	4.35	1.51	49
analogy	8.32	2.17	48	4.54	1.71	56
outline	8.53	1.78	46	4.44	1.63	54
dummy	8.66	1.73	45	4.52	1.73	54
total	8.46	1.97	182	4.46	1.64	213

missing cases 45 14

19.8% 6.2%

Tracing

Students were instructed to relate the paragraphs in the article that they were reading to numbered sections of the organizer. Students were not told that one of the organizers was a dummy, that is, had no relation to the article at all. Trace scores were positively correlated with Gates-MacGinitie reading comprehension scores ($r=.18$, $p=.01$), and with lettergrade ($r=.21$, $p<.01$) (see rows 1 and 2 of Table 4). The low correlations indicate that tracing involves different skills than are measured by these two aptitudes. A one-way analysis of variance showed that the four treatment groups had statistically reliable differences in trace scores ($F=18.21$, $p<.01$).

Duncan post-hoc comparisons subsequently indicated that students in the outline group traced far more successfully than students in any other group ($p<=.01$). The outline group score was 61%, while the scores for the other three groups ranged from 29% to 41% of the maximum score which was 30 (see Table 5). The higher trace scores for the outline group are expected because this group had the easiest task. Because the outline included information that the students were also reading in the article, the students could relate the text information to the outline simply by recognizing common information.

TABLE 4

Means, Standard Deviations, and Correlations

among Predictor and Achievement Variables

Variable	Mean	S.d.
1. reading comprehension	8.44	1.97
2. lettergrade	6.44	1.64
3. trace	12.78	7.84
4. analogy/abstract contrast (V1)	.04	.70
5. online/buoy contrast (V2)	.00	1.08
6. conceptual/pseudo contrast (V3)	-.02	1.06
7. trace x V1	.99	7.84
8. trace x V2	1.52	12.40
9. trace x V3	-2.90	10.75
10. lettergrade x V1	.17	3.26
11. lettergrade x V2	-.02	3.16
12. lettergrade x V3	-.08	4.77
13. short-answer 01 (FR)	1.62	.88
14. short-answer 02 (FR)	1.90	1.25
15. short-answer 03 (FR)	1.64	1.39
16. short-answer 04 (FR)	.96	.88
17. short-answer 05 (FR)	.39	.80
18. short-answer total (FR)	6.71	3.36
19. appropriate-categories (CT)	.63	.28
20. correct-items (CT)	9.68	3.94
21. perfect-categories (CT)	.43	.27
22. multiple-choice Part 1	6.98	2.76
23. mc Pt. 2 - identity-wrong	6.14	2.85
24. mc Pt. 2 - abstract	2.85	1.71
25. mc Pt. 2 - analogy	2.66	1.78
26. mc Pt. 2 - online	8.49	3.11

* indicates correlations with p<.01

Decimal points have been omitted from correlation coefficients.

TABLE 5

Means, Standard Deviations, and Cell Sizes of Trace Scores
by Group

Treatment Group	mean		s.d.	n
	score	percent		
abstract concept	8.80	29%	3.91	51
analogy	11.22	37%	5.69	60
outline	18.33	61%	5.88	58
dummy	12.36	41%	10.74	58
total	12.78	43%	7.86	227

]

Trace scores were low (41%) for the dummy group.
Since the sections of the dummy organizer bore no relation
to the text on computer crime and prevention, the correct
tracing for this group was to identify all paragraphs in
the text as having nothing to do with the organizer. It
appears that students in this group did their best to find
some sort of connection, even though none was there. This
inference is drawn from teachers' reports that the only
students who asked other than methodological questions
during the reading and tracing exercise were from the dummy
group. Students wondered if they were doing something
wrong because they thought that the organizer had nothing
to do with the article.

Trace scores were lowest for the two conceptual
organizer groups, 29% for the abstract group, and 37% for
the analogy group. These low scores indicate that the task
of relating new information in the article to the
conceptual organizers is a difficult one. There was a
statistically reliable difference between the means of the
abstract concept and the analogy groups (Duncan post-hoc,
$p <= .10$). The abstract concept group had the greatest
difficulty in tracing. The abstract concept organizer is
more abstract, more general, and is at a hierarchically
higher level of information than the analogy. Content in
the abstract concept organizer was the most difficult for
students to relate to paragraphs in the text.

The general difficulty of making connections to the
conceptual advance organizers has major implications for
the interpretation of previous research. The lack of
effects due to types of organizers reported in many studies
may be due to the lack of effective use of the organizers
by students rather than to characteristics of the
organizers themselves. Studies that compare groups given
different types of organizers without offering empirical
evidence that the organizers were actually used may, in
reality, be comparing groups that were unable to make
proper use of an organizer, whatever type it was. Of
course, if subjects were not making connections between the
organizer and a text while learning, no differences among
groups would be the expected result.

Effects on achievement

To explore the relationships between achievement and
different types of organizers further, a multiple
regression analysis with backward rejection of
statistically unreliable predictors was carried out. In
backward regression, all predictors are initially entered
into the regression equation. Then, statistically
unreliable predictors are removed, one by one, until only
statistically reliable terms are left in the equation.
Achievement measures served as the criterion variables in
these analyses. Predictor variables entered into the
equation were lettergrade, trace, three a priori group
contrasts and six aptitude-treatment interactions.

Three a priori contrasts of groups were included to make the following comparisons :

1. compare the two conceptual organizer groups, analogy and abstract, against each other (V1);

2. compare the two pseudo-organizer groups, outline and dummy, against each other (V2);

3. compare the combined conceptual organizer groups against the combined pseudo-organizer groups (V3).

The student's average lettergrade reflects a broad group of skills that promote achievement in school. The lettergrade measure is by far the most common measure used in practice to assess a student's success in learning at school. Reading comprehension is another measure that is generally correlated with successful achievement. Reading comprehension is a measure of a narrower group of skills. Although it would have been valuable to include reading comprehension as a predictor in regression analyses on students' achievement, this measure was left out of the regression analyses for the practical reason that scores for 20% of the sample were unavailable. Such a large reduction in sample size seemed too high a price to pay for the potential additional predictive power to be gained by including reading comprehension. Reading comprehension and lettergrade are positively correlated ($r=.53$, $p<.01$), indicating that there is some overlap in the skills measured by the two aptitudes.

One-way analysis of variance earlier showed that there were statistically reliable differences in tracing success among the treatment groups. This finding led to inclusion of trace in the regression equation, both as a main effect, and in interaction with group contrasts.

Two sets of interactions were included - interactions of lettergrade with the three group contrasts, and interactions of trace scores with the three group contrasts.

The regression analysis yields a regression equation for each criterion variable. The equations are of the form -

$$criterion\ variable = constant + b_1 X_1 + b_2 X_2 + b_3 X_3 + ...$$

where b's represent regression coefficients and X's represent predictor variables. Simplified regression equations can be calculated to show the effect of each of the predictor variables separately using a method described in Winne and Marx (1983). For example, to find the equation for the effect of X_1, all terms not containing this variable are collected together, yielding

$$criterion\ variable = (constant + b_2 X_2 + b_3 X_3 + ...) + b_1 X_1$$

Then, appropriate group means are substituted for the terms within the parentheses to produce a single constant. This yields a simplified regression equation of the form -

criterion variable = new constant + $b_i X_i$.

This method allows for a straightforward interpretation of
the unique effect of each predictor variable.

In the following discussion, each criterion variable
and its corresponding regression equations will be
discussed separately. In these discussions, it is
important to keep in mind that the predictor variables are
<u>residualized</u> variables. The procedures of multiple
regression make all the predictor variables in a regression
equation statistically independent of each other. Except
in the rare case where predictor variables are completely
uncorrelated with each other, the multiple regression
procedure changes the construct that is represented by a
particular variable (Winne, 1983). In backward regression,
all predictor variables remaining in the regression
equation are residualized for all other predictor variables
still in the equation.

For example, suppose that two predictors, lettergrade
and trace, remain at the final step of a backward
regression on some criterion variable. These two variables
are positively correlated (r=.21, p<.01). Multiple
regression removes the common variance shared by the two
variables, leaving two residualized variables that
represent constructs that are <u>different</u> from the original
ones defined by the lettergrade and trace scores. In this
particular case, lettergrade in the regression equation

would represent a measure of student success in school with the impact of trace removed. Similarly, trace in the regression equation would represent a measure of tracing ability with the impact of lettergrade removed.

The changes to construct validity increase with increasing values of the zero-order correlations between predictor variables. Many of the predictor variables in this study have low correlations with each other (see Table 4). It is impossible to define precisely what constructs the residualized variables represent. However, it is important to remember during the following discussion that the constructs represented by predictor variables in the regression equations may have slightly altered meanings as a result of the regression procedures.

Achievement on short-answer questions. The five short-answer questions in the free-recall task were each targeted on a different level of the hierarchical map of the content. Because it was hypothesized that there would be a relationship between type of organizer and success at answering questions at particular hierarchical levels, individual question scores as well as the total free-recall score, were treated as criterion variables in six separate regression analyses.

Regression equations for total score on the free recall task (see Tables 6, 7) showed statistically reliable main effects due to lettergrade, trace and the a priori group contrast comparing the combined conceptual organizer

groups with the combined pseudo-organizer groups. As
expected, performance on this task improved with the
ability of the student. More importantly for this study,
performance also improved with success in tracing. The a
priori contrast showed that the combined pseudo-organizer
groups outperformed the combined conceptual organizer
groups on the free recall task (see Tables 6, 7). In the
vector for the contrast, the group mentioned first, in this
case, the combined conceptual group, is coded +1. The
group mentioned second, in this case, the combined
pseudo-organizer group, is coded -1. Since the regression
coefficient is negative in this case (-1.52), the adjusted
mean for the conceptual group is lowered, while that for
the pseudo-organizer group is raised. This result is
consistent with theory. Advance organizer theory suggests
that use of organizers will enhance meaningful learning and
therefore, achievement on tasks requiring transfer, but may
actually impede recall of low-level details. Since the
free recall task is one in which memory of details is
tested, the conceptual organizer groups are expected to
perform worse than the pseudo-organizer groups, who are
presumably learning less meaningfully.

TABLE 6

FINAL STEP OF BACKWARD REJECTION REGRESSION ANALYSES

Short-Answer Questions (Free Recall)

Criterion Variable	Adjusted R^2	Predictors	b	t	p	Variance %
total	.22	lettergrade	.70	5.20	<.01	.11
		trace	.14	3.94	<.01	.06
		trace x V3	.13	3.56	<.01	.05
		V3	-1.52	-3.32	<.01	.04
		constant	2.10	3.09	<.01	
short-answer question 1 hierarchy level = lowest	.09	lettergrade	.07	1.73	.09	.01
		trace	.04	3.75	<.01	.07
		trace x V3	.04	3.45	<.01	.06
		trace x V1	-.02	-2.44	.02	.03
		V3	-.37	-2.77	.01	.04
		constant	.90	4.66	<.01	
short-answer question 2 hierarchy level = highest	.20	lettergrade	.22	4.49	<.01	.08
		trace	.05	3.92	<.01	.06
		trace x V3	.04	3.45	<.01	.05
		trace x V2	.01	2.05	.04	.02
		V3	-.46	-2.70	.01	.03
		constant	.33	1.31	.19	
short-answer question 3 hierarchy level = highest	.13	lettergrade	.20	3.29	<.01	.05
		trace	.05	3.13	<.01	.04
		trace x V3	.04	2.37	.02	.03
		l.gr. x V2	-.06	-1.87	.06	.02
		V3	-.46	-2.22	.03	.02
		constant	.26	.88	.38	
short-answer question 4 hierarchy level = middle	.05	lettergrade	.13	3.35	<.01	.05
		constant	.39	2.17	.03	
short-answer question 5 hierarchy level = middle	.03	lettergrade	.09	2.72	.01	.04
		constant	.17	1.06	.29	

NOTES - Variance % is the squared semi-partial correlation coefficient.
- R^2's are adjusted for the degrees of freedom absorbed by predictors in the regression equation.
- b's are the regression coefficients for the full model.

TABLE 7

EFFECTS OF INDIVIDUAL PREDICTORS
Short-Answer Questions (Free Recall)

criterion	effect	predictor	intercept	b	adj. mean
short-answer total score	main	lettergrade	3.23	.70	
		trace	4.57	.14	
	contrast	V3 - conceptual/pseudo			
		conceptual			4.84
		pseudo			7.88
	interaction	trace x conceptual/pseudo (V3)			
		conceptual	4.84	.27	
		pseudo	7.88	.02	
short answer #1	main	lettergrade	1.17	.07	
		trace	.95	.04	
	contrast	V3 - conceptual/pseudo			
		conceptual			1.09
		pseudo			1.83
	interaction	trace x conceptual/pseudo (V3)			
		conceptual	1.28	.08	
		pseudo	2.02	.00	
		trace x analogy/abstract (V1)			
		analogy	1.51	.02	
		abstract	1.51	.06	
short-answer #2	main	lettergrade	.84	.22	
		trace	1.16	.05	
	contrast	V3 - conceptual/pseudo			
		conceptual			1.36
		pseudo			2.28
	interaction	trace x conceptual/pseudo (V3)			
		conceptual	1.59	.09	
		pseudo	2.51	.01	
		trace x outline/dummy (V2)			
		outline	1.74	.06	
		dummy	1.74	.04	
short-answer #3	main	lettergrade	.71	.20	
		trace	.94	.05	
	contrast	V3 - conceptual/pseudo			
		conceptual			1.12
		pseudo			2.04
	interaction	trace x conceptual/pseudo (V3)			
		conceptual	1.31	.09	
		pseudo	2.23	.01	
		lettergrade x outline/dummy (V2)			
		outline	1.58	.14	
		dummy	1.58	.26	
short-answer #4	main	lettergrade	.39	.13	
short-answer #5	main	lettergrade	.17	.09	

NOTE - b's are regression coefficients computed from the full model using the method of Winne and
Marx (1983) to investigate specific effects

One statistically reliable interaction was found. Improved tracing had very little effect on scores for the psuedo-organizer groups, but led to higher scores for the conceptual organizer groups. This finding indicates that conceptual advance organizers that are used effectively do promote learning of details. Considered together with the statistically reliable contrast between conceptual and pseudo-organizer groups, this interaction suggests that it may be students' inability to use an organizer effectively that impedes learning of details, rather than a characteristic of the organizer itself (see Figure 3).

One-way analyses of variance of all six free recall scores showed no statistically reliable differences among groups on five of the measures. A statistically reliable difference among groups was found only on short-answer question #3 (F=2.08, p=.10). A Duncan post-hoc test (p=.10) showed that the abstract group performed worse than either the analogy or the dummy group. This result is consistent with advance organizer theory which predicts that use of an abstract organizer would lead to greatest negative impact on recall of factual details.

FIGURE 3

Graphs of Disordinal Interactions

Free Recall Task
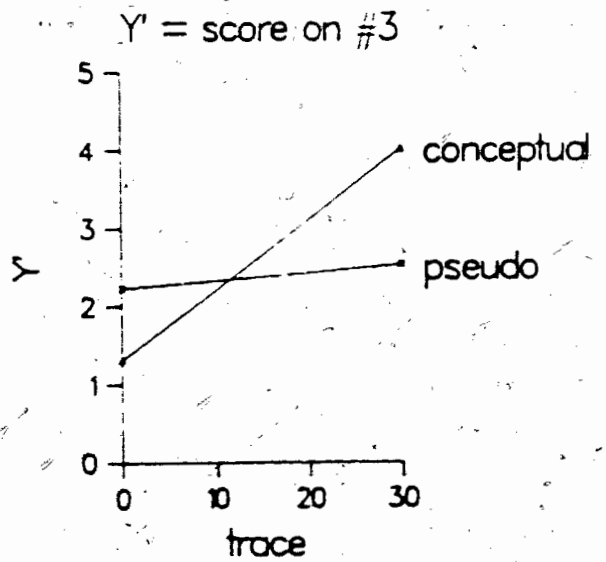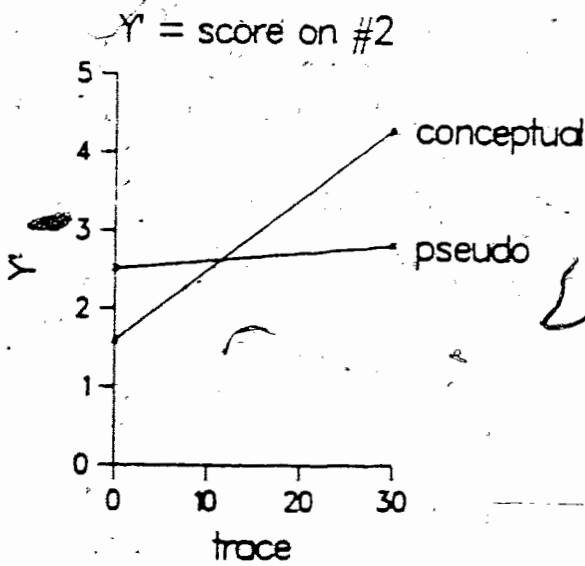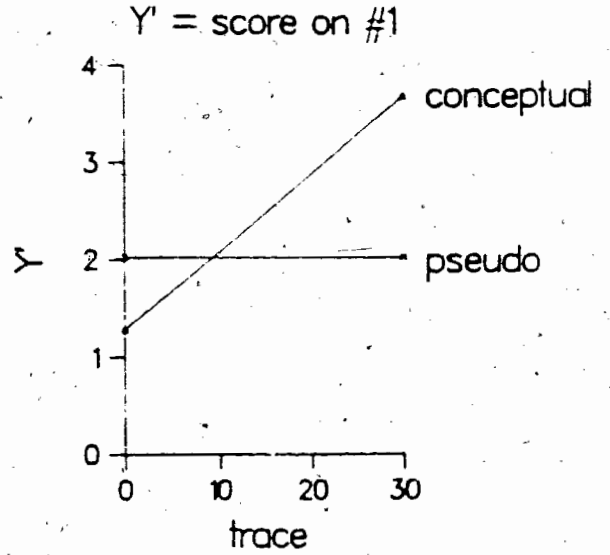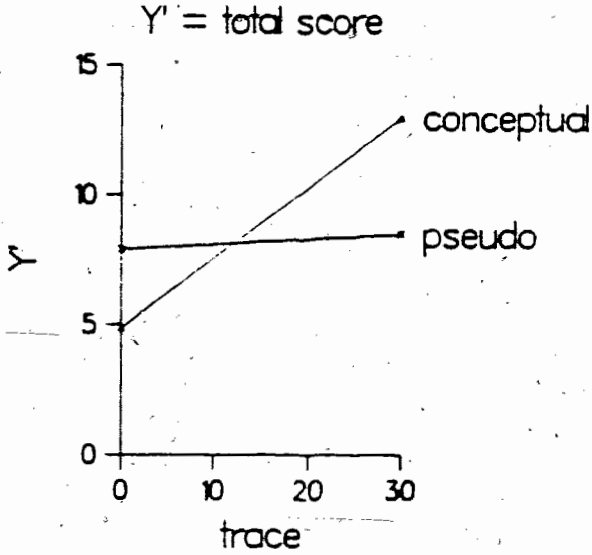
Analyses of regression equations for individual
questions were not very illuminating. Two of the
questions, #4 and #5, which were targeted at the middle of
the content map, showed no effect due to type of organizer
or tracing. The regression equation for question #1, which
was targeted at the lowest level of the hierarchy, was very
similar to the equations for questions #2 and #3, which
were targeted at the highest level of the hierarchy. All
three of these questions showed a statistically reliable
disordinal interaction between group and tracing (see
Figure 3). Scores for the conceptual organizer groups
improved with better tracing, but scores for the
pseudo-organizer groups were not affected by tracing. It
is possible that differences among questions were obscured
by the students' extremely low performance on the free
recall task in general. Group means on this task were
about 10% of the maximum score. Also, single items have
low reliability.

Achievement on categorizing task. Achievement on the categorizing task, in which students had to group technical terms from the article, was measured by three scores. The appropriate-category score is the percentage of total group names that were appropriate given the context of the article. This score is used as an indicator of the existence of a skeletal cognitive structure in the student's mind. The correct-items score is the number of terms that were correctly placed in appropriate categories, and is treated as a measure of memory for low-level details. The perfect-category score is the percentage of the total number of categories a student generated that were appropriate and that contained only correctly placed terms. This score indicates the strength of the students' cognitive structure for this information.

One-way analyses of variance of the three categorizing task scores showed no statistically reliable differences among groups on two of the measures. However, a statistically reliable difference among groups was found on the perfect-categories measure (F=2.49, p=.06). A subsequent Duncan post-hoc comparison (p<=.10) showed that the outline group performed better than any of the other three groups. These results are consistent with theory because the outline group was given an explicit pattern which contained the upper levels of the hierarchical map of the new material. This outline provided a clear and explicit representation of information in a format not

unlike that which students had to produce in the
categorization task. Hence, the outline group probably
simply repeated what they had studied earlier in tracing
the outline's connections to the article.

The regression equations (see Tables 8, 9) for the
three criterion variables yielded the following results.
The pseudo-organizer groups had higher appropriate-category
scores than the conceptual organizer groups. This
difference suggests that students in the conceptual groups
had difficulty building a sensible cognitive structure of
the information in the article, and is consistent with the
finding that students in the conceptual groups had the most
difficulty in making links to their respective organizers.
This interpretation may be questioned, however, because no
statistically reliable interactions of group and trace were
found. An interaction that showed a positive correlation
between successful tracing and appropriate-category score
for the conceptual organizer groups would be needed to
confirm that inability to relate to the organizer was the
likely cause of poor performance.

On the same measure, a main effect due to lettergrade
was found. The negative regression coefficient indicates
that better students mixed in more inappropriate categories
than poorer students. While this effect is statistically
reliable. it is a very slight relation (b=-.02).
Therefore. no particular importance is attributed to this
finding.

On the correct-items score, students in the pseudo-organizer groups again performed better than students in the conceptual organizer groups. This indicates that students in the conceptual groups had a harder time recalling low-level details, as predicted by theory. Students could not correctly place an item unless they had also chosen appropriate groups. That this result is not just a reflection of the appropriate-category score is shown by the low correlation of these two measures $(r=-.07, p=.16)$.

A strong main effect on the correct-items variable was found due to lettergrade. Better students categorized items more successfully than poorer students. Failure to find any effects due to trace or to interactions with trace indicates that the use of organizers had very little to do with success in this task. A disordinal group x lettergrade interaction was found (see Figure 4). The higher regression coefficient for the conceptual organizer groups $(b=1.26)$ compared to the pseudo-organizer groups $(b=.71)$ shows that poorer students have much more difficulty with the task if they were given a conceptual organizer. This finding may be a reflection of the difficulty of effectively using a conceptual organizer.

TABLE 8

FINAL STEP OF BACKWARD REJECTION REGRESSION ANALYSES

Categorizing Task

Criterion Variable	Adjusted R^2	Predictors	b	t	p	Variance %
appropriate categories	.04	lettergrade	-.02	-1.82	.07	.02
		V3	-.05	-2.67	.01	.03
		constant	.79	14.27	<.01	
correct items	.18	l.gr. x V3	.27	1.83	.07	.01
		lettergrade	.99	6.59	<.01	.18
		V3	-1.51	-2.11	.04	.02
		constant	5.39	7.54	<.01	
perfect categories	.10	lettergrade	.04	2.98	<.01	.04
		trace	.01	2.35	.02	.03
		trace x V3	.01	2.17	.03	.02
		V3	-.12	-2.88	<.01	.04
		constant	.20	3.16	<.01	

NOTES - Variance % is the squared semi-partial correlation coefficient.
- R^2's are adjusted for the degrees of freedom absorbed by predictors in the regression equation.
- b's are the regression coefficients for the full model.

TABLE 9

EFFECTS OF INDIVIDUAL PREDICTORS
Categorizing Task

criterion	effect	predictor	intercept	b	adj. mean
appropriate	main	lettergrade	.79	-.02	
categories	contrast	V3 - conceptual/pseudo			
		conceptual			.64
		pseudo			.75
correct items	main	lettergrade	5.39	.99	
	contrast	V3 - conceptual/pseudo			
		conceptual			8.28
		pseudo			11.30
	interaction	lettergrade x conceptual/pseudo (V3)			
		conceptual	3.88	1.26	
		pseudo	6.90	.71	
perfect	main	lettergrade	.26	.04	
categories		trace	.33	.01	
	contrast	V3 - conceptual/pseudo			
		conceptual			.30
		pseudo			.54
	interaction	trace x conceptual/pseudo (V3)			
		conceptual	.33	.02	
		pseudo	.57	.00	

NOTE - b's are regression coefficients computed from the full model using the method of Winne and
Marx (1983) to investigate specific effects.

FIGURE 4

Graphs of Disordinal Interactions

Categorizing Task
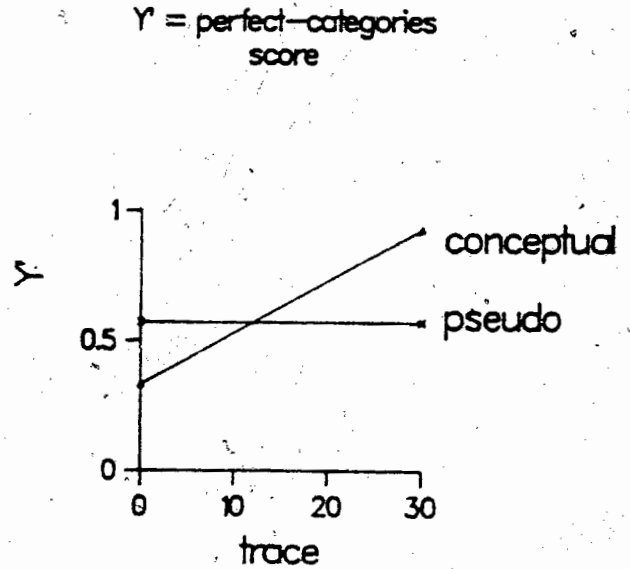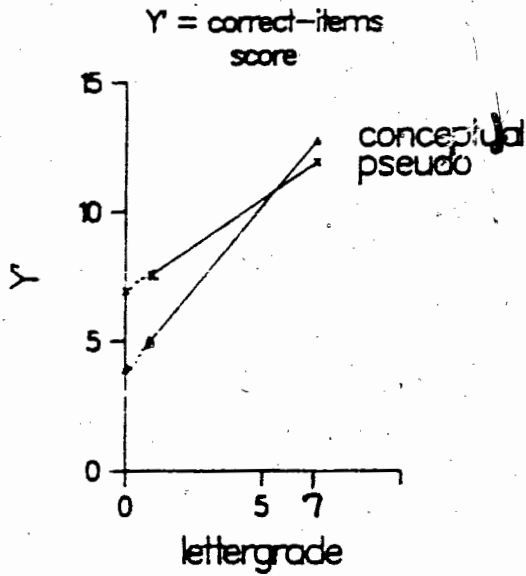
NOTE - Sections of a graph that are extrapolated beyond the
actual range of values on a predictor variable are
shown by ·······

The perfect-categories score showed the same difference between groups as the other two measures, namely, that students in the pseudo-organizer groups performed better than students in the conceptual organizer groups. Small main effects due to lettergrade and trace were also found, with better students and better tracers showing better performance. An interesting interaction was found between group and trace (see Figure 4). Trace had no effect on the scores of students in pseudo-organizer groups, but led to a small improvement in performance for students in the conceptual groups. This finding is consistent with the idea that effective use of advance organizers promotes learning. However, the effect is very small.

Achievement on multiple-choice tests. In Part I of the multiple-choice test, students had to recognize the correct answer from among four alternatives. This test can be thought of as a measure of near transfer. In Part II, students had to rank the four alternatives, where three were correct and only one was wrong. This part of the test required more than just recall. Because students must think about and rank the four given alternatives for each question, it is inferred that this task requires the use of more complex cognitive processing than does the task of choosing the correct alternative in the conventional multiple-choice test (part I). Therefore, this task is

used as a measure of far transfer. Results of analyses are
given in Tables 10 and 11.

On Part I of the multiple-choice test, no
statistically reliable differences were found due to group,
but statistically reliable main effects were found due to
lettergrade and trace. As can be expected, better students
performed better on the test than poorer students. Also,
better tracing led to improved performance. As with
previous results, this finding indicates that organizers
regardless of their type do enhance learning when they are
effectively used.

Two lettergrade x group interactions were found. They
showed that students using the abstract concept organizer
showed a greater improvement in scores with increasing
lettergrade than did students using the analogy organizer.
Lettergrade had almost no effect on scores for students in
the outline group but led to improved scores for students
in the dummy group. The first interaction is consistent
with findings in some previous research that abstract
advance organizers have most value for high-ability
students. This would be true if using abstract advance
organizers required a higher or more difficult level of
cognitive processing than using analogies.

TABLE 10

FINAL STEP OF BACKWARD REJECTION REGRESSION ANALYSES
Multiple-Choice Tests

criterion Variable	Adjusted R^2	Predictors	b	t	p	Variance %
Multiple-Choice Pt. 1	.18	lettergrade	.38	3.37	<.01	.05
		trace	.14	4.54	<.01	.09
		trace x V3	.04	2.49	.01	.03
		trace x V2	.10	3.46	<.01	.05
		l.gr. x V2	-.37	-3.41	<.01	.05
		l.gr. x V1	-.12	-2.31	.02	.02
		constant	5.34	9.41	<.01	
Multiple-Choice Pt. 2 identifying the wrong answer	.19	lettergrade	.58	5.19	<.01	.11
		trace	.09	2.98	<.01	.04
		trace x V3	.11	3.50	<.01	.05
		trace x V2	.03	1.79	.08	.01
		trace x V1	-.05	-2.08	.04	.02
		V3	-1.09	-2.82	.01	.03
		constant	3.35	5.91	<.01	
Multiple-Choice Pt. 2 abstract	.03	lettergrade	-.15	-1.98	.05	.02
		trace	-.03	-1.69	.09	.01
		constant	3.80	10.34	<.01	
Multiple-Choice Pt. 2 analogy	.10	l.gr. x V3	-.23	-3.13	<.01	.05
		lettergrade	-.27	-3.71	<.01	.06
		V3	.88	2.52	.01	.03
		constant	3.28	9.32	<.01	
Multiple-Choice Pt. 2 outline	.16	V2	-1.67	-2.50	.01	.03
		lettergrade	.43	3.27	<.01	.05
		trace	.14	3.81	<.01	.06
		trace x V3	.05	2.72	.01	.03
		trace x V2	.11	3.03	<.01	.04
		constant	4.60	6.95	<.01	

NOTES - Variance % is the squared semi-partial correlation coefficient.
- R^2's are adjusted for the degrees of freedom absorbed by predictors in the regression equation.
- b's are the regression coefficients for the full model.

TABLE 11

EFFECTS OF INDIVIDUAL PREDICTORS
Multiple-Choice Tests

criterion	effect	predictor	intercept	b	adj. mean
multiple-choice	main	lettergrade	7.59	.38	
Part 1		trace	7.42	.14	
	interaction	trace x conceptual/pseudo (V3)			
		conceptual	9.45	.19	
		pseudo	9.45	.11	
		trace x outline/dummy (V2)			
		outline	8.67	.24	
		dummy	8.67	.05	
		lettergrade x outline/dummy (V2)			
		outline	9.23	.00	
		dummy	9.23	.75	
		lettergrade x analogy/abstract (V1)			
		analogy	9.28	.25	
		abstract	9.28	.50	
multiple-choice	main	lettergrade	4.01	.58	
Part 2		trace	5.39	.09	
identify-wrong	contrast	V3 - conceptual/pseudo			
		conceptual			5.49
		pseudo			7.67
	interaction	trace x conceptual/pseudo (V3)			
		conceptual	6.05	.20	
		pseudo	8.23	-.01	
		trace x outline/dummy (V2)			
		outline	6.43	.12	
		dummy	6.43	.07	
		trace x analogy/abstract (V1)			
		analogy	6.70	.04	
		abstract	6.70	.15	
multiple-choice	main	lettergrade	3.47	-.15	
Part 2		trace	3.11	-.03	
abstract					
multiple-choice	main	lettergrade	3.28	-.27	
Part 2	contrast	V3 - conceptual/pseudo			
analogy		conceptual			2.95
		pseudo			1.18
	interaction	lettergrade x conceptual/pseudo (V3)			
		conceptual	4.16	-.50	
		pseudo	2.39	-.04	
multiple-choice	main	lettergrade	6.81	.43	
Part 2		trace	6.92	.14	
outline	contrast	V2 - outline/dummy			
		outline			7.05
		dummy			10.39
	interaction	trace x conceptual/pseudo (V3)			
		conceptual	8.97	.19	
		pseudo	8.97	.09	
		trace x outline/dummy (V2)			
		outline	6.39	.25	
		dummy	9.73	.03	

NOTE - b's are regression coefficients computed from the full model using the method of Winne and
Marx (1983) to investigate specific effects

The second interaction is more puzzling. The expected relationship, namely, that performance should improve with lettergrade, is found in the dummy group. Since the dummy organizer had nothing to do with the article, it is reasonable that it should have no impact on performance. However, the lack of variation in performance with lettergrade for the outline group indicates that the outline organizer washes out ability differences among students. It is not immediately clear why this should be so. One can speculate that use of the outline organizer forces students into making only internal connections, thus preventing better students from using more successful strategies of their own.

Two trace x group interactions were found. Students in the combined conceptual organizer groups showed a higher rate of increasing performance with improvement in tracing than students in the pseudo-organizer groups. This finding suggests that use of a conceptual organizer promotes learning. The second interaction showed that, for the dummy group, better tracing had little impact on performance. The dummy organizer has nothing to do with the text. Recognizing that fact gives a student no advantage in learning the text material. On the other hand, for the outline group, performance improved with improved trace scores. This indicates that the connections that a student makes to the outline do help in learning the material, as tested by a recall task.

Four scores were computed from Part II of the multiple-choice test. The identify-wrong score was the number of times that the wrong alternative was correctly ranked in the last spot. The abstract, analogy, and outline scores were the number of times that the corresponding alternative was ranked as the best answer.

The identify-wrong score, like most of the other measures, showed main effects due to lettergrade and trace. Higher scores were associated with higher lettergrades and with better tracing. A statistically reliable group contrast showed that students in the pseudo-organizer groups performed better on this task than students in the conceptual organizer groups. This result apparently contradicts findings of previous research that students given conceptual advance organizers perform better at tasks requiring far transfer.

This apparent contradiction is resolved when interactions are examined. All three trace x group interactions were statistically reliable. A disordinal interaction (see Figure 5) showed that for the conceptual organizer groups, success in tracing led to better performance on the test. For the pseudo-organizer groups, there was almost no difference in performance with improved tracing. In fact, there was a slight decrease in scores as tracing improved. As trace scores increased, there was a greater improvement in test scores for students in the abstract concept group than the analogy group. Successful

FIGURE 5

Graphs of Disordinal Interactions

Multiple-Choice Test
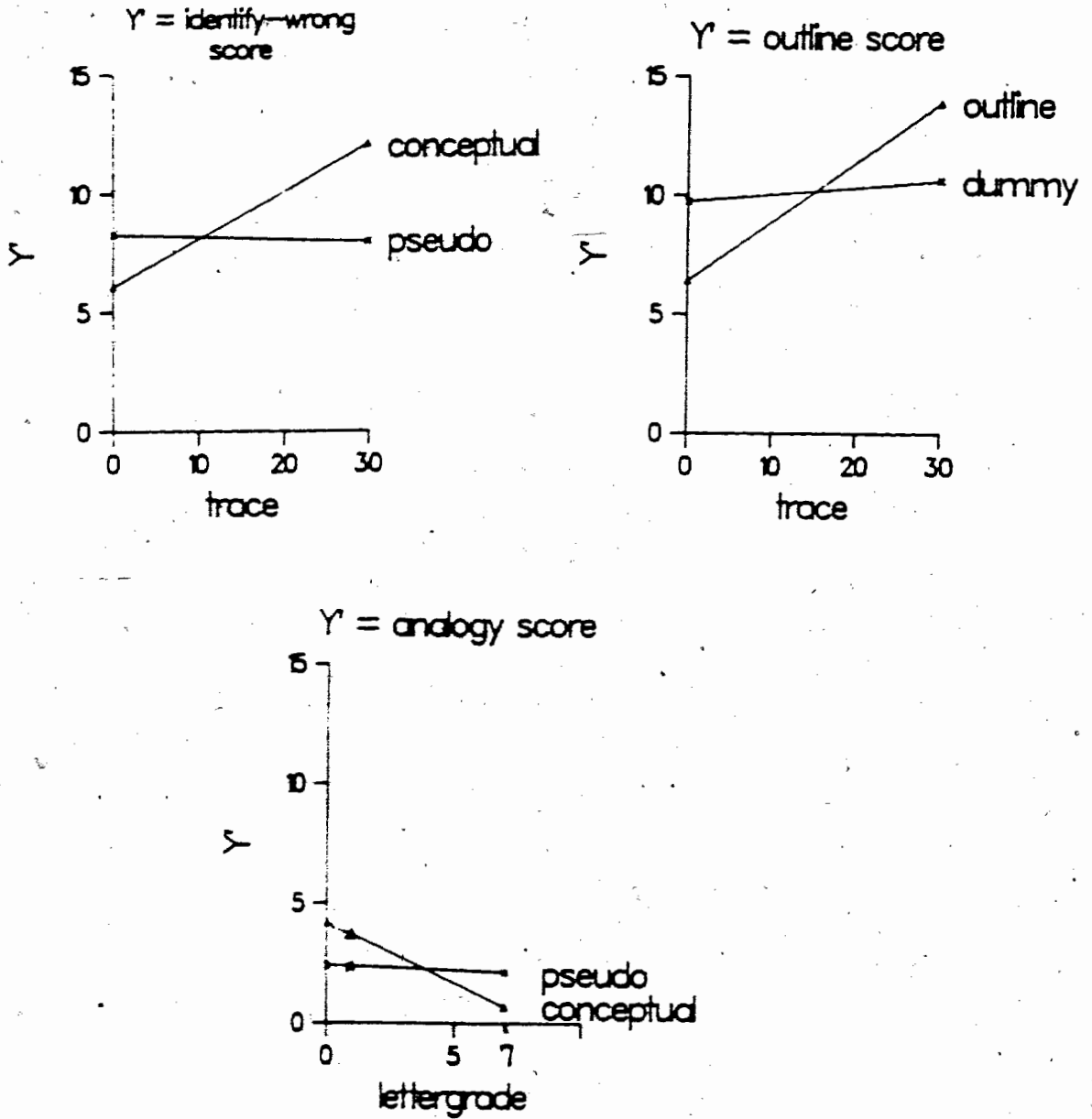
NOTE – Sections of a graph that are extrapolated beyond the
actual range of values on a predictor variable are
shown by ·······

tracing led to a greater rate of increase in performance for the outline group than the dummy group. These findings support the notion that conceptual advance organizers do enhance learning when they are used effectively. The abstract concept organizer may be the most difficult to use, but it promotes the best result on this type of task when used correctly (see Figure 5).

It was hypothesized that students in a group receiving either the abstract, analogy, or outline organizers would show a preference for alternatives that were expressed in terms of their organizer. It was predicted that each group would rank its corresponding alternative as the best answer more often than the other groups would.

The abstract score showed main effects due to lettergrade and trace, but no statistically reliable contrasts or interactions. The main effect for both variables was a negative correlation. Better students and better tracers were _less_ likely to choose the abstract alternative as the best answer.

The analogy score showed a main effect due to lettergrade with better students being less likely to choose the analogy alternative as the most correct answer. One statistically reliable group contrast was found, showing that the students in the conceptual groups ranked the analogy as the most correct choice more often than students in the pseudo-organizer groups. A disordinal lettergrade x group interaction (see Figure 5) showed that

for the pseudo-organizer groups, lettergrade had almost no effect on choosing the analogy as the most correct alternative. However, better students in the conceptual organizer groups showed a decreasing tendency to choose the analogy alternative.

The outline score showed main effects due to lettergrade and trace, with better students and better tracers choosing the outline alternative as the most correct answer most often. A statistically reliable contrast between the outline and dummy groups showed a higher score for the dummy group on this measure than for the outline group. This result is puzzling because the actual group mean for the outline group is higher than the mean for the dummy group (see Table 4). This result may be an artifact of the residualizing of variables in multiple regression. No other explanation suggests itself.

Two statistically reliable trace x group interactions were found. Better tracers in the conceptual organizer groups chose the outline alternative more often than better tracers in the pseudo-organizer groups. A disordinal interaction (see Figure 5) showed that correct tracing in the dummy group had little effect on choosing the outline alternative as the most correct answer, but correct tracing had a positive effect on the outline group.

The puzzling finding here is that better students and better tracers regardless of group generally chose the outline alternative as the best and avoided the other two

correct alternatives. No sensible explanation was found
for this in the context of this study. One is tempted to
speculate that better students' idea of the "most correct
answer" is the answer that is most like the text that they
read.

CHAPTER 5

CONCLUSIONS

The goal of this study was to compare the effects on achievement of different types of organizers. Students in the study were required to trace relationships between sections of the organizers and paragraphs of the article that they studied to ensure that they actively used the organizers while learning. Differences among groups were predicted on a variety of achievement measures. The major hypothesis was that the conceptual organizer groups would perform better than the pseudo-organizer groups on measures of far transfer, but less well on measures of near transfer. Further, it was predicted that the analogy group would perform better on measures of near transfer than the abstract concept group.

Summary of important findings

One-way analysis of variance showed no statistically reliable differences (p>.10) among groups on twelve of fourteen achievement measures. These results are similar to the findings of many earlier studies that concluded that advance organizers have no facilitative effect on learning.

However, multiple regression analyses revealed that most achievement measures showed a statistically reliable main effect due to trace, with achievement scores generally increasing with increasing trace scores. This is an important result because it indicates that the

effectiveness of any type of organizer depends on the student's ability to relate new information to it.

Five achievement measures, namely, total free recall score, all three categorizing task scores, and the "identify wrong" score from the second part of the multiple-choice test showed a statistically reliable group contrast between the conceptual organizer groups and the pseudo-organizer groups. In all five cases, the pseudo-organizer groups outperformed the conceptual organizer groups. This result is similar to results of previous research that found no positive effect of advance organizers on learning. Analysis of trace scores showed that students have a great deal of difficulty in making connections between a conceptual organizer and new information. It is the contention of this author that the apparent negative results here and in previous research are likely due to subjects' inability to effectively use the organizer.

This contention is borne out by an analysis of the interactions between trace and group. Five achievement measures, namely, total free recall score, the perfect categories score and three of the multiple-choice scores, showed a positive regression slope relating trace scores and achievement for the conceptual organizer groups. However, regression slopes for trace scores and achievement for the pseudo-organizer groups were near zero. This finding is particularly important because it shows that

effectively used conceptual organizers do promote learning.
This effect may be obscured in previous research by the
difficulty of making the connections between new
information and conceptual organizers. Other statistically
reliable interactions showed positive regression slopes
relating trace scores and three multiple-choice scores for
the outline group, but not the dummy group. One
statistically reliable interaction was found that showed a
higher positive regression slope for trace and achievement
for the abstract concept group than for the analogy group.

While the results described above are all
statistically reliable, they must nevertheless be
interpreted with caution. Most of the effects were quite
small in magnitude, generally accounting for only a few
percent of the variance in a particular criterion variable.

Contribution to advance organizer research

The overall conclusion to be drawn from this study is
that effectively used conceptual organizers do promote
learning. The student's ability to make correct
connections between the organizer and the new information
is a critical step in the process.

Previous research has investigated the effects of
advance organizers on different types of learning and in
relation to different student abilities. Generally, an
advance organizer was presented to the learner; and was
then ASSUMED to be used by the student in learning new
material. While theory suggested mechanisms by which

different types of organizers were presumed to act, little
empirical evidence was offered to support these ideas.

The major contribution of this study to research on
this topic is that it shows that conceptual advance
organizers have a positive effect only when the students
are able to make correct connections between the new
information and the advance organizer. When students are
unable to make these connections correctly, their
performance on achievement tests may actually suffer
compared to groups that have not been given an advance
organizer.

Student ability to make correct connections to an
organizer was operationalized in a very simple way in this
study. Further research is needed to explicate this
"connections" step. In particular, the types of cognitive
processes students use as they try to relate the organizer
to new material need to be identified.

This study showed weak indications that there was a
difference in effect between the abstract concept organizer
and the analogy. Even in recent research, these two types
of organizers have been used under the general umbrella of
"advance organizer". This potential difference should be
pursued in further research. First, attempts should be
made to replicate the finding reported here. If the
finding is replicated, the differences in effect of these
organizers should be explored further both in terms of the
cognitive processing that students engage in while using

these organizers and in terms of learning outcomes. This study has made an attempt to operationalize definitions of different types of advance organizers. Studies using other topics as the new material for learning need to be done to determine whether the results of this study are generalizable.

Many previous studies have explored the interactions between student ability and use of advance organizers. Results of this study do not shed much more light on this topic. A few statistically reliable lettergrade x group interactions point in the direction of increasing efficacy of conceptual organizers with increasing student ability. However. the statistically reliable effects are small and some measures showed no statistically reliable lettergrade x group interactions at all. Since the question of effect of ability in combination with advance organizers remains unresolved, this area needs further investigation.

More rigorous theoretical and operational definitions of "ability" are needed. While there are many different operationalized measures of "ability" available. there is no consensus among researchers regarding theoretical definitions of ability in relation to use of advance organizers. Moreover, it would be much easier to compare across studies if researchers would use similar measures for student ability.

A major focus of previous research has been interactions between type of organizer and learning

outcome.. These studies generally show that conceptual
organizers promote far transfer but not near transfer.
This study made some attempt to distinguish between
achievement tasks that required far transfer and those that
required near transfer, but essentially concentrated on
determining the effects of advance organizers on learning
of any sort.

Unlike the findings of previous studies, and counter
to the predictions of advance organizer theory, this study
found that effectively used conceptual organizers appeared
to promote near transfer quite successfully. This result
may be an artifact of incorrectly classifying the
achievement tasks. However, operationalizing far transfer
is more of a problem than operationalizing near transfer.

The results in this area must be interpreted with
caution. The difficulties in this study and elsewhere in
exploring the effects of advance organizers on different
types of learning outcomes have their roots in the poor
operational definitions of learning outcomes. Even studies
that do operationalize near and far transfer (e.g. Mayer
1975b, 1976a), generally do so in a way so closely
connected to the content of the new information, that it is
difficult to apply the definitions in other studies. In
previous research, far transfer has been defined in terms
of the number of separate steps needed to construct an
answer (Mayer, 1976a) and in terms of categories of
problems (Mayer, 1975b). What is needed is a general

definition in terms of the quantity and quality of
cognitive processing steps needed to produce the answer.

The predictions of advance organizer theory are
totally bound up with hypothesized and inferred cognitive
processes that learners are believed to perform while they
are using advance organizers. This study has shown that
the assumption that students will use an advance organizer
effectively just because it is presented may not be valid.
If there is a single recommendation for further research to
be drawn from the results of this study, it is that future
research must try to identify the types and gather evidence
of the use of these cognitive processes.

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APPENDIX A

<u>TEXT</u>

Materials for students were printed double-spaced, at 8 characters per inch and 8 lines per inch, giving a slightly different appearance than here. In the student booklet, the instructions were two pages and the text material was eight pages.

For the reading and tracing task, each student received a set of instructions, one of the four types of organizers, and the article about computer crime and prevention.

INSTRUCTIONS

You will be reading some information about Computer Crime and Prevention.

The first page is an introduction. Its purpose is to help you organize your thoughts so that you will remember the new information better.

A

The introduction is divided into 4 numbered sections. As you read each paragraph of the article about Computer Crime and Prevention, try to relate the paragraph to one of the 4 sections of the introduction.

B

There is a box beside each paragraph in the article. As you finish each paragraph, think about which section from the introduction the paragraph relates to most closely. Write the number of the section in the box. You may refer back to the introduction. If you think that the paragraph you have just read is totally unrelated to the sections of the introduction, write 0 (zero) in the box.

The paragraphs in the article may not use the same words that are used in sections of the introduction. You will need to decide how the paragraphs in the article relate to the sections in the introduction based on ideas, not just words.

When you are finished reading, you will be asked to
answer some questions about the article.

The next page shows an example of what you will be expected
to do.

INTRODUCTION

A

:1: Liquid water is more dense than solid water
(ice).

:2: Water will dissolve more substances than will
any other liquid.

PONDS

B

Dissolved minerals in pond, lake, and
stream waters include phosphates,
nitrates, chlorides, sulfates, carbonates
and others. All plants and animals
require small amounts of these minerals in
building their cells. Floating plants
take their minerals directly from the
water; rooted aquatic plants from the pond
bottom. ------------------------------->

2.

EXPLANATION

The paragraph is about the ways that pond plants take
in minerals from the water. This idea relates most closely
to section #2 in the introduction. Therefore, "2" was
written in the box.

DO YOU UNDERSTAND THE INSTRUCTIONS?

How well do you understand what you have to do when you read the real article? Circle the number that best describes your opinion.

I'm not sure.   It's perfectly clear.
I need some help.   I know exactly what
                                                     to do.

          1   2   3   4   5

NAME_____ A   B   C   D

Circle the letter in the title of your introduction.

COMPUTER CRIME AND PREVENTION

Computer crime is a new type of crime in which criminals use computers. It involves knowing how to use the company's computer time for personal use. It also involves finding ways to steal software and misusing the data in the memory of computers. Computers have been used to help people gain both power and money. For example, computers have been used to steal money from bank accounts. Computers have also been used to get private information about people. --->
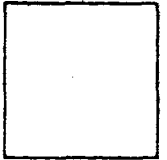
Our culture is starting to suffer more from computer crimes. A great deal of data is stored in computer files. Many people often have access to the data in these files. One can use the computer to move data or delete data from a file. Many of today's unsolved crimes involve moving data from one file to another using a computer. ---------------------->

Crime using computers will likely grow in the future. One way of committing computer crime is to steal computer time from one's boss. Some office workers are likely to use the company computers for

private work. For example, about $250 000 of valuable

computer time was stolen by two programmers for their

own business. These people were able to use their

company's computer to rescore their music. Some

protection will have to be used, such as making checks

on workers, if employers want to avoid losing computer

time. -->
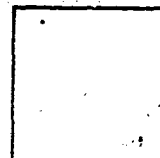
A second way to commit computer crimes is to

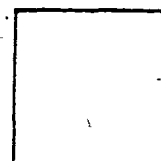change a stored data file. The computer criminal

usually profits from a crime in some special way. A

data entry clerk, for example, might add false data to

files. A business rival might change stored data in

another's file. These illegal actions will often hurt

that business in some way. A person could increase

his own profits a great deal by hurting another's

business. --->

The third way of committing a computer crime is

the theft or spoiling of stored data. The rise in

such crimes will be due to the fact that something can

by gained by such actions. Some workers are likely to

sell data files to their company's rivals. When this

happens, there will be a certain gain for those who

sell these files. Angry workers can spoil programs to

spite their current bosses. -------------------------->
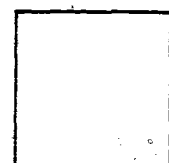
One effect that computers are having on crime is that new methods are being designed. There are a number of new crime methods available for people with special skills. Three of the most common new types of computer crime are described below.
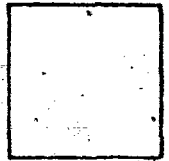
Data diddling involves changing the original data before it is stored in the computer. This is easily done by a data-entry clerk. An example of where this type of crime might occur is at a hotel. A person who arrived at a busy hotel without a reservation could pay a 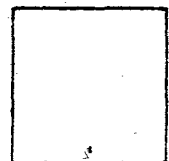dishonest clerk to arrange for a room. The clerk would only have to enter the reservation into the data bank. Once the data from the clerk is entered, it is stored so that the change won't be seen and corrected. To find this change, the original handwritten data must be checked. Complete data traces are then needed to find this type of error.

The salami method involves the theft of stored money that is managed by a computer. This method involves taking a small "slice" or piece of data that represents the real money. A payroll clerk, working for a very large company, might steal a penny from each person's paycheque when it is calculated by the computer. This method could easily permit stealing large amounts from the company employees. A computer

system and many accounts are needed to make this type
of crime worthwhile. One could not steal much money
without these. ----------------------------------->
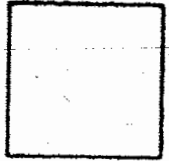
A _Trojan horse_ describes a crime that places
extra instructions into programs. The program does
its normal job and it also performs illegal tasks.
These illegal instructions would have been inserted by
a computer programmer. Trojan horses often have been
inserted so they hurt business activities or steal
something of great value. An angry worker or greedy
person may often be tempted by this type of crime. ->

We have seen that data management in our culture
has changed due to the use of computers. We are also
starting to have problems keeping this data safe.
Some people will learn to use computers to help them
with their present jobs. For example, bank tellers
can quickly check bank balances and update bank
accounts using a computer. Other computers will be
used illegally and some data will be misused by
criminals. For example, bank tellers can use
computers to steal money from others' accounts. The
problem of people committing such crimes will be hard
to stop. ----------------------------------->
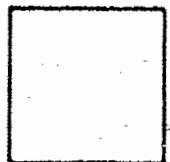
There are a number of reasons why the misuse of
computers will be hard to stop. One reason is that

current legal statutes do not clearly define computer crimes in this country. This means that it is often necessary to charge a criminal with a lesser crime. For instance, it is often easier to charge a person with something like petty theft than stealing computer time. --->
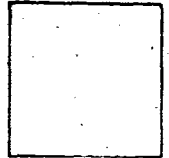
Some people can hide their crimes very easily and for long periods of time. They may be able to go for months or years before their crime is detected. This makes it posible for a criminal to commit a computer crime without an arrest being made. For example, a clever bank teller may steal a small amount on many occasions before the crime is found. When records are checked over and over again by a person, he may report a crime if it is found. The courts will then likely have problems with the criminal prosecution and conviction. -->
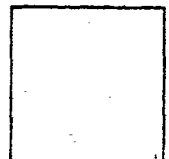
A business may at times try to guard its reputation by hiding a computer crime from others. One reason for this is that a company could easily lose business and its profits. When a company can't stop the computer crimes of its workers. the clients could lose their trust in the business. When crime is unreported. the criminal may go free. This means that stopping computer crimes will be hard. ------------->
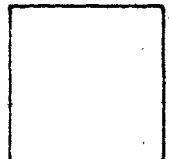
Law enforcement agencies don't understand computer crimes in business very well. A criminal conviction for a computer crime would be easier if there were improved-laws, knowledgeable police, lawyers, judges, and juries. When our legal system can't convict a person of a computer crime, many criminals go free. This will likely mean that these crimes will continue to occur. ---------------------->

We have just looked at problems linked to criminal actions that are partly due to the growing use of computers. Improvement of safety measures is needed to guard computer systems. Personnel identification is one method that some use when guarding computer systems from improper access. An identification card is like a bank card that is used in automated bank tellers. At the present time, these cards appear most dependable when coded on the back with magnetic strips. --------------------------->
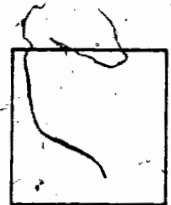
Another safety measure linked to restricting access is the use of passwords. A password is a secret code that restricts access to a computer system. Passwords made up of letter or number characters will identify authorized users to the computer. Computer access will be stopped if the computer is not given the right password. A wrong password will not allow any action by the user. ---->
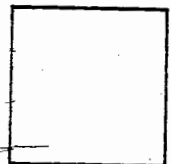
Some body measurements have been used for identifying users. At times, facial features of computer users can be measured and matched to coded records. For example, lipprints and photographs have been tried. If the records show a proper match. then the person can gain computer access. Voice and finger prints can also be used for identifying proper users to a computer system. Most people don't like to use these methods. Computer systems can provide users with easier identification methods, such as magnetized cards and secret passwords. ----------------------------→

Control of stored data will continue to create problems in our culture. As computers get cheaper, more people will use them to store data. Companies using computers in the future will have to make sure they have the proper protection. The computer system will have to guard its data so that it will be safe from criminals. Companies must be able to trust their employees with the valuable information in data banks. The biggest problem will be to make sure employees remain honest in their use of stored data. Companies will have to keep checking on data safety all the time. There are a number of steps that can be taken to ensure data security. -------------------------->
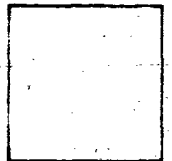
Important data is often contained on computer printouts, printer ribbons, and notes. One could find

private information about people in certain data

banks. For instance, information on people's

backgrounds could be obtained, such as their medical

histories. Private financial records might also be

stolen from people's banks. To ensure that criminals

won't gain illegal access organizations can shred

paper waste. Companies could also dispose of waste in

locked containers. -------------------------- ------------>

Another way companies can secure their data is to

use passwords. A password is a code that lets the

computer identify users. Passwords also allow the

system to identify those files that can be opened for

each user. Once the file is opened the user can work

on it. Frequently changing passwords helps companies

guard their computer and data. ----------------------->
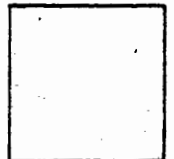
One way to spot improper entries and data changes

is by doing an _audit trail_. An audit trail traces

data from its original source to a final output. For

instance, an audit trail in a bank might trace the

data from a customer's deposit slip. Such data would

be traced to the output on the statement from the

bank. This allows improper changes and errors to be

discovered. These checks are usually done by company

auditors or other people hired for checking files. ->
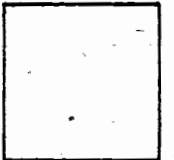
Another way to spot improper access is by using
transaction logs which are kept by computers. These
logs keep records or lists of system users.   This is
one way that allows records of computer access to be
maintained easily by the computer. ---------------->

Encrypting the stored data.is one way that
information can be secured from illegal access.
Knowing the correct code is the only way a person can
change stored data into forms that can be understood.
-->

Special program instructions can be placed into
software in order to prevent improper access.   These
instructions allow people with proper identification
numbers to gain access to the computer system.
Another function that these instructions might have is
to keep records of all attempted entries.   ---------->

Several things can be done to prevent software
from being stolen by thieves. One way is to copyright
valuable computer programs.   This usually involves
copyrighting program codes.   It can also involve
copyrighting flowcharts.   Copyrighting each program
part will usually mean that other people won't be able
to legally copy the computer program.   At times,
people can copy these programs by getting special
permission from the author.   This helps guard the

author from losing money through illegal program

copying. --->
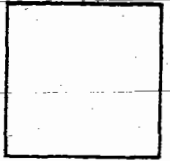
Another way authors can guard computer software

is to <u>lock computer programs</u> with special

instructions. For instance, careful authors could

write some instructions on the magnetic disks between

the normal tracks. This would make it harder for the

criminal to copy the program. ----------------------->
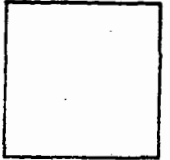
A third solution to the theft problem is to

<u>booby-trap</u> computer programs. These programs will

then stop working when certain conditions occur. For

example, certain programs, booby-trapped by authors,

can be fixed to stop their operation. This process

would take place after several runs had been made of

the computer program. ------------------------------->
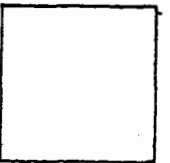
There are a number of steps that must be taken to

ensure privacy of personal information. The first

step is to get the relevant data from accurate and

up-to-date sources. This is necessary in order to

help prevent any misunderstandings by those using the

data. The person must then be able to examine the

data that has been gathered to ensure that it

accurately reflects the whole truth. If the gathered

data is not right then the person should be able to

make corrections in false data entries. ----------->
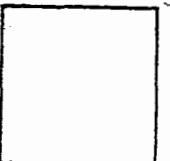
Private people should be told when information about them is being used for any reason. The person should be told in writing the reason for using the information. A proper explanation should include the user's specific intent and legal obligations. In this way the person can be sure that the data is properly used by the other person. ------------------------->
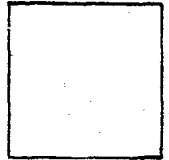
Personal information should only be used for the intended purposes. An organization should only use personal information about someone if it has the proper authorization from the person. These data files should be managed by charging a person with their safety. All government files gathered on a person should be reported to that person. Every personal file gathered on a person should be available for examination by that person. ------------------->
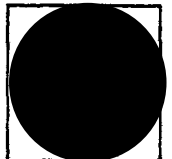
APPENDIX B

ORGANIZERS

Materials for students were printed at 8 characters per inch and 8 lines per inch, giving a slightly different appearance than here. In the student booklet, each organizer was one double-spaced page.

For the students, the organizers were labelled - "INTRODUCTION".

INTRODUCTION	TYPE OF ORGANIZER
A	analogy
B	abstract concept
C	outline
D	dummy

COMPUTER CRIME AND PREVENTION

INTRODUCTION A

|1| Today you will be learning about a new type of crime
- computer crime. There are many similarities in the ways
that people use computers illegally and the ways that
people illegally use other kinds of equipment that they
work with. There are similarities too in the ways that
employers try to prevent such crimes.

|2| For example, think of photocopiers. If you want to
photocopy something for yourself, you have to pay for it.
Many people who use photocopiers at work also use the
machines for themselves in improper ways. Some people use
the company machine to make copies of personal documents,
for example - their income tax returns. Others might make
additional copies of company documents, thus stealing
information about the company. Some people might do
photocopying for acquaintances using their employer's
machine and then charge money for them.

|3| Illegal use of photocopiers is a difficult problem to
control. A lot of people just don't take it seriously.
In a busy office, where many people use the photocopier,
it's hard to tell when it is being misused and even harder
to catch the person who is misusing it.

:4: However, there are measures that employers can take to prevent illegal use of photocopiers. Supervisors can check the internal counter of the photocopier several times a day. The photocopier can be locked, and only certain people can be given the key to use it. People who use the photocopier can be required to fill out a log indicating how many copies they made and for what reason. Employers do these things to discourage dishonest people from taking what is not rightfully theirs.

COMPUTER CRIME AND PREVENTION

INTRODUCTION B

⌐1⌐ New inventions often seem to create new types of crime. As a result, we must readjust our idea of what stealing is, make new laws to govern the new situation. and think up new methods of protecting the invention.

⌐2⌐ Our laws are a reflection of what society believes is right and wrong. Theft is wrong; it is against the law to steal from other people. Nevertheless, we know that some people do steal. When people make new discoveries or create new inventions, dishonest people may think up new ways of stealing. We try to apply our old rules to them. But sometimes, the old rules don't fit the new inventions very well.

⌐3⌐ New methods of stealing may be very difficult to deal with. They may be hard to detect. The language of our existing laws may be difficult to relate to the new invention. Thieves might get away with some kinds of stealing until we make new laws to govern the new situation. Important inventions are often followed by a period of legal turmoil until we come to understand the new kinds of problems that they create and come to develop methods of coping with the new problems.

[4] We try to prevent theft in several ways. We try to educate people to understand that stealing is wrong. We protect our belongings to make it more difficult for someone to steal them. We punish thieves when we catch them. New inventions may need to be protected in new ways. People might have to think up new ways of guarding these inventions, because the old methods are no longer effective.

COMPUTER CRIME AND PREVENTION

INTRODUCTION C

[1] computer crime

- definition of computer crime

- ways of committing computer crime

- examples of computer crime

[2] problems in preventing computer crime

- inadequate current laws

- difficulties in detection

- lack of knowledge

[3] preventing computer crime by protecting hardware

- ID cards

- passwords

- body measurements

[4] preventing computer crime by protecting software

- controlling stored data

- protecting programs

- ensuring privacy

COMPUTER CRIME AND PREVENTION

INTRODUCTION D

[1] Twenty years ago, if you wanted to see a computer you had to visit a university, a government agency or a large business corporation. Computers were very large and expensive. Most of them were locked away in closely guarded rooms with only a few people allowed in to use them.

[2] Today, computers are everywhere. You don't have to go anywhere special to see them. You will find them at school. Many small businesses as well as doctors, lawyers and engineers have their own computers. You may even have your own microcomputer at home.

[3] Computers have thousands of new uses. They are contained in many appliances like microwaves and television sets. Many automobiles are partially computer-controlled. Doctors use them to monitor patients in hospitals. Schools use computers to help students learn many different subjects. Computer-based video games are a popular amusement for young people.

[4] During the last twenty years, computers have changed drastically. They have become smaller and less expensive. Ordinary people can now afford to own and use computers.

CORRECT TRACES

Paragraph	Organizer Section			
	abstract	analogy	outline	dummy
1	1	1	1	0
2	3	1	1	0
3	2	2	1	0
4	2	2	1	0
5	2	2	1	0
6	1	1	1	0
7	2	2	1	0
8	2	2	1	0
9	2	2	1	0
10	3	3	2	0
11	3	3	2	0
12	3	3	2	0
13	3	3	2	0
14	3	3	2	0
15	4	4	3	0
16	4	4	3	0
17	4	4	3	0
18	4	4	4	0
19	2	2	1	0

Paragraph	Organizer Section			
	abstract	analogy	outline	dummy
20	4	4	4	0
21	4	4	4	0
22	4	4	4	0
23	4	4	4	0
24	4	4	4	0
25	4	4	4	0
26	4	4	4	0
27	4	4	4	0
28	4	0	4	0
29	4	0	4	0
30	4	0	4	0

APPENDIX C

QUESTIONNAIRE

The questionnaire, as given to students, was printed at 8 characters per inch, single-spaced, on paper fourteen inches long. In this form, the entire questionnaire fit on one page.

COMPUTER CRIME AND PREVENTION

NAME _____ A   B   C   D

Circle the letter in the title of your introduction.

Answer the following questions by circling the number that

is closest to your opinion.

	not at all				very much

1. How much did you like this   1   2   3   4   5

   article?

2. How hard do you think it will be   1   2   3   4   5

   for you to remember the

   information in the article?

3. How much do you know about   1   2   3   4   5

   computers in general?

4. How difficult to read was this   1   2   3   4   5

   article?

5. Do you agree that boys have more 1   2   3   4   5

   talent for computers than girls?

6. Were the ideas in the article   1   2   3   4   5

   clear to you?

7. Before reading the article, did   1   2   3   4   5
    you like computers?

8. How much harder do you think it   1   2   3   4   5
    would have been to remember the
    information in the article if you
    had not read the introduction
    first?

9. Would you like to learn more   1   2   3   4   5
    about computer crimes?

10. How well do you think you   1   2   3   4   5
    remember the information in the
    article?

11. Do you think that students who   1   2   3   4   5
    have computers at home do better
    in school than students who don't
    have computers at home?

12. How well do you think you   1   2   3   4   5
    understood the ideas in this
    article?

13. Would you like to learn more   1   2   3   4   5
    about computers in general?

14. Can you relate the ideas in the   1   2   3   4   5
    article to other facts that you

knew before reading it?

15. How much experience have you had   1   2   3   4   5

    working with computers?

16. Do you think that the   1   2   3   4   5

    introduction helped you to

    remember the information in the

    article?

APPENDIX D

FREE RECALL TASK

COMPUTER CRIME AND PREVENTION

NAME _____ A   B   C   D

Circle the letter in the title of your introduction.

Answer the following questions on the attached lined paper.
You may ask for more paper if you need it.

Be sure to number each question.

Write down as many important points as you can remember to
answer each question.

1. According to the article, why do people commit computer
   crimes?

2. What methods does the article describe by which
   businesses can protect themselves from computer crimes?

3. What important points does the article give about
   computer crimes?

4. What does the article say about the privacy of
   information stored in computer files?

5. According to the article, why is computer crime such a
   serious problem?

APPENDIX E

CATEGORIZING TASK

Student sheets for this task were printed at 8 characters per inch, single-spaced, on fourteen-inch long paper. In this form, the instructions were one page; the example was one page; and the answer sheet was one page. The fifteen terms used in the categorizing task were typed on index cards, one term per card.

TERMS USED IN CATEGORIZING TASK

computer time for personal use

changing a stored data file

spoiling stored data

data diddling

salami method

Trojan horse

identification card

passwords

finger prints

audit trail

transaction log

encrypting

copyright

lock computer programs

booby-trap
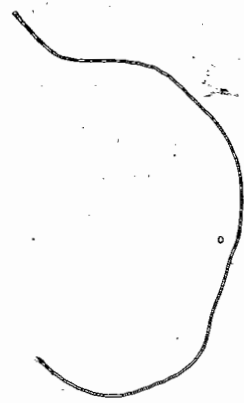
COMPUTER CRIME AND PREVENTION

1. You will be given a set of 15 cards containing terms from the article that you read. Put these cards into groups. You have to use at least 2 groups, but you must not use more than 5 groups. Every card must go in a group. No card may belong to more than one group.

2. Make up a good name for each group, but don't use a term that is on one of the cards. List the names of your groups on the attached work sheet. Write a one-sentence description of each group. If you do not need 5 groups, leave the extra ones blank.

3. Look at each group individually. Rank the cards according to how good an example they are of that group. Put the card that is the best example of the group at the top; the card that is the worst example will be last. Ties are not allowed — write only one term on each line. DO NOT WRITE ANYTHING ON THE CARDS.

4. When you are satisfied with your arrangement, copy it down on the worksheet. Use a column for each group. List the terms on the cards in order, with the top one first.

5. Before you start, look at the example of what you
   will be expected to do. The example is on the next
   page. Look carefully at each part of the example
   to see what you will have to do for each part of
   the instructions.

DO YOU UNDERSTAND THE INSTRUCTIONS?

How well do you understand what you have to do when you get
the real cards? Circle the number that best describes your
opinion.

I'm not sure.   It's perfectly clear.

I need some help.   I know exactly what

                                                          to do.

1   2   3   4   5

EXAMPLE

You will have to arrange a set of terms related to computer crime and prevention. Here is a worked example of an arrangement of terms about food.

TERMS

CORN ON THE COB   APPLE   CORN CHIPS

BANANA CHIPS   TOMATO   FRENCH FRIES

A   After looking at the terms, I decided that APPLE and BANANA CHIPS belonged together. I put CORN ON THE COB, CORN CHIPS, TOMATO, and FRENCH FRIES all together in another group.

B   I called the first group - FRUIT and the second group - VEGETABLES.

GROUP 1

NAME FRUIT

DESCRIPTION Fruits are sweet or sour plant foods that people eat for snacks or dessert.

C   1) APPLE

2) BANANA CHIPS

I put APPLE first because I think that it is the best
example of a fruit.

I think that BANANA CHIPS are a worse example because they
are dried not fresh.

B

GROUP 2

NAME <u>VEGETABLES</u>

DESCRIPTION <u>Vegetables</u>
<u>are plant foods that</u>
<u>people usually eat with</u>
<u>the main part of their</u>
<u>meals.</u>

C

1) CORN ON THE COB

2) FRENCH FRIES

3) TOMATO

4) CORN CHIPS

I put CORN ON THE COB first because everybody knows that it
is a fresh vegetable.

I had a hard time deciding whether to put TOMATO or FRENCH
FRIES next. I know that FRENCH FRIES are potatoes, which
are vegetables. I think that TOMATO is a vegetable too.
But I remember reading that some people call TOMATO a
fruit. Because of this, I decided to put FRENCH FRIES
ahead of TOMATO.

I really don't think that CORN CHIPS are much of a
vegetable. But they are made from corn. That's why I put
them last in this group.

This was my idea of a good arrangement. Other people doing
this exercise might have come up with a totally different
set of groups.

COMPUTER CRIME AND PREVENTION

NAME _____   A   B   C   D

Circle the letter in the title of your introduction.

GROUP 1

NAME _____

DESCRIPTION _____

_____

_____

_____

_____

GROUP 2

NAME _____

DESCRIPTION _____

_____

_____

_____

_____

1)

2)

3)

4)

5)

6)

7)

8)

9)

1)

2)

3)

4)

5)

6)

7)

8)

9)

GROUP 3

NAME _____

DESCRIPTION _____

_____

_____

_____

_____

1)

2)

3)

4)

5)

6)

7)

8)

9)

GROUP 4

NAME _____

DESCRIPTION _____

_____

_____

_____

_____

1)

2)

3)

4)

5)

6)

7)

8)

9)

GROUP 5

NAME _____

DESCRIPTION _____

_____

_____

_____

_____

1)

2)

3)

4)

5)

6)

7)

8)

9)
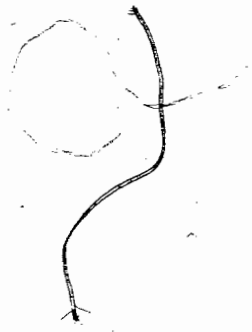
APPENDIX F

MULTIPLE-CHOICE TESTS

Student sheets for these tests were printed at 8 characters per inch, single-spaced, on eleven-inch long paper. Part 1 of the multiple-choice test was printed on white paper. Part 2 of the test was printed on yellow paper. The colour was changed to emphasize the difference in the task that the students had to do.

COMPUTER CRIME AND PREVENTION

NAME _____ A   B   C   D

Circle the letter in the title of your introduction.

PART I - Write the letter of the correct answer in the box

beside each question.

1.   "Software piracy" means

A. theft of computer data

B. illegal use of computer time

C. changing instructions in programs

D. illegal copying of programs

2.   One precaution that can be taken to make sure that

information about private people is used correctly is

to

A. charge money for the use of the information

B. allow only the government to use this

information

C. inform people of the reason for using the

information

D. allow information from a person's file to be

used only once a year

3. A person changes some information before the information has been stored in the computer. This person is committing a crime called

    A. Trojan horse

    B. data diddling

    C. red herring

    D. salami method

4. "Computer crime" is a term used to describe

    A. the ways that people misuse computers

    B. the ways that computers displace people from jobs

    C. the ways that computers can malfunction

    D. the ways that people can steal personal computers

5. A computer criminal using the salami method is stealing

    A. food

    B. information

    C. computer supplies

    D. money

6. A Trojan horse is a computer crime in which the criminal

    A. destroys computer data

    B. changes computer data

    C. adds extra instructions to programs

    D. steals programs

7. Businesses often do not report computer crimes when they are discovered because

   A. they don't want their employees to go to jail

   B. computer crimes don't affect them very much

   C. they are afraid that they will lose their clients' trust

   D. they can't afford the expense of court costs

8. The only way that a person can get access to encrypted data is to

   A. have a key to the computer

   B. know how to program the computer

   C. be trusted by his/her employer

   D. know the correct code

9. Computer criminals are often charged with lesser crimes because

   A. computer crimes are not very important

   B. current laws do not clearly define computer crime

   C. computer crimes are non-violent

   D. most people believe that the penalties for computer crimes are too severe

10. Personal information about people is often stored in computer files. People should be able to examine this information so that

    A. they can correct any information that is wrong

    B. they can erase what they don't want to be in their file

    C. they can decide how much money to charge for the use of the information

    D. they can find out information about other people

11. The crimes of a clever computer criminal may go undetected for

    A. days or weeks

    B. weeks or months

    C. months or years

    D. years or decades

12. Which of the following methods of guarding computer systems do people dislike the most?

    A. fingerprints

    B. ID cards

    C. passwords

    D. magnetized cards

13. One way of committing computer crime that is mentioned in the article is

    A. stealing computer time from the company

    B. stealing a computer from the company

    C. taking computer paper home from the office

    D. bringing in friends to play games on the company computer

14. Used computer printouts are often shredded before being thrown away because

    A. paper manufacturers don't want people to reuse old paper

    B. shredded paper can be sold for additional profit to the company

    C. shredded printouts take less room in garbage bins

    D. people try to steal computer data by collecting and reading old printouts

15. One way to detect improper access to a computer system is to use a

    A. Trojan horse

    B. transaction log

    C. booby-trap

    D. copyright

COMPUTER CRIME AND PREVENTION

NAME_____A   B   C   D

Circle the letter in the title of your introduction.

PART II - In this section, each question has several answers that are more or less correct. Rank the answers for each question. Mark the answer that you think is most correct #1, the next most correct - #2, etc. The answer that you think is least correct (or wrong) will be marked #4. Write your numbers in the boxes beside each question.

READ THE EXAMPLE BELOW TO SEE WHAT YOU WILL HAVE TO DO WHEN YOU ANSWER THE REAL QUESTIONS.

EXAMPLE

Plants' ability to get nourishment from pond water is

2	A. possible because there are minerals dissolved in the water
3	B. part of the balance of nature
1	C. like our getting nourishment from eating food
4	D. the cause of water pollution

NOTE - This ranking shows my idea of how correct the various answers are. Another person might come up with a different ranking.

===

QUESTIONS

1. Computer criminals are often charged with lesser crimes because

   A. computer criminals are more like people who bring home office supplies from work than they are like bank robbers

   B. it takes time for laws to catch up with new technology

   C. current legal statutes do not clearly define computer crimes

   D. no one is hurt very much by computer crimes

2. People should be able to examine data that is stored about them in computer files

   A. because it's interesting to find out what other people know about you

   B. so that they can be sure that the information is correct

   C. just as you have a right to see your test after the teacher has marked it

   D. because people have a right to protect their privacy

3. A person who uses the company computer for his/her own

    work is

    A. stealing computer time

    B. like the mechanic who uses the shop tools to

       fix his/her own car

    C. practicing a new type of crime

    D. getting the most out of his/her job

4. A computer criminal using the salami method is

    A. committing a type of crime that did not exist

       before computers

    B. stealing small amounts of money from many

       different bank accounts

    C. reprogramming electronic scales in meat stores

       so the weight is less than it should be

    D. like a store clerk who shortchanges many

       customers by a nickel or a dime and keeps it

5. Before a computer worker can gain access to sensitive

    information in the computer, (s)he must type in a

    special code. This action is:

    A. a new way of protecting a new invention

    B. the use of a password

    C. the reason why computers are so time-consuming

    D. like the secret handshake of club members

6. One characteristic of many computer crimes is that they

A. are like petty theft in factories

B. are a new type of crime

C. involve moving around information stored in computers

D. involve machines affecting other machines, not people

7. Computer criminals can often commit their crimes without being arrested because

A. their crimes may not be discovered for years

B. they can blackmail law officers to leave them alone

C. new types of crimes are always difficult to detect

D. their crimes are like forgeries - people often don't notice that anything is wrong

8. A computer can be programmed to keep records of all people who use the computer system. This technique is

A. a protection of the computer system from unauthorized use

B. called keeping a transaction log

C. like keeping track of all the people who have keys to the school

D. too expensive to be practical

9. Booby-trapping is a method

    A. that was adapted to a new invention - computers

    B. to catch people trying to steal computer

       equipment

    C. like giving the wrong answers to a person who

       wants to copy your homework

    D. to protect programs from being illegally copied

10. Computer crimes are often unreported because

    A. a computer crime is like a "skeleton in a

       closet".

    B. people are too afraid of computer criminals

    C. new crimes are difficult to understand at first

    D. business people are afraid of losing their

       clients

11. An audit trail is

    A. like retracing your steps to find something

       that you lost

    B. a record of the sounds made by a person

       committing a computer crime

    C. following the pathway of a piece of information

       through the system

    D. a new method developed to cope with a new type

       of crime

12. A computer criminal using a Trojan horse is

   A. illegally changing some of the instructions in
      a computer program

   B. using a special password to illegally use a
      computer system

   C. like a person who fixes a vending machine to
      give back the wrong change

   D. committing a type of crime that results from a
      new invention

13. Important computer data can be protected by storing it
   in mixed up form. Only people with the right code can
   change it back to an understandable form. This method

   A. is very expensive to use

   B. similar to what pay TV companies do to protect
      their signal

   C. is an example of a new way of protecting a new
      invention

   D. is called encrypting

14. A computer criminal doing data diddling is

A. like the person at the grocery store who eats some "bulk food" before it is weighed

B. one who writes over important computer printouts so that they become illegible

C. committing a type of crime that did not exist before computers

D. changing the original data before it is stored in the computer

15. Protecting the privacy of personal information stored in computer files means

A. using the information only with proper authorization

B. preventing new inventions from causing people new problems

C. the same thing as not telling your friend's secrets without his/her permission

D. that there should be security guards wherever computer files are stored

ANSWERS TO MULTIPLE-CHOICE TEST - PART 1

1. D
2. C
3. B
4. A
5. D
6. C
7. C
8. D
9. B
10. A
11. C
12. A
13. A
14. D
15. B

ANSWER CLASSIFICATIONS FOR MULTIPLE-CHOICE TEST - PART 2

1. A.   analogy
   B.   abstract concept
   C.   outline
   D.   wrong

2. A.   wrong
   B.   outline
   C.   analogy
   D.   abstract concept

3. A.   outline
   B.   analogy
   C.   abstract concept
   D.   wrong

4. A.   abstract concept
   B.   outline
   C.   wrong
   D.   analogy

5. A.   abstract concept
   B.   outline
   C.   wrong
   D.   analogy

6. A.   analogy
   B.   abstract concept
   C.   outline
   D.   wrong

7. A.   outline

   B.   wrong

   C.   abstract concept

   D.   analogy

8. A.   abstract concept

   B.   outline

   C.   analogy

   D.   wrong

9. A.   abstract concept

   B.   wrong

   C.   analogy

   D.   outline

10. A.   analogy

    B.   wrong

    C.   abstract concept

    D.   outline

11. A.   analogy

    B.   wrong

    C.   outline

    D.   abstract concept

12. A.   outline

    B.   wrong

    C.   analogy

    D.   abstract concept

13. A.   wrong

    B.   analogy

    C.   abstract concept

    D.   outline

14. A.   analogy

    B.   wrong

    C.   abstract concept

    D.   outline

15. A.   outline

    B.   abstract concept

    C.   analogy

    D.   wrong

APPENDIX G

TEACHER INSTRUCTIONS

DAY 1

1. Give out instructions. Go over instructions with the
students. When finished

> ASK - Please put up your hand if you
>
> circled 3 or higher.

Based on response, go over instructions with the class
again or individually as necessary.

The text packages are arranged in random order. Give
them out, without changing around the order, by your
usual method. Tell students that

- they may tear off the introduction sheet, but should

    take care to keep the rest of the package stapled

    together

- they will have about 25 minutes to complete the task

    they must put a number in every box and only one

    number to a box

While they are working, please check that they have

written their name on the paper and correctly circled

their introduction letter.

Collect papers when they have finished or 30 minutes are

up - whichever comes first.

2. Hand out questionnaires. Tell them that they must answer every question. Go over the fact that "1" means "not at all"; "5" means "very much". If they cannot make up their minds what to put down, they should circle "3". Please check that they have written their name on the paper and correctly circled their introduction letter. Collect papers when finished.

3. Hand out last section - "5 questions". Tell students that they have the rest of the period to answer them. Go over instructions printed on the sheet. Please check that they have written their name on the paper and correctly circled their introduction letter. Hand out more foolscap if needed and staple it to their other papers. Collect papers when finished.

FOLLOW YOUR NORMAL ROUTINES AS MUCH AS POSSIBLE.

DAY 2

1. Hand out sheets - 1a, 1b, 1c. Go over instructions with the students and let them study the example. When finished

   ASK - Please put up your hand if you

   circled 3 or higher.

   Go over instructions with the class again or

   individually as necessary.

   Give out card sets. You may want to remove the rubber bands yourself before you give them out. Give students about 30 minutes to complete this task. Please check that they have written their name on the paper and correctly circled their introduction letter.

   When finished, collect papers and cards.

   PLEASE KEEP CARDS TOGETHER IN THEIR PACKETS OF 15 AS THEY MUST BE REUSED SEVERAL TIMES.

2. Hand out Part I (white) of the multiple choice test. Go over instructions. Tell students that there will be a second part which will have different instructions. Please check that they have written their name on the paper and correctly circled their introduction letter. Tell them to put up a hand when they are finished this part.

3. As you pick up Part I, hand out Part II (yellow).

   Please draw students' attention to the DIFFERENT

   instructions for this part. Please check that they have

   written their name on the paper and correctly circled

   their introduction letter.

   Collect the papers when finished.

APPENDIX H

FREE RECALL MODEL ANSWERS

For each short-answer question, the following lists are given. First, there is a list of verbatim points from the text with the paragraph number that they were found in given in parentheses. Second, there is a list of points that make up the actual model answer. The second list is a reorganization of the first, leaving out repetitions that are found in the original text. Finally, examples of irrelevant, extraneous, and wrong points are given.

1. According to the article, why do people commit computer crimes?

   - to help people gain power (P1)

   - to help people gain money (P1)

   - computer criminal profits from crime (P4)

   - something can be gained (P5)

   - gain for those who sell files (P5)

   - to spite their bosses (P5)

   - because people are angry (P9)

   - because people are greedy (P9)

   MODEL ANSWER -- #1

   - general idea of gain

       - gain, profit, personal profit, to make profits

   - power

       - power, control

   - money

       - money, wealth, greedy, to get rich

   - spite

       - spite, anger, revenge, to get back at the boss,

         unhappy with boss, to hurt the company

   - knowledge

       - sell files, get personal knowledge, find out

         things you shouldn't

       Examples of Irrelevant Points

   - by changing information

   - they can steal something

   - an easier way to steal

- it is hard to commit computer crimes

- to get computer time

- to get a hotel room without making reservations

- because they don't get caught

    Examples of extraneous points

- to cheat on their taxes

- for fun

- because they are dishonest

- to become famous

- to make phony idea (sic) cards

- to get an increase in pay

- to make photocopies without paying

    Examples of Wrong Points

- because they want to

- yes, people do commit computer crimes

- so they can work in their business

- 250,000

2. What methods does the article describe by which
   businesses can protect themselves from computer
   crimes?

- make checks on workers (P3)

- guard computer systems from improper access (P15)

- personnel identification (P15)

  password - secret code (P16)

  password restricts access to a computer system (P16)

  body measurements used to identify users (P17)

facial features measured and matched to records
(P17)

lipprints (P17)

photographs (P17)

voice prints (P17)

fingerprints (P17)

- companies trust their employees (P18)

- make sure employees remain honest (P18)

- keep checking data safety (P18)

- organizations can shred paper waste (P19)

- companies dispose of waste in locked containers
(P19)

- companies secure data by passwords (P20)

- passwords identify files that can be opened (P20)

- frequently changing passwords (P20)

- spot improper entries and data changes (P21)
audit trail (P21)

- spot improper access (P22)

- transaction log (P22)

- maintain computer records of access (P22)

- encrypting (P23)

- information secured from illegal access (P23)

- special program instructions to prevent improper
access (P24)

- keep records of attempted entries (P24)

- prevent software from being stolen (P25)

- copyright valuable programs (P25)

- guard computer software (P26)

- lock programs with special instructions (P26)

- make it harder for criminal to copy programs (P26)

- booby-trap (P27)

- make programs stop when certain conditions occur
(P27)

MODEL ANSWER - #2

- general points

    - take some precautions, check the computer. only

let people in authority use it. keep computers in a

locked room, only certain people have access.

protecting software, secret methods, protection of

hardware

- audit trail

- booby trap

- copyright

- ID cards

- encryption

- guard computer system from improper access

- lock computer programs

- password

- transaction log, keep a record of users

- shred paper waste

    Examples of Irrelevant Points

- salami method

- Trojan horse

- ensuring privacy

- clerks can open a bank account

- data diddling

- theft of data

    Examples of Extraneous Points

- new inventions are needed to prevent computer crimes

- photocopier

- keep a list of people who use the photocopier

- don't have computers

- don't put so much into computers

- pay for computer time lost

- make sure nobody is getting extra computer time

- educate people that stealing is wrong

- punish thieves

- have special computer alarms

    Examples of Wrong Points

- by being an author

- computer banks

- by locking themselves in their houses

- by the busy offices

- businesses that can protect themselves are banks

- easily find out what title you want

- I forgot it

3. What important points does the article give about

computer crimes?

- new type of crime using computers (P1)

- use of company computer time for personal use (P1)

- misuse data in memory of computers (P1)

- steal money from bank accounts (P1)

- get private information about people (P1)

- computer crime will grow in the future (P2)

- steal computer time for private work (P2)

- example of people who rescored their music on the

  company computer (P2)

- change stored data files (P4)

- spoiling stored data (P5)

- workers sell data files to company's rivals (P5)

- new methods being designed (P6)

- data diddling (P7)

- changing data before it is stored in the computer

  (P7)

- hotel reservations example (P7)

- salami method (P8)

- theft of stored money (P8)

- payroll clerk example (P8)

- small slice stolen from many different accounts (P8)

- Trojan horse (P9)

- extra instructions in program to do illegal tasks

  (P9)

- hurt business activities (P9)

- steal something of value (P9)

- bank tellers use computers to steal money from

  accounts (P10)

- computer crime will be hard to stop (P10)

- legal statutes do not clearly define computer crime

  (P11)

- computer criminals often charged with lesser crimes

  (P11)

- computer crimes can be easily hidden (P12)

- courts have problems with convictions (P12)

- stopping computer crimes will be hard (P13)

- law enforcement agencies don't understand computer

  crimes very well (P14)

  MODEL ANSWER - #3

- characteristics of computer crimes

      - general - new type of crime, illegal,

        dangerous, cause trouble, hurt people

      - easy, happen all the time

      - serious, hard to stop

      - will grow in future

      - can go undetected

      - laws inadequate

- types of computer crime

      - general - many methods, how people perform

        crimes

      - steal time

      - steal money

- steal/destroy data

- motives for committing computer crime

    - general - why they do it, for benefit

    - to get money

    - because people are dishonest

    - from spite

    - to get information

- examples of computer crime

    - data diddling

    - salami method

    - Trojan horse

    - $ cost of crime

- methods of prevention

    - general - need new methods, how to prevent.

    people shoud be careful

    - need new laws

    - copyright

    - booby-trap

    - protect data

    - have honest employees

    - encryption

    - passwords

- results of computer crimes

    - people are hurt

    - businesses are hurt

    - loss of money

    - invasion of privacy

Examples of Irrelevant Points

- none

Examples of Extraneous Points

- when price drops, many will buy computers

- they can do crimes in their own homes

- not to steal

- new inventions may cause new crimes

- important parts are printers, disks, programs

Examples of Wrong Points

- there are no important points

- can be very handy and useful

- hard to do

- you're going to have to ask a higher official

4. What does the article say about the privacy of information stored in computer files?

- computers used to get private information about people (P1)

- many people have access to data in computer files (P2)

- many unsolved crimes involve moving data from one file to another (P2)

- some data will be misused by criminals (P10)

- computer system will have to guard its data (P18)

- companies must be able to trust their employees (P18)

- private information about people found in data banks (P19)

- information about people(P19)s background (P19)

- information about medical histories (P19)

- private financial records (P19)

- ensure privacy of personal information (P28)

- get data from accurate and uptodate sources (P28)

- prevent misunderstanding by those using data (P28)

- person must be able to examine gathered data (P28)

- person must be allowed to ensure that it accurately
  reflects the whole truth (P28)

- person should be able to correct false entries (P28)

- people should be told when information about them is
  being used (P29)

- person should be told reasons in writing (P29)

- reasons should include user's specific intent and
  legal obligations (P29)

- information should only be used for intended
  purposes (P30)

- organization should have proper authorization (P30)

- a person should be in charge of the safety of data
  files (P30)

- all government files about a person should be
  reported to him/her (P30)

- every personal file should be available for
  examination (P30)

MODEL ANSWER - #4

- problems

    - general -

    - computers can be entered easily, privacy

  ineffective, unsafe, can be stolen

    - dishonest people

    - many/wrong people have access to computers

- descriptions of data

    - general - important information

    - confidentiality

    - personal lives

    - government data

    - financial info

    - medical info

- methods of ensuring privacy

    - general - be careful, don't tell

    - honest/authorized people

    - info should be accurate

    - people have legal rights

    - inform people that their data will be used

    - get people's permission

    - keep data save, guard it

  Examples of Irrelevant Points

- hurt a company by finding their files

- difficult to prevent computer crime

- don't use computers for personal uses

Examples of Extraneous Points

- arrests for invasion of privacy

- only the owner can see his file

- steal plans for planes, subs, trains

Examples of Wrong Points

- privacy helpful in storing info

- ask a higher official

- privacy prevents many crimes

- valid information

5. According to the article, why is computer crime such a

serious problem?

- problems in keeping data safe (P10)

- many reasons (P11)

- current legal statutes do not define computer crimes

  very well (P11)

- necessary to charge criminals with lesser crimes

  (P11)

- people can hide computer crimes easily (P12)

- people can hide computer crimes for long periods of

  time (P12)

- criminal can commit crime without an arrest being

  made (P12)

- courts have problems with prosecution and conviction

  (P12)

- business may hide computer crime (P13)

- when a crime is unreported, criminal may go free

  (P13)

- law enforcement agencies don't understand computer

  crime very well (P14)

MODEL ANSWER - #5

- general points

    - many reasons, easy to do, hard to prevent,

      computers are used for everything

- computer crimes are hard to detect

    - can hide crimes easily, can hide crimes for

      long time, businesses may hide computer crime,

      criminal goes free when crime unreported

- legal problems

    - computer criminals can get away with it, laws

      don't define computer crimes very well,

      criminals may be charged with lesser offenses,

      can commit crime without being arrested, law

      enforcement agencies don't understand crime

      very well

    Examples of Irrelevant Points

- can ruin business

- against the law

- steal money in banks

- get secret information

- because it's wasting people's money

- secret plans will be spread about

- cheat other people

- hurt other people

- because many things are being stolen

- won't be able to trust employees

- because it is stealing

    Examples of Extraneous Points

- new inventions cause new crimes

- the more it is done, the more people want to do it

- it happens to people who can't afford it

- everyone does it

- with new inventions crimes get bigger

- can be used to commit burglaries

- can cause a lot of worse things to happen

- don't want to pay for using a photocopier

    Examples of Wrong Points

- they should stop making movies about it

- it protects others' rights

- you can stop it easily

- it isn't serious

- just like the article says

- a computer can't think

- it can help you do what you want

APPENDIX I

SUMMARY OF CATEGORY NAMES USED BY STUDENTS

This appendix contains lists of category names that were actually used by students when they did the categorizing task. A separate list is given for each group. Numbers in parentheses indicate the number of students who used a particular category name. If there is no number following the name, only one student chose the name. The list for each group is broken down into the classifications that were used in marking, namely, computer crime, preventing computer crime by protecting hardware, preventing computer crime by protecting software, prevention of computer crime, and inappropriate. The names that students gave to categories were classified by considering both the name and the description. This is why similar-sounding category names may be classified differently.

ABSTRACT CONCEPT GROUP

<u>category names classified as equivalent to or subsets of</u>

<u>"computer crime"</u>

abusing information

breaking and entering a computer

breaking in

breaking into a program

breaking into computer files

breakins

changing data

computer crime methods

computer crimes (5)

crime

crime methods (3)

crime systems

crimes (5)

crimes committed

criminal methods

data changes - should not be done

data deleting

destruction of companies' data

how crimes are started

how you can hurt a business

illegal program methods

illegal things to do

methods of committing computer crimes

methods of computer crime

methods of crime

methods of stealing

methods of taking programs

mistreating business

moving data around

names of things wanting to steal

personal gain crime

program destroying

ruining a company by using computers

sabotaging data

taking money

tampering with computer programs

theif (sic) methods

thieves do

types of crime on computers

uses for computer crime

using a computer for yourself - when you shouldn't

ways of breaking into programs

ways of computer crime (2)

ways of stealing

ways to break into computers

ways to commit computer crime

wrong computer methods

<u>category names classified as equivalent to or subsets of</u>

<u>"preventing computer crime by protecting hardware"</u>

permission to use computers

ways to show you have the privilege of using the computer

<u>category names classified as equivalent to or subsets of</u>

<u>"preventing computer crime by protecting software"</u>

how you can trace back crimes

prevent a stolen program from being copied or used

stopping someone trying to steal a program

ways of checking files

ways of finding computer crimes

ways of finding out who entered a program

<u>category names classified as equivalent to or subsets of</u>

<u>"prevention of computer crime"</u>

anti computer crime

catchers

clues to catch a criminal

code for unlocking computer

computer codes

computer identifications

computer identifying methods

computer information that can help you track them

computer protection

computer security

computer traps

copying programs

crime detecting

crime prevention (6)

crime stoppers

identification

keep out methods

methods to stop computer crime

needing information to start a computer

personal protection

precautions

preventing computer crimes

preventing theft

prevention (3)

prevention of computer crime

prevention systems

preventions (2)

preventions of computer crime

programs to prevent computer crimes

protected programs

protection (3)

protection of data

protectors

safety devices

security (2)

security programs

stop computer crimes (2)

stopping crimes

theft prevention

theft tracing

things to prevent stealing

to catch a thief

to find computer crime

types of identification

ways of preventing crime

ways of prevention

ways to detect

ways to prevent and protect from computer crimes

ways to stop piracy

category names classified as inappropriate

boobey (sic) trap

catalog

computer business

computer names

computer parts

computer terms

computer times

data diddling

diddling cards

different methods of using computer

different methods to use on computers

different types of data

enjoying a computer

erasing mistakes

forms of data

free time

I didn't know what they meant

losing memory

mickey mouse

misc.

miscellaneous

mistakes

new programs

no name (4)

odds – things I can't place in a group

orders

others (2)

outside methods

personal uses (2)

playing with the keyboard

programs (2)

they all have the same name – data – on the cards

things you can use computers for

Trojan method

unknown

uses for computers (2)

ways people can use computers

ways to do something on a computer

ways to use a computer

your computer

ANALOGY GROUP

<u>category names classified as equivalent to or subsets of</u>

<u>"computer crime"</u>.

bad ways computers are used

breaking in (2)

changing computer programs and data

changing data crimes

changing data for money

common computer crimes

computer crime (3)

computer crime methods (3)

computer crimes (9)

crime methods to do with data

crime nicknames (2)

crime of computers

crimes (2)

destructions

examples of computer crimes

famous crimes on a computer

fooling around

getting into computers

if you misuse a computer

illegal computer uses

illegally altering information

invading privacy - mess up a business

method of programming illegally

methods of breaking into a computer

methods of computer crime (3)

methods of ruining programs

names of crime methods

names of methods of computer crime

offences

phrases about ruining data

some of the things people do to commit a crime

spoiling a program

tapping into computers

theft

types of computer crimes

types of crime

ways of computer crime

ways of theft

ways of wrecking programs

ways to break in

ways to steal data

what happens when some people gain access to computers

what the criminals do

wrong uses for computers

<u>category names classified as equivalent to or subsets of</u>

<u>"preventing computer crime by protecting hardware"</u>

identification (3)

like credit cards

protecting use of computers

things to be done if wanted to go to computer

ways of checking

ways of identifying

category names classified as equivalent to or subsets of

"preventing computer crime by protecting software"

catching people in the midst of it

don't copy

finding the criminal

keep your programs safe

protecting data

protecting programs

tracking crime

use to find thief after computer crime

ways computer crime might be handled

ways of finding computer crimes

ways of protecting programs

ways of stopping the copying of computer programs

category names classified as equivalent to or subsets of

"prevention of computer crime"

access to computer files

catching and preventing

catching computer criminals

computer crime prevention (3)

computer crimes security

computer traps

crime prevention (4)

crime stoppers

data saver

for safety use of computers

getting caught

how to protect data

identifying crimes

keeping data safe

other ways of stopping computer crimes

precautions

prevent computer crimes from happening

preventing computer crimes

preventing crimes

preventing thiefs (sic)

prevention

prevention of computer crime (3)

prevention of crime

prevention of illegal use

preventions (2)

preventive measures

protecting your computer from people who misuse it

protection (4)

protections against crime

safeguarding

security (3)

stop computer crime

stopping personal use

things you do in order to prevent computer crime

things you have to know to get into the program

trap

trap

types of security

ways of catching or preventing a thief

ways of preventing computer crimes

ways of preventing theft

ways of stopping computer crimes

ways to keep protected

ways to prevent computer crime (3)

ways to prevent data from being ruined

ways to protect your own data

what to do after computer crime

<u>category names classified as inappropriate</u>

? (2)

a thing of doing things

bizarre words not known

change

changing

computer codes about the computer

computer for personal use

computer terms (3)

computer words

computers

computers help us

copy

crosswords

data

data file

data files

data using

datas

describe something

different kinds of computer projects

entertainment

I don't know

I don't know where else they belonged

important information

introduction

learning about computers

lock programs

methods (2)

methods for using a computer

methods to use on a computer

mystery

no name

personal use (2)

personalized uses

private stuff you don't show anybody

programs

stored data

the main horse

time table

undeciferable

use of computers

using time

ways a computer is used

ways of using computer

ways to get data

what computers do

what to do with a computer in your own time

words I don't know

xerox

OUTLINE GROUP

<u>category names classified as equivalent to or subsets of</u>

<u>"computer crime"</u>

abusing data

breaking in

breaking in computers

breaking into a computer

computer changing data

computer crimes (11)

computer data in crime

crimes (3)

criminal offence

destroying data

erasing computer programs from memory banks

examples of illegal usage

fooling around with data

getting into computers

how people misuse computers

illegal usage

illegal use of computers

methods for computer crime

methods of committing computer crimes

methods of computer crime (2)

methods of crime (3)

methods of disrupting computer programs

methods to get into computer banks

problems for protecting computers

problems with computers

results of computer crimes

ruining programs

something that could go wrong during computer crime

stealing data

stealing names

theft

types of computer crimes (3)

types of crime (2)

using computers for personal gain

ways of committing computer crime (2)

ways of computer crime (3)

ways of getting information illegally

ways to commit computer crime

ways to destroy or change computer software

what computer crime is

why people break into computers

wrecking programs

<u>category names classified as equivalent to or subsets of</u>

<u>"preventing computer crime by protecting hardware"</u>

code entering

computer protection in hardware

crime prevention

how to keep computers safe

1D to use a computer

people getting cards to get into computers

precautions

preventing computer hardware crime

secret ways to get to use a computer

things to do with identification

things you need to get into the computer

ways to identify staff

ways to protect computer hardware

category names classified as equivalent to or subsets of

"preventing computer crime by protecting software"

checking data

computer protection in software

crimestopper - store computer programs without being stolen

data protection

discovering computer criminals

good methods of computer software

how to prevent people from disturbing or changing programs

illegal copying

legal computer copying

making programs hard to copy

preventing computer software crime

privacy

program protection

protecting data

safety device

safety of data

safety of programs

the rights of anything owned that no one could copy

ways of preventing computer crime in software

ways to keep programs safe

<u>category names classified as equivalent to or subsets of</u>

<u>"prevention of computer crime"</u>

capture

catching computer criminals

codes (2)

computer crime prevention

computer crimestoppers

computer prevention

computer traps

crime control

crime prevention (3)

crime stoppers

defense

detecting computer crime

easy computer crime prevention

hard computer crime prevention

helping to prevent computer crimes

how to stop computer crime

identification

identifying rightful owners of data

keep people from breaking into your computer

methods of preventing computer crime

prevent computer crimes (2)

preventing computer crime (2)

prevention (4)

preventions against computer crime

preventions of computer crime (2)

proper use

protection

protection of computers

safety measures

secret codes

security

signals to get into a disk

stopping computer crime (2)

stopping computer criminals

stopping crime

things for a secret code

track down the criminal

traps (3)

ways computers prevent computer crime

ways of catching a computer criminal

ways of getting in

ways of getting into your personal computer filings

ways of preventing computer crimes (2)

ways of preventing illegal use of computers

ways of protecting computers

working computers - programs you can do

<u>category names classified as inappropriate</u>

?

about the computer

bank

beginning and logging off a computer

big money

computer games (2)

computers

data (2)

data files

different programs and languages for the computer

different things you can do on a computer

tooling

games.

I don't know

ideas for your computer

junkyard

methods of doing something

miscellaneous (2)

no name (3)

odd things

other

personal home computers

personal programming

personal things

personal use

school subjects

storing

they all start with C

things to do with a computer

things to do with data

things to do with games

things to do with horses

unknown

using the data

words I forget

words that are left

words that are weird

working on computer

wrath

DUMMY GROUP

__category names classified as equivalent to or subsets of__

__"computer crime"__

breaking-in

breakins

cheat

cheating

computer breaking

computer changing

computer crime (3)

computer crime methods (3)

computer crimes (4)

computer stealing

crime methods (2)

crime things

crimes (3)

damaging programs

data changing methods

data tampering

destroying

different things you can do on a computer - wrong

different ways to steal programs

done in computer crime

fooling with data

hacking - pirate someone else's programs

now crime starts on computers

how to change or delete data files...to ruin a company

illegal computer activities

illegal computer use

invasions

methods in computer crime using data

methods of computer crime (2)

methods of gaining money)

methods of stealing

methods to change computer files

names of computer crimes

results of computer crime

ruining disks

screwing up data

stealing

stealing time on a computer

the crime

things about wrecking data

way of committing crimes

way to break into a computer

ways computer crimes are committed

ways of committing computer crimes

ways of destroying or changing data

ways of doing computer theft

ways of taking advantage of computers for oneself

ways of typing in and removing data

ways people commit computer crimes

ways to take things on a computer

<u>category names classified as equivalent to or subsets of</u>

<u>"preventing computer crime by protecting hardware"</u>

access

authorized people only

guarding computer room

identification

person identification

preventions by users

secret words to get into a computer

user passes

ways to get you information from a computer

ways to get your computer's secret identity

<u>category names classified as equivalent to or subsets of</u>

<u>"preventing computer crime by protecting software"</u>

caught

data protection

helping tracking

information - accurate records

information - helps you find something when you need it

keeping computer programs safe

preventions by programmers

privacy (secrecy) of files

protections

so your programs aren't stolen

things that keep people from copying

tracing methods

traps to catch people

<u>category names classified as equivalent to or subsets of</u>

<u>"prevention of computer crime"</u>

bank computer prevention

catching crime on computers

catching the criminal

codes to break a program

computer crime prevention (4)

computer protection

computer safety

crime fighters

crime prevention

data safety

getting a person to stay out of the computer

getting through to use the computer

how a crime can be detected and caught

how to stop computer crime

identification (2)

identification of data

identified privacy to allow access

identify yourself

keep it safe - prevent crime

keep safe from computer crimes

methods of catching people who break into computers

methods to protect computers

prevent computer crime

prevent stealing

prevention (2)

prevention methods

prevention of computer crime

prevention of crimes

preventions for computer crimes

preventions of getting data

protecting computers

protecting programs

protection

protections

protections methods

safety precautions

security

security on a computer

stop computer crime

stoppers

things that make cracking illegal

traps (4)

types of protection

ways of catching people messing around with computer data

ways of getting caught

ways of stopping crimes

ways to catch or stop someone from committing computer
crime

ways to get access to computer files

ways to prevent computer crimes

ways to prevent programs from being spoiled

<u>category names classified as inappropriate</u>

all people do it

computer files

computer knowledge

computer terms (2)

computer things

computer time

computer use

copyright

data

data things

doing things on a computer

extra ideas for your computer

filing

food

free time

fun

funny words

have to do with data

I don't understand what they mean

important words

key words

left alone - it wouldn't fit any other groups

methods for doing things

methods to help you do something faster or better

mystery

no group so put together

no name (2)

personal computer

personal usage

programs that do things

programs to do   --

question cards - I have totally forgotten what they are

remainder

result that happens after what you done

save programs or no

secrets

special

strange words

symbols

terms I don't know

these cards meant nothing to me

they all have "data" in the word

things able to do on a computer

things to do with computers

things you can do with computers

unidentified words

unknown terms

unknown words

unknowns

uses of computers

using computer time

ways to use your computer

words unknown