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THE FACILITATIVE EFFECTS OF ADVANCE ORGANIZERS AND INSTRUCTIONAL OBJECTIVES ON LEARNING AND RETENTION OF VIDEO-DISPLAYED SCIENCE MATERIAL

by

CLAYTON R. WRIGHT

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

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ABSTRACT

The primary purpose of this investigation was to examine the effect of advance organizers and instructional objectives on learning from video-displayed science material. The interaction of the treatments with age, general cognitive ability and level of cognitive skill was also considered.

An experimental population of 225 grade 7 General Science students, and an equal number of grade 11 Biology 20 students were involved in the study. The subjects were randomly assigned, within each class, to three treatment groups--advance organizer, instructional objectives and placebo. Students were given two minutes to read a 166-word written preinstructional strategy or a placebo. One or two days later, students received the same written material, viewed an ecology-oriented video-displayed material, and completed a 24-item multiple-choice criterion test. Two weeks later, they received an identical test. Students and teachers completed questionnaires that were designed to provide information concerning the extent to which the preinstructional strategies were utilized, and to provide additional information which could be used to explain the study results.

The primary data anlysis was a four factor ANOVA with the fourth factor being a repeated measure. This analysis was performed on the following scores: total test, knowledge subtest, and high level cognitive (application, analysis, synthesis and evaluation) subtest.

The three null hypotheses were rejected at the $p \leq 0.01$ level of significance. Instructional objectives performed best for all grade 7 students irrespective of cognitive ability or level of cognitive task. Advance organizers facilitated the learning of grade 11 students who

were required to complete high-level skills, as well, they were successfully employed by high ability grade 11 students, and to a lesser extent by low ability grade 11 students. Instructional objectives assisted notably the average grade 11 students and all senior students who were required to complete knowledge-level tasks.

The study provided support for the attention-directing step of Gagne's (1970, 1978) instructional theory, Rothkopf's (1971) theory of mathemagenic behavior, and Ausubel's (1963) theory of meaningful verbal learning. A strong support for the process of supplantation (Salomon, 1979) was not established. It was concluded that preinstructional strategies could be effectively utilized to assist student learning from fixed-paced, fixed-sequenced media. However, the characteristics of the learner and the type of cognitive task must be considered. Based on the responses to the questionnaires, students and teachers appear to be willing to employ these written instructional aids.

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CHAPTER I

INTRODUCTION

Educational technology is an applied science whose main concern is developing systematic ways of designing, delivering and evaluating the total process of learning and instruction. In order to do this effectively, it focusses on human learning and communication (Frase, 1975; Fleischer, 1977; AECT, 1977). It is an applied science because it attempts to translate into action the theoretical and empirical data gathered from different fields (Gagné, 1980).

The field of instructional development is one of the areas in which educational technologists apply their knowledge and experience. According to the recent issues of Educational Communication and Technology Journal, Instructional Innovator, Educational Technology, Journal of Educational Psychology, and Canadian Journal of Educational Communication (formerly Media Message), the thrust of today's educational technology research is no longer aimed at a series of comparisons of one medium to another (see Bovy, 1981; Torkelson, 1977). Rather, it is now aimed at investigating: 1) what medium is suitable for a particular audience? 2) how to increase learning by using an instructional media package that has been designed for a general audience? and 3) the strategies required to develop cognitive skills. These questions lead educational technologists to a growing awareness of the need to consider a combination of learning theory and individual differences in the planning, designing and implementation of their media-based instructional packages (Ausburn and Ausburn, 1978; Bovy, 1981; Allen, 1975; Clark, 1975; Cronbach and Snow, 1977; Di Vesta, 1975; Gagné, 1980; Salomon and Clark, 1977; Shapiro, 1975; Snow and Salomon, 1968; Rhetts, 1974).

In recent years there has been an increase in the use of video-displayed learning material for classroom instruction as well as for distance education and industrial training. In order to make effective use of this instructional tool, we must find better ways to design, deliver and evaluate its impact on learning and instruction (see Ives, 1971; Sceiford, 1978).

Perhaps learning and instructional theories can suggest how we can improve learning from video-displayed material (see Melton, 1968; Wager, 1980). Learning theory is useful because it gives educational technologists a systematic way to gain insight into the manner in which the student's cognitive structure acquires, stores and retrieves information. Instructional theory provides a sequence of external events which may assist the student to assimilate and accommodate new information, and to effectively respond to external stimuli.

We know a great deal about such aspects of learning as conditioned responses, perceptual skills and motor skills, and we are rapidly gaining knowledge about problem-solving and decision-making. We are aware that factors such as attention, motivation, age and intelligence affect learning. However, educational technology is still in the early stages of research aimed at attempting to design instructional environments which can deal effectively with the above factors. Can learning theories provide a solution?

According to Gagné (1974b, pp.20-21), learning theory can reasonably be expected to serve the following educational processes:

1. help in planning by setting limits to what is possible in instruction;

2. direct the conduct of instruction by guiding the choice of action; and
3. allow for some precision in educational assessment by comparing what students are able to do with what they are expected to do.

Thus the science of learning can provide guidance for the management of learning by providing directions, options and priorities. The role of the educational technologist, who lies between the theoretical scientists and the classroom teachers, is to incorporate learning theory into the management of instruction. As the theory is applied, it will become modified by its interplay with the classroom environment and in turn will lead to a refining of the instructional process.

In order to reveal the laws of instruction, theories must be proposed, tested, and modified, perhaps in the manner suggested by T. Kuhn (1970) in The Structure of Scientific Revolutions. Although there are several learning theories, some more specific than others, this study deals primarily with two theories that have been and are under investigation from a cognitive perspective (Sprague, 1981). In the theory of meaningful verbal learning, Ausubel (1963, 1968, 1978) suggests that learning will be more complete if the individual can establish a hypothetical cognitive superstructure that can be used to organize and relate the incoming stimuli to existing knowledge. The theory of mathemagenic behaviour (Rothkopf, 1971) suggests that preinstructional activities can improve the efficiency of the learning process by reducing the number of items attended to and processed by the individual.

In the past, these theories have been applied predominantly to situations involving the use of written learning material, (see

McConkie, 1977; Rickards, 1979), and immediate posttests that were designed to measure low level cognitive skills (see Dayton and Schwier, 1979). This study attempted to extend previous results by investigating low and high level cognitive learning from video-displayed science material that possesses characteristics which are dissimilar to those of written material (Levie and Dickie, 1973). Further, the delayed-retention test scores of this study were used to explore the interaction of selected learner characteristics (grade and intelligence) with two preinstructional strategies (advance organizer and instructional objectives).

CHAPTER II

A SELECTED REVIEW OF THE LITERATURE

2.1 Introduction

To reiterate, the aim of educational technology is the improvement of instruction by the use of systematic procedures which have their roots in learning and instructional theory. Theories provide suggestions as to how the instructional plan may be used to manipulate the external situations or circumstances that may lead to the necessary behavioral changes within an individual. It is usually inferred that these behavioral changes reflect alterations to cognitive mechanisms or to the learner's structure of knowledge.

Although theories are an important aspect of educational technology, the systematic manner in which they are applied to instructional problems is of prime importance (Calder, 1980; Sprague, 1981; Wildman, 1980). A systematic approach such as those suggested by Gagné (1977), Gagné and Briggs (1979), Glaser (1978), Greeno (1978), and Snelbecker (1974) are ones in which the objectives of the instructional process are identified; the characteristics of the learner are noted; the means of arranging the learning experience to attain these objectives are outlined; and, the scientific methods to evaluate the process and to plan modifications to the instructional plan are stated.

Media are instructional tools which educators use in the instructional process as a means to achieve specified objectives. Thus the psychological and functional attributes of media need to be considered when attempts to determine the extent to which these educational goals may be reached. Many attempts have been made to design a taxonomy of media attributes that would be useful to researchers and practitioners.

Allen (1967), Dale (1946, 1954, 1969), Cheek (1977), Clark (1975) and Kemp (1973) are just a few of the researchers who have attempted to relate the characteristics of media to the instructional process. Their methods have not been outstandingly successful (Ausburn and Ausburn, 1978). Ausburn and Ausburn (1978, p.343) state that "all these approaches to establishing guidelines for the selection and use of media ... suffer from too much generality and lack of specific interactions between learners, learning tasks and instructional treatments." Perhaps a practical model that takes into consideration the specific characteristics of the learner, the cognitive skills necessary for learning, the attention-directing functions of the instructional process, and the characteristics of media would be more fruitful. Due to the factors involved in the creation of this model, it would be necessary to consider several learning and instructional theories.

Although many theories exist, this study deals primarily with those indicated below. Bloom (1969) and Gagné (1970, 1977) describe ways in which the cognitive skills--the products of instruction--may be classified. How these skills are to be obtained via instruction is outlined by the instructional theory developed by Gagné (1977). Rothkopf (1971) provides the theory of mathemagenic behaviors which attempts to explain the attention-directing aspect of Gagné's systematic approach to instruction. The theory of meaningful verbal learning outlined by Ausubel (1963, 1968, 1980) suggests procedures for acquiring cognitive skills by using specific preinstructional strategies.

2.2 Instructional Theories

The learning theories reviewed here, provide a great deal of background for the educational technologist. However, the theories are not always directly applicable to the classroom setting. In order to translate these properties of learning into classroom applications, instructional theories were developed. By considering the nature of the learning task, the relationship of the procedure to the performance, and the relationship between instruction and the learner, instructional theories attempt to make learning more efficient and effective.

No theory exists that is accepted by all researchers. However, there are various commonalities which may form the basis of a meta-theory (Hilgard and Bower, 1975; Snelbecker, 1974). The work of Gagné (1970, 1977) and Gagné and Briggs (1979) has been selected because Gagne's theory provides an amalgamation of many behavioristic and cognitive learning theories (Sprague, 1981). For example, Gagné's theory possesses a hierarchical arrangement of learning which is similar to those proposed by Ausubel (1965a), Bloom (1969) and Piaget (see Flavell, 1963); the category of stimulus-response learning is similar to Skinner's operant conditioning, and Thorndike's trial and error learning (see Snelbecker, 1974); the description of chaining bears a strong resemblance to the ideas presented by Guthrie and Skinner (see Hilgard and Bower, 1975); and the use of verbal association and discrimination learning are similar to the work of Ausubel (1968) and Gibson (1969).

Building on this analysis of learning, Gagné investigated the conditions under which learning occurred. He concluded that regardless of the type of learning, there are commonalities among the conditions that support them. Not only does the learning occur over a period of

time, but the sequence of events which lead to behavioral or internal processing changes is basically the same for all types of learning. The following is a description of this sequence of events. The first phase involves attending to the stimulus by focussing on one particular locus in the stimulus field (see Livingstone, 1959). The stimuli are then perceived and coded (see Bell, 1981; Broadbent, 1958; Clark, 1978, Horowitz, 1978; Norberg, 1966, 1978; Paivio, 1971, 1975, 1978) so that they can be interpreted by various cognitive structures. Through the use of short- and long-term memory structures (see Broadbent, 1965, 1970; Klahr and Wallace, 1976; Neisser, 1967; Norman 1968, Waugh and Norman, 1965), the new stimuli can be associated with previous stimuli or stored as a single entity. While the entity is in storage, it may be involved in cognitive restructuring so that transfer of an item from one storage point to another occurs, or in generalizations which involve input from various storage points (see Di Vesta, 1972, 1975). Usually when an individual is called upon to retrieve the stored entity, these processes are triggered (see Lindsay and Norman, 1972; Norman, 1969). The type of response an individual gives will depend on the request generated by an external stimulant or the learner (see Atkinson and Shriffin, 1971). A simple recall of an item may require recognition and retrieval of a single entity, whereas restatement, transfer and higher-order intellectual skills may be involved in other requests. Depending on the feedback an individual receives as a result of his/her response, the intellectual activities may be positively reinforced or modified. Thus, irrespective of the type of learning, the following phases are involved: apprehension, acquisition, storage and retrieval.

Given the above progression of learning events and his learning theory, Gagné created a series of hierarchically arranged instructional events which form the basis of his instructional theory. These instructional events, which are described below, specify the conditions that must be met before learning will take place (Gagné, 1974b, 1977). Note that these externally structured learning activities (conditions) of learning are similar to the internal events of learning.

1. Activating motivation.

This calls for the arousing of long-lasting expectancies which are stored in the learner's memory. Sometimes there are simple motives such as the desire for food; other times there are more complex ones such as social motives, intellectual curiosity and a desire for mastery. It may not be necessary for instruction to be relevant at all times. In highly motivated learners the motivation function of instruction may not get the same emphasis as it will for lower motivated students.

2. Informing the learner of the objective.

This state involves the establishment of a relatively specific expectancy concerning the outcome of learning. Much work in this area has been completed by Bloom (1956, 1969) and Mager (1962) who have coined the phrase behavioral or instructional objectives. Rothkopf and Kaplan (1972) have found that specific objectives produce substantially higher recall of information relevant to the expected outcomes than do broader objectives or goals.

3. Directing attention.

The learner must be directed to certain stimuli within his/her stimulus field. This forces the learner to narrow his/her field of concentration thereby reducing confusion and inefficiency. This can be

accomplished by the use of cues, hints, or questions (Rothkopf, 1965) and perhaps with the use of advance organizers and instructional objectives.

In an actual classroom setting, both informing the learner of the objective and directing his/her attention are usually combined into one stage.

4. Stimulating recall.

Means must be found to stimulate recall and recovery of previously learned entities so that the learner is able to build upon his past experiences. Ausubel's (1967) work on advance organizers sheds light on the importance of recall and the need to guide the learner (see instructional activity number six).

5. Presenting the stimuli inherent to the learning task.

The stimulus to which the learner must be directed is presented. This stimulus can take many forms, but for this particular study a videotape presented the material to be learned.

6. Providing learning guidance.

This is an essential step in the instructional sequence because it directs the encoding of what is to be learned, and directs its entry into the memory storage of the learner. The amount of learning guidance required will vary with the length and complexity of the communication and the sophistication of the learner. According to Gagné such guidance will reduce the occurrence of irrelevant "hypotheses" and thereby increase the efficiency of learning.

The work of Krietzberg and Frase (1975) indicates that precise directions in a learning event reduces the number of irrelevant activities that impinge upon performance. Learning will be enhanced when the

stimuli relevant to learning are readily discriminated by the student (Miller, 1957).

7. Enhancing retention.

This can be achieved with the use of spaced reviews (Davis, 1966) or the inclusion of additional examples over a period of time. These examples will enable the student to experiment with his newly acquired knowledge, and to enhance cognitive retention and retrieval. Conversely, inclusion of incidental materials can support or interfere with learning (Frase 1969). Thus when in doubt, only examples that are directly related to the instructional event should be included.

The principle of integrative reconciliation (Ausubel, 1967) points to another way by which retention can be enhanced. Ausubel states that once new ideas are introduced, they must be related to old ideas, thereby pointing out similarities and differences. Since it will be related to what has gone before, the new knowledge will be better rooted in the cognitive structure.

8. Promoting transfer of learning.

The transfer may be vertical--promoting new learning within a course, or lateral--to other fields of study. This stage calls for the introduction of new events that are based upon that which is already required. The aim is to increase the generalizability of the newly acquired ability.

9. Eliciting the performance; providing feedback.

On the occasion of the last sequence of instruction the learner is not only asked to indicate his/her accomplishment of the objectives, but also receives feedback concerning the correctness of his/her response. This permits reinforcement to occur. As suggested by Skinner (1968a,

1968b), reinforcement may be used to establish more precise and elaborate learning.

Each of the instructional events occurs in a sequence in order to insure that the stimulus will have the desired effect upon the learner. However, Gagné (1970, 1977) notes that not all of these events may be necessary for learning to occur, nor should the sequence be followed precisely. For example, opportunities to practice and thereby retain the newly acquired capability may come sometime after the initial feedback.

The attention-directing phase of Gagne's theory is a crucial step since the success of the remaining stages depends greatly on what the student attends to. Rothkopf's (1971) theory of mathemagenic behaviors suggests that the use of preinstructional strategies may not only direct the student to the salient points of the instructional message, but the strategies may also alter the manner in which the selected material is processed cognitively. Ausubel (1963) describes a type of strategy that may be most successful, not only for directing attention, but also for stimulating recall and enhancing retention.

Learning is not solely reliant upon the stimuli presented to the learner. What is performed internally by the learner is just as important as the external stimuli. The learner is not a tabula rasa, but a complex, individualistic modifier of stimuli. What the learner does with the newly acquired knowledge depends greatly on the way he/she perceives the environment and on the way his/her central nervous system encodes, transfers and recalls information (see Fleming, 1977; Jonassen, 1980). Since learning is idiosyncratic any consideration of the instructional process must keep in mind the individualistic nature of learning (Bovy, 1981).

It is impossible to deal with all of the cognitive and affective characteristics of the learner, but a teacher can easily identify two characteristics--age and general cognitive ability--which have profound effects upon the learner. Piaget (see Flavell, 1963; Inhelder and Piaget, 1958; Piaget, 1972; Phillips, 1969; Sund, 1976) and others (e.g. Case, 1978) have noted that there are stages of cognitive development which limit the tasks that can be accomplished at various ages. Although Piaget describes four stages of development, each with a varying number of steps, only the concrete- and formal-operational stages will be dealt with in this study. The grade 7 subjects are generally classified as being in the concrete-operational stage which is marked by the ability to perform simple mental operations such as one-to-one correspondence and classifying. The older grade 11 subjects are said to have a greater ability to deal with abstract, nonconcrete conceptual thinking and are therefore classified as being formal operators. One would generally expect that grade 11 students could deal effectively with tasks requiring analysis, synthesis and evaluation.

The other easily recognized trait of a learner is general cognitive ability. Kanner and Rosenstein (1960) and Kraft (1961) report that students of high ability learn more than students of low ability, regardless of the method of instruction or mode of presentation. Although this conclusion is widely accepted, there is some disagreement as to whether an intelligence test can precisely measure this trait. An intelligence quotient (IQ) simply provides an indication of how well an individual can perform cognitive tasks relative to other members of the same age group. The intelligence quotient was used to classify the cognitive ability of the subjects who participated in this study.

Based on the characteristics of the learner and the instructional intent, it becomes necessary to employ the instructional procedures which will lead to the successful completion of the task. This study focussed on the attention-directing step of Gagné's instructional theory. Can devices be created that will direct the learner to certain stimuli, while taking into consideration the nature of the learner and the task? This is the subject of the next section.

2.3 Attention and the Theory of Mathemagenic Behavior

Gagné (1977) states that there are three important factors which will determine the successful application of his instructional theory. These factors are attention, motivation and development. Of the three, attention is the factor that can be manipulated easily in an instructional setting. Attention is not only the maintenance of cognitive processes on a particular stimulus or stimuli, but is also concerned with the perception, selectivity and limitation of the incoming stimuli (Bakan, 1966; Bovy, 1981; Deutsch and Deutsch, 1963; Neisser, 1967; Norman, 1969; Pick and Pick, 1970). According to learning and instructional theories, items such as pre-instructional strategies that direct, select and limit the type and quantity of stimuli should be useful because they will aid the learner (Gagné, 1980). The strategies should increase the probability that the information will be stored and available for future recall. This study will attempt to determine whether advance organizers and instructional objectives can be successfully employed as attention-directing devices.

The theory of mathemagenic behavior which was used by Rothkopf (1970) to explain the use of adjunct questions (Frase, 1968b, 1973; Rothkopf, 1971) may provide support for the use of instructional objectives and advance organizers. Rothkopf (1973, 1974) states that by adjusting the conditions in the educational environment, the behaviors of the learner can be modified. These behaviors affect a learner's orientation to the material to be learned. Although they have been referred to as inspection behavior (Rothkopf, 1971), the term mathemagenic behavior or activity has been applied because they "give birth to learning." Mathemagenic activities have been classified as follows:

Class I: Orientation activities which initiate and maintain the learner's attention to the instruction.

Class II: Stimulation activities which arouse student interest.

Class III: Translation and processing activities which modify the student's reading, listening and viewing behaviors.

Advance organizers and instructional objectives may be classified as mathemagenic activities. They are intended to modify a learner's orientation to the material and therefore may alter the manner in which they process stimuli received while reading, listening and viewing. Advance organizers specify the general theme or structure of the material, and provide a means by which the learner can order and determine the relationships within the information that is provided. Therefore, advance organizers are primarily Class III mathemagenic behaviors because of their translation and processing activities. Furthermore, they are Class I and II mathemagenic behaviors. They orient the learner, provide an outline of the learning material and arouse interest. Instructional objectives can be more specific since they are intended to help the student to focus his/her attention on certain items. Although they have been used in this latter manner in most empirical studies, instructional objectives written at the higher levels of Bloom's taxonomy may also be classified as Class III mathemagenic behaviors.

Although it is apparent that advance organizers and instructional objectives can be designated as mathemagenic activities, is there any basis for assuming that the theory of mathemagenic behavior is empirically sound? To support their theory, Rothkopf (1971) and others (Boker, 1974; Rothkopf, 1972; Rothkopf and Bloom, 1970; Rothkopf and Billington,

1974) inserted factual knowledge questions before (inserted prequestions), after (grouped postquestions at the end of the learning sequence), and within (inserted postquestions before or after each secton for which the question is relevant) an instructional document. It was hopèd that these questions would modify the learner's behavior towards the printed material. In the majority of cases, adjunct questions modified student behavior. Rothkopf (1972) and Rothkopf and Bloom (1970) report that inserted postquestions resulted in significantly greater learning than when no questions were used. These results are in agreement with earlier findings by Frase (1967), Frase (1968a), Frase, Patrick and Schumer (1970), and Natkin and Stahler (1969). Frase (1967, 1968a) found that the use of prequestions resulted in significantly more learning than the no question condition; however, postquestions yielded higher results than prequestions. Thus it is concluded that the addition of factual knowledge questions to printed material, irrespective of location, has a direct facilitative effect on learning because questions modify a learner's mathemagenic behaviors. It should also be noted that similar findings were confirmed by Brody and Legenza (1980) who state that location and type of picture affected reading comprehension.

Relatively few studies have used higher-level questions to substantiate this conclusion (Dayton, 1977). However, Watts and Anderson (1971) who used application questions, and Felker and Dapra (1975) who employed comprehension questions, indicate that the use of questions can encourage learners to perform transformations of the printed instructional stimuli. This study concerned itself with the effects of both knowledge and higher-level questions, i.e. application, analysis,

synthesis and evaluation questions. Further, since the development of the theory of mathemagenic behavior has been based on learning from printed material (see McConkie, 1977), this study explored new ramifications by investigating the non-print medium of television.

Although there are a number of studies which have investigated the insertion of questions into films (Hoban and Van Ormer, 1951; Lumsdaine, May and Hadsell, 1958; Teather and Marchant, 1974), few have considered Rothkopf's mathemagenic behaviors in their research design. The Dayton and Schwier (1979) studies, described in detail below, provide the most recent account of an attempt to apply mathemagenic activities to learning cognitive skills from fixed-paced, fixed-sequenced media. These experiments were performed to explore the effects of postquestion treatments on learning from the fixed-paced, fixed-sequenced medium of a slide-tape presentation.

The first experiment attempted to determine the facilitative effects of inserted postquestions. One hundred and forty-three college students were asked to individually view a 14.5 minute slide-tape program. Students received inserted or grouped postquestion treatments. Factual knowledge questions were presented in written form on the projection screen. When the question slides appeared, the students stopped the tape recorder and answered the questions. The questions remained on the screen until the student reactivated the tape recorder. Two days later, treatment students completed a learning test. "The Newman-Keuls procedure indicated that the intentional learning means for both the inserted-question and grouped-question treatments were significantly greater than for the no-question treatment at the $p < 0.05$ level.

The difference between the inserted- and grouped-question treatments was not statistically significant" (Dayton and Schwier, 1979, p.105).

The second experiment investigated the effects of aptitude on inserted questions and the effect of the questions on learning efficiency. Based on their Scholastic Aptitude Test (SAT) scores, 45 freshmen college students were randomly selected from a stratified sample. Five subjects were placed in each of nine cells. The matrix table had the following six labels: Treatment--no questions, inserted questions, grouped questions; Aptitude--low, medium and high. All students received the same slide-tape set and followed the same procedures as in Experiment 1. However, unlike the first investigation, students completed the treatment and posttest during a single session. The Newman-Keuls procedure "... indicated that for intentional learning the mean for the inserted-question treatment was significantly ($p < 0.05$) greater than that for the grouped-questions treatment" (Dayton and Schwier, 1979, p.106). The grouped-question treatment was significantly less efficient (i.e., fewer correct responses within a given period of time as compared to other treatments) for intentional learning than either the no-question or inserted-question treatments. No other significant effects or interactions were found.

In the third experiment, an attempt was made to replicate the findings of Experiment 2 on learning efficiency with a younger population and to investigate aptitude by treatment interactions among the question treatments, verbal abilities and field-dependence-independence of the subjects. One hundred and eighty-eight junior high school students were randomly assigned to treatment groups--95 to the no-question treatments, 93 to the inserted postquestion treatment.

Students viewed a modified version of the slide-tape presentation used in the previous two experiments. The narration on the tape was adjusted to the reading level of the students. The fourteen factual intentional multiple-choice questions were randomly distributed throughout the presentation. The inserted postquestions were found to improve intentional learning, but they did not affect learning efficiency (the number of correct responses in a given period of time). No significant aptitude interactions were found.

These three experiments on slide-tape presentations produced the following significant results:

1. Inserted postquestions can lead to greater intentional learning.
2. Inserted postquestions do not appear to affect intentional learning efficiency.
3. Grouped postquestions decrease intentional learning efficiency.

In addition to the above,

> No significant interactions were found between the question treatments and the three aptitudes investigated (scholastic aptitude, verbal ability and field dependence/independence) on any of the dependent measures (intentional learning, incidental learning, intentional learning efficiency and incidental learning) (Dayton and Schwier, 1979, p.111).

The following aspects limit the general application of the Dayton and Schwier (1979) studies:

1. No mention is made by the investigators of the relevance (meaningfulness) of the chosen topic to the subjects. Was the slide-tape presentation on Nigerian independence relevant to liberal arts, freshmen or junior high school students? Did the material relate to other facets of the students' educational programs? If the students felt that the treatment was a superfluous or irrelevant exercise, they may not have paid significant attention to it.

2. Dayton and Schwier considered the effect of motivation on learning. They presented students with silver dollars, movie tickets and milkshake coupons to encourage their participation. In theory, this idea would appear to be ideal because the students would be motivated towards doing their best. However, it is unclear as to whether movie tickets or a milkshake are adequate learner stimulants that would affect all students equally. Further, in the typical school setting, students are not faced with such inducements. Therefore, how can one apply the results of the studies to actual classroom settings where non-material forms of motivation are used i.e. to pass the course or to learn for oneself?
3. Only the effect of preinstructional strategies on the learning of factual information was examined by Dayton and Schwier. The higher cognitive tasks which are included in the majority of school curricula were not discussed.
4. The reader is not informed as to what aspects of the slide-tape presentations were examined. The test question may have been based on the visual or auditory components.
5. Since the students in Experiment 1 were permitted to view the inserted questions for varying lengths of time, results derived from different students were not directly comparable.
6. The slide-tape program in Experiment 1 could not be classed as being truly fixed-paced since the completion times for each student varied. The pace of the program was learner controlled.
7. In Experiment 2, a small sample of 45 participants was utilized. Only five subjects were placed in each cell of the 3x3 design. The reliability of the test results is thus open to question.

8. Since delayed-retention tests were not employed, except in Experiment 2 where a two-day delay was included, one can infer that the studies actually measured immediate recall rather than long-term learning.

It is hoped that the above aspects of the Dayton and Schwier (1979) studies were eliminated or minimized in the study that is outlined in this document. In this study, 225 grade seven and 225 grade eleven students formed the sample population. Therefore, there were 25 students in each cell of the data matrix. Students received instructional objectives and advance organizers which had been operationally defined. In an instructor-centered setting within a specified time, all students viewed a fixed-paced, fixed-sequenced, non-print learning material. This material was related to the students' existing course work. After this activity, students took an immediate and a delayed-retention criterion test. These tests consisted of questions based on various levels of Bloom's taxonomy and were designed to involve both the iconic and auditory stimuli presented via the video-displayed material. In the present study, no material inducements were offered upon completion of the learning material. However this study attempted to maximize the ego-involvement of the subjects (see Ausubel, 1960). After the students completed the criterion test, their tests were graded. The marks for each member of the class were posted on the class notice board. This procedure was thought to be more representative of actual classroom practice than the distribution of motivational devices such as milkshake vouchers.

2.4 The Preinstructional Strategies

In the previous section, advance organizers and instructional objectives were identified as the possible means by which the attention of the learner could be altered. This section presents the theoretical and empirical data that supports the use of these devices in an instructional setting.

2.41 Advance Organizer

After proposing his own learning theory, Ausubel (1963, 1968) suggested that advance organizers could be used to enhance student learning. The following is a description of his theory and a presentation of the research findings which tested his claim that general abstract statements placed before material to be learned would be beneficial to the learner.

Although specific features of Ausubel's theory are unique, it is related to the ideas of many theorists and practitioners who believe that specific information must be placed in some form of structure or it will be rapidly forgotten (Bruner, 1960; McDonald, 1965; Schwab, 1972; Tyler, 1950). Learning that is part of an integrated whole achieves a meaningful context and is thus retained.

Ausubel states that meaningful learning refers "primarily to a distinctive kind of learning process and only secondarily to a meaningful outcome" (Ausubel, 1963, p.21). The learner must employ a meaningful learning set and the material to be learned must have potential relevance to the learner. The learning process is termed meaningful when it considers the nature of the task and the learning set of the learner, and integrates new information into the existing cognitive structures.

For Ausubel, the most important prerequisite of meaningful verbal learning is the "existence of a cognitive structure that is hierarchically organized" (Ausubel, 1963, p.24) so that one idea or concept will subsume or incorporate less inclusive concepts. This idea is supported by Bell (1981), Bloom (1956), Gagné (1970) and Piaget (Flavell, 1963) who state that meaning has different levels, with the higher levels being dependent on the lower levels. The process of learning involves the organization of new material into the cognitive structure so that a hierarchy of suitable anchoring ideas will be formed (Ausubel, 1968). Each anchoring idea or subsumer, will be linked to the next higher step through the process of subsumption.

Due to the limited capacity of the learner's information-processing system (see Broadbent, 1970; Jacobson, 1951a, 1951b), Ausubel and Robinson (1969) believe that the mind does not deal with every minute bit of information that impinges on the learner, but rather with the essence of meaning (see Bell, 1981). As meaningful information is taken in from the environment, it interacts with the existing structure. Each piece of new information is placed or assimilated under an appropriate concept locus in order to provide anchorage but may later be transferred to a different locus. If the learning material is a specific example of a concept that already exists in the cognitive structure, derivative subsumption is said to have occurred. Correlative subsumption occurs when the new information is an extension or elaboration of previously-learned concepts (Ausubel, 1968). If the learning material cannot fit easily into a concept that already exists in the cognitive structure, the learning material may promote the establishment of a new concept locus. This process is referred to as accommodation. As time

passes however, obliterative subsumption occurs in which the mind attempts to economize by making generalizations out of the many specific bits of information. Details may be differentially lost or forgotten in this process. A new or modified subsumer is then formed. Meaningful learning has occurred if there is a change in the cognitive structure.

In the instructional process, Ausubel states that it is necessary to establish or find a subsumer within the learner's cognitive structure so there will be an anchor to which the new learning material can be linked. Without a subsumer, the information may be lost because it is not recognized as being meaningful or because it may be misclassified in the cognitive structure, thus making transfer and retrieval processes inefficient. If one is lacking a subsumer or wishes to establish an anchor in the existing cognitive structure, Ausubel proposed and empirically verified that an advance organizer should be utilized in the instructional process to relate the potentially meaningful learning materials to the existing cognitive structure of the learner (Ausubel, 1968, 1978; Ausubel and Fitzgerald, 1962). Thus, the advance organizer becomes a link between the potential meaning of the subject matter and the actual meaning of that material to the particular learner. Consequently, the use of advance organizers should involve derivative and correlative subsumption, as well as accommodation.

An advanced organizer can be defined as "an appropriately relevant and inclusive introductory material ... introduced in advance of learning ... and presented at a higher level of abstraction, generality and inclusiveness" (Ausubel, 1968, p.148) than the learning material itself. The organizer functions to "provide ideational scaffolding for the stable incorporation and retention of more detailed and differen-

tiated material that follows" (p.148). The ideational scaffolding in the cognitive structure is the hierarchy of subsumers. If the learner does not have the necessary subsumers, an expository organizer must be used to produce inclusive subsumers that relate existing ideas in the cognitive structure to the detailed information in the learning material (accommodation). If however, the learner already possesses relevant subsumers, a comparative organizer might be needed to relate the incoming information to the various existing subsumers by explicitly pointing out the principle similarities and differences among them (derivative and correlative subsumption). The main purpose of an advance organizer is to enable the learner to structure new incoming material by effectively utilizing his/her existing knowledge.

An advance organizer is not an overview or summary. The latter is normally written at the same level of abstraction as the material to be learned and lacks specific detail (Chaudhari and Buddhisagar, 1980). For example, some summaries contain sentences which are embedded in the learning material. An advance organizer is a general inclusive idea, which is written at an abstract level relative to the instructional material and is presented before the material. The advance organizer provides a conceptual framework in which specific, more differentiated material is placed. In order to be effective, an advance organizer must be capable of organizing the new material and must be clearly understood by the learner.

Ausubel and his associates conducted studies which provide an empirical and theoretical basis for advance organizers (Ausubel, 1960; 1963; Ausubel and Fitzgerald, 1961, 1962; Fitzgerald and Ausubel, 1963). Since the publication of his original works, numerous studies have been

performed. This paper will present only a brief overview of specific studies and literature reviews by Barnes and Clawson (1975), Blanton (1971), Blanton and Tuinman (1973), Christie and Schumacher, 1975, Hartley and Davies (1976), Livingston et al (1979), Luiten, Ames and Ackerson (1980), Kozlow and White (1979), Mayer (1979), Novak (1977), Ring and Novak (1971), and West and Fensham (1974).

The later studies (after 1967) were carried out by investigators who not only widened the area of inquiry, but used more complicated methodological and statistical procedures in an effort to overcome some of the problems inherent in earlier studies (Hartley and Davies, 1976).

Of the 32 studies analyzed by Barnes and Clawson (1975), 12 demonstrated significant facilitative effects. Therefore Barnes and Clawson acknowledged that the "efficacy of advance organizers has not been established" (p.651). They also examined the following variables: length of the treatment, ability levels of students, subject area being studied, grade level, type of organizer and level of the learning task. The reviewers were not able to state clearly the effects of these variables upon the use of advance organizers. However, in a recent article, Chaudhari and Buddhisagar (1980), corroborated Grotelueschen and Sjogren's (1968) statement that students classified as being highly intelligent perform significantly better than those who possess low intelligence when both groups receive written advance organizers and learning material.

Kozlow and White (1979) wished to correct the shortcomings of previous advance organizer study reviews, such as those conducted by Barnes and Clawson (1975), and Hartley and Davies (1976). Glass (1976) suggests that meta-analysis be performed on existing research to study

the untapped knowledge that has failed to be revealed by non-statistical reviews (1976, p 4) In order to use Glass's suggestion, Kozlow and White examined 76 studies They stated that in general "advance organizers are probably more likely to show facilitative effects when the reading level is appropriate to the grade level, when the rate of introduction of new ideas is slower, when the content is less complex, and when students are given more time to process the advance organizer information" (Kozlow and White, 1979, p 39) In addition, advance organizers were more effective when they were used at higher grade levels and for the classification of concepts It is also suggested that comparative advance organizers are more effective than expository ones. In a sense all expository organizers have attributes of a comparative organizer because it would be difficult to imagine the use of a preinstructional strategy that has no relation to the learner's experience, and learning material that lacks some form of structure.

Mayer (1979) suggests that in general, research studies on organizers will show no significant difference if they do not take into account the type of cognitive theory in which organizers can maximize their potential. He advances three cognitive theories and states that the "advance organizers can influence the outcome of learning if used in appropriate situations ..." (Mayer, 1979, p.371), such as those which require the use of the assimilation encoding theory. This theory provides several reasons for the success or failure of advance organizers.

1. The advance organizer would be unsuccessful if the content and instructional procedure already contains a form of organization that could relate to existing cognitive structure. This is in

agreement with Meyer and McConkie (1973) who state that "recall for units low in (the) structure was considerably better than recall for units high in (the) structure."

2. The advance organizer must encourage the learner to integrate the new information.
3. If the learner already possesses a set of relevant subsumers or past experiences and knowledge which s/he has incorporated using his/her own strategy, then advance organizers may not be effective (Mayer, 1979, pp.375-376).

To prove that his theory was correct, Mayer conducted nine studies. He reports that "advance organizers, when used in appropriate situations and when evaluated adequately, do appear to influence the outcome of learning" (Mayer, 1979, p.381). Mayer states that the question that should be asked is not "Do advance organizers facilitate learning?" but rather, "What is learned when advance organizers are used and under what circumstances?"

The results of recent advance organizer studies (see Hartley and Davies, 1976) do not illustrate a clear case for the use of organizers, but at the same time they do not state that advance organizers have a negative effect on the learning process. In the interpretation of these study results, Kozlow and White (1979) indicate that there are three cautions that should be noted. First, some of the non-significant results may be due to the inability of the student to comprehend the abstract information contained within the organizer. Secondly, in the findings which demonstrate the significant facilitative effects of the advance organizer, it is possible that the advance organizer contributes directly to the answering of test questions. Also, the inequality of study time for treatment groups may have affected the research results.

The literature examined to this point has indicated the extent to which advance organizers are successful in instructional settings, and it suggested how the research could be improved. Additional suggestions are outlined below. Probably the most pressing problem suggested by researchers and reviewers (Hartley and Davies, 1976) is that an operational definition for the advance organizer must be determined. Ausubel (1978) indicates that he had defined it as introductory material at a higher level of abstraction, generality and inclusiveness than the learning passage itself. However, he also states that a more limiting definition would not be possible without considering the nature of the learning material, the age of the learner and the degree of prior familiarity with the learning passage (see Ausubel, Novak and Hanesian, 1978). This may be true, but the fact remains that organizers vary so widely in scope and format that if researchers cannot determine what an organizer is, then it would be difficult for those educators less knowledgeable in the field to select or design their own.

Mayer (1979) offers the following guidelines for effective organizer production (1979, p.382):

1. Does the organizer allow one to generate all or some of the logical relationships in the to-be-learned material?
2. Does the organizer provide a means of relating logical relationships in the to-be-learned material?
3. Is the organizer learnable?
4. Would the learner normally fail to use an organizing assimilative set for this material?

Once the organizer has been constructed, Mayer (1979) suggests that judges should be asked to determine whether the materials to be learned

can be subsumed by the main concept identified in the organizer. This procedure was followed in the present study.

It should be noted that the type of advance organizer described by Mayer is only one of many possible types of advance organizers. They may take various forms such as the graphic-word organizer suggested by Barron and Stone (1974), the instructional sequence relationship specified by Merrill (cited by Crawford, 1977), those proposed by Ausubel (1963, 1968), or the modified Ausubelian version suggested by Mayer (1979). In order to provide a list of easily recognizable characteristics, similar to those developed by Mager (1962) for behavioral objectives, the successful organizers should be checked to determine their common elements (see Koran and Koran, 1973). If Ausubel's (1978) theory regarding organizers is true, a simple format for an organizer may not be found. Instead an aptitude-trait treatment form of research would have to be embarked upon in order to yield significant results with learners differing in age, cognitive style, naivete and competency, and with materials differing in organizational properties and subject matter. This study focussed on the interaction of treatment, age, and general cognitive ability when students are asked to learn ecological information from video-displayed material.

Another aspect of advance organizers that must be examined further deals with the conditions under which organizers are successful. Based on the research findings, it appears that an organizer can be used successfully if the advance organizer is written at a level that students can comprehend, and if it encourages students to integrate new concepts into their cognitive structure. Advance organizers can be used in situations where learners lack the necessary rich set of subsumers or strategies for dealing with new information, and in circumstances that

provide learners with an adequate amount of time to process the preinstructional strategy.

In discovering the conditions under which organizers are successful Barnes and Clawson (1975) and Kozlow and White (1979) emphasize that conclusions made from research findings must not be taken as the last word unless the experiments themselves have met all conditions for valid experimental research. Each study must include

> ... independence of subjects, use the appropriate statistical tests, test for mastery of the organizer prior to the presentation of the material to be learned, be certain that the test of the advance organizer and all tests of the material to be learned are different from one another, include a retention measure if possible, follow established procedures for test construction and maintain high reliability and validity" (Barnes and Clawson, 1975, p.657).

The list of the conditions above includes testing for the mastery of the organizer before the experimental procedure is initiated. This particular point is important since the research results will prove insignificant because the organizer will not promote a change in the cognitive structure if no change is required. In other words, if a subsumer already exists, then the organizer will have no effect. As pointed out by Ausubel (1978) and Lawton and Wanska (1977), few studies have accounted for this confounding variable. Determining prior to an experiment which subsumers and learning strategies exist in the cognitive structure while minimizing the effect on the posttest results, is not an easy task. Pretesting may initiate cognitive restructuring prior to the advance organizer. To minimize this problem in research design, Campbell and Stanley (1963) have suggested designs such as those that incorporate equivalent groups. This latter research design will form the basis of this investigation.

It should also be noted that even though a research study has been designed and implemented with great care, non-significant results may still be produced. Posttests that only assess concept-definition, recall or recognition are open to rote-learning contamination in which organizers will show no effect (Lawton and Wanska, 1977, p.243). Criterion tests that require only verbatim retention of material will be inappropriate for testing the positive facilitative effect of organizers on meaningful learning (Ausubel, 1978, p.254). Tests that deal with higher-level questions requiring students to utilize the comprehension and application aspects of concepts in this study.

If, however, organizers are not found to be consistently effective under specified conditions, one must surely ask not only whether advance organizers are an effective means of generating subsumers, but whether Ausubel's theory is the correct paradigm to work with. Alternately, his theory may be correct, but the organizer may not produce subsumers. Mayer (1978, p.886) states that when information has been produced in a logical manner or when texts are written that provide transitions between sections, organizers prove to be ineffective. If this is the case, alternative explanations for research results must be sought.

Despite the volume of literature that has been produced, only a few have dealt with non-prose advance organizers. The Nugent, Tipton and Brooks (1980) study is one example. The researchers presented 943 students in two basic college chemistry courses with a 2.5 minute televised vignette concerned with the conflict of job pressures and personal values. A narrator delivered a twenty-second advance organizer while inconsequential introductory scenes were displayed. The control group did not recieve a "voice over" advance organizer. The content of the

program immediately followed the opening scenes and the advance organizer. The design of the experiment enabled one to consider the comparisons between groups of students who receive:

1. advance organizer and no advance organizer;
2. titles and no titles; and
3. advance organizer and titles, and no advance organizer or titles.

The results of the study reveal that the advance organizer significantly increased comprehension, but significantly decreased affective response and ratings of program appeal. The advance organizer restricted students' thinking but provided a general structure that enabled students to infer main ideas from specific events. The absence of a title was more facilitative to affective responses for higher ability students. To summarize, the Nugent, Tipton and Brooks study reveals that the advance organizer does not enhance affective responses but does facilitate cognition.

However, the conclusions of the study cannot be taken at face value. There are a number of possible flaws in the research procedures and design which may have led to the stated findings.

1. The televised instruction was extremely short. It is difficult to assume that the findings of the study as a result of an exposure to a 2.5 minute program could lead to accurate results.
2. Contrary to the procedures followed in many studies which use advance organizers, the students were presented with the advance organizer immediately before the instructional material was presented. Therefore the necessary subsumers may not have been established before the learning material was presented. However, the study did appear to suggest that the subsumers had been formed.

3. An open-ended question, whose answers were rated on a five point scale, was used to determine students' comprehension of the learning material. Due to the interpretation procedures utilized by these researchers, it is possible that the reliability of these data might be questioned. A series of multiple-choice questions would have provided more reliable data.
4. The conclusions of the study were based on the examination of the immediate posttest or immediate questionnaire results. Due to the short time period of the learning material and the absence of a substantial delay between viewing and testing, it is possible that only recall was measured and not learning.

In order to avoid a number of the above mentioned difficulties, the study conducted here:

1. included a longer instructional television program;
2. was designed to permit an interval of time between exposure to the advance organizer and learning material thereby fostering the establishment of subsumers;
3. utilized a series of multiple-choice questions to measure different levels of cognition; and
4. measured the retention of the learning material on a delayed-retention test.

Ausubel's theory has been restricted to verbal learning, and has been tested extensively with printed learning material. To test whether the same theory is applicable to learning from audiovisual material, educational technologists should design and test advance organizers for use in audiovisual settings (Kozlow and White, 1979).

2.42 Instructional Objectives

Advance organizers and instructional objectives evolved differently. The Ausubelian-advance organizers are based on the theoretical construct of the subsumption theory, whereas instructional objectives are based on the practical intuition of the practitioner, and the need to define teaching and learning in terms of observable performances (see Gronlund, 1973; Mager, 1962; Popham and Baker, 1970; Skinner, 1968a; Tyler, 1950). Although developed under a behavioristic paradigm, instructional objectives appear to be congruent with both the emerging cognitive perspective in educational technology (Sprague, 1981), and the construct of the mathemagenic process (Rothkopf, 1971).

The use of instructional objectives by educators relies on the assumption that if the learner is told what is expected of him/her, s/he will learn more effectively. This assumption is supported by the work of several researchers (Duchastel and Brown, 1974; Frase and Krietzberg, 1975; Rothkopf and Kaplan, 1972). Instructional objectives function to simplify the stimulus environment by reducing the number of irrelevant bits of information that impinge on the learner and also modifies the subsequent test performance (Frase, 1975).

Depending on their proponents, instructional objectives are labelled as behavioral objectives, performance objectives or educational objectives (see Sprague, 1981). Irrespective of the label used, objectives indicate what the learner is expected to do after the learning activity has been executed. Instructional objectives vary from being very broad, as those promoted by Eisner (1969) or very specific, as those suggested by Mager (1962) and Popham (1969, 1973). The latter form appears to be more prevalent. Mager (1962) stated that an objective must include the following parts:

1. identification of the learner;
2. the performance expected;
3. the conditions under which the learning task will be performed; and
4. the criterion of success (usually expressed in the percentage of correctly answered questions).

There is a great deal of disagreement concerning the use of objectives (see Ammons, 1979). For example, Cronbach (1971) indicates that using objectives means reducing the theoretical constructs or intangible phenomena, such as knowing and understanding, to observable, measurable terms. This usage prevents the creation and application of abstract phenomena which have guided our thoughts for centuries. Others (Eisner, 1967; Ebel, 1970) believe that instructional objectives will lead to convergent, trivial thinking that limits the growth of the individual. Merrill (1970) reports that reasoning ability is reduced when objectives are available for student use. Conversely, proponents of instructional objectives such a Popham (1969, 1970), state that instructional objectives are needed to render the implicit educational goals explicit. Gagné (1965) suggests that by providing students with objectives, the student could not only better organize his/her instructional time, but could also evaluate his/her own progress. Frase (1975) proposes that external goals, objectives being an example, influence the internal goals of the student because they have the potential to change learning behaviors; so the use of objectives would selectively direct the student's attention.

Since 1950, and especially after the publication of Mager's book entitled Preparing Educational Objectives (1962), many researchers and reviewers (Barth, 1974; Duchastel and Merrill, 1973; Hartley and Davies,

1976; Kaplan and Rothkopf, 1975; Lawson, 1974; Merrill, 1974; Melton, 1978; Olsen, 1973; Walbesser and Eisenburg, 1972) have studied the effect of instructional objectives on student learning from printed prose material. Similar to the findings of the advance organizer research, instructional objective studies have produced mixed results. The brief literature review that follows outlines the effectiveness of this preinstructional strategy, and the conditions under which instructional objectives may be successfully employed.

Blaney and McKie (1969) report that objectives are more effective than general introductions or pretests. Tyler (1950) and Oswald and Fletcher (1970) support the use of general objectives, while Dalis (1970) and Rothkopf and Kaplan (1972) favour the more specific objectives. Jenkins and Deno (1971) and Janeczko (1972) state that there is no significant difference between the effects of specific and general objectives. However, one of the problems with these comparisons of effectiveness is that with the use of a wide variety of operational definitions of instructional objectives, it becomes difficult to compare results and make valid generalizations (see Tyler, 1964). This study used objectives that were written in the form suggested by Mager (1962) and Gronlund (1978).

The Rothkopf and Kaplan (1972, 1974) studies state that the use of behavioral objectives enhances intentional and incidental learning. Perhaps if one can argue that behavioral objectives and inserted questions are similar because both direct the student to a goal, then the results obtained from research involving inserted questions may provide additional information. If this argument is accepted, then the work of Frase (1967, 1970), Frase and Kreitzberg (1975), Rothkopf (1966,

1973, 1974) Rothkopf and Bibicos (1967), Royer (1977), Sanders (1974), and Santiesteban and Koran (1977) may shed some new light. These researchers state that postquestions generally tend to be more effective than prequestions and that they facilitate the learning of incidental material more than do prequestions.

A rationale for the above results is offered by Kaplan and Simmons (1974) and McGraw and Grotelueschen (1972). They suggest that the processes of repetition, selection and search affect the subject's ability to learn from objectives. When objectives are placed before the material to be learned, the learner is directed towards specific items. Once these items have been located, the learner proceeds to find the next piece of information dictated by the instructional objective. Irrelevant information is passed over quickly. This procedure enables one to acquire intentional or objective-relevant knowledge (Wittrock and Lumsdaine, 1977). Conversely, when objectives are placed at the end of a study, the learner carefully examines all the information presented since s/he is unsure of what to look for. After reading the objectives, the learner then searches through all the incidental and relevant material for the information required. Not only does s/he acquire intentional knowledge as specified by the objectives, but also incidental knowledge, since the latter was examined on his/her initial reading of the material and again during his/her search for objective relevancy. Thus, a selective attention model appears to explain many of the recent findings about adjunct questions and objectives (Wittrock and Lumsdaine, 1977).

To this point the benefits of placing questions before and after text material have been considered. If questions are grouped and

spread throughout the text, Kaplan (1974, 1976a) states that this method of part-presentation results in greater intentional learning than whole presentations. However, the inspection time for part presentations is greater than those obtained from whole presentations. Contrary to Kaplan's findings, Papay (1971) reports inconclusive results for intentional learning in situations involving part and whole presentations.

The number of objectives and the quantity of material to be learned may also affect the effectiveness of objectives (Duchastel and Merrill, 1973). Rothkopf and Kaplan (1972, 1974) indicate that intentional and incidental learning increase with the number of objectives used. At the same time, there is a decrease in effect if the number of relevant sentences is increased. Similar results are reported by Rothkopf and Billington (1975).

However, it should be noted that in an instructional setting, the emphasis is on intentional learning. This type of learning is normally classified in a manner similar to Bloom's (1956) taxonomy of the cognitive domain. Of the seven studies investigated by Duchastel and Merrill (1973), only that of Papay (1971) yielded significant results when knowledge and higher levels of learning were used as criteria. The difference was only apparent on the posttest and not on the delayed-retention test. Thus, Duchastel and Merrill were unable to make generalizable statements regarding a significant interaction of objectives and types of learning. However, Hartley and Davies (1976), who reviewed 40 empirical studies that focussed on preinstructional strategies, were able to make the following tentative statements:

> Behavioral objectives do not appear to be useful, in terms of ultimate posttest scores, in learning tasks calling for knowledge and comprehension. On the other hand, objectives do appear to be more useful in higher learning tasks calling for analysis, synthesis and evaluation (p.250).

The effectiveness of objectives appears to vary with the characteristics of the learner. A few of the significant findings are presented below. According to Smith (1967), slow learners appear to benefit from the use of instructional objectives. Perhaps this is because the objectives act as supplanting devices (see Ausburn and Ausburn, 1978; Bovy, 1981). Cook (1969) indicates that the middle ability students profit most from an objective-hierarchy treatment. This was the type of treatment that was included in the study described in this document. Based on Etter's (1969) findings, high socioeconomic males score significantly higher than other groups when objectives are used. Behavioral objectives can reduce the level of the subjects' anxiety in a long-term study (Merrill and Towle, 1971).

Perhaps the most important student variable is motivation. Again, if one can accept the premise that adjunct questions are similar to instructional objectives, the work of Frase, Patrick and Schumer (1970) may provide useful information regarding this variable. In order to assess whether motivation affects the use of pre- and postquestions, the researchers employed three levels of incentives. Postquestions are reported to be effective under low incentive conditions. However, as the level of motivation increases, the prequestion and control groups produce an increasing number of correct responses. One should note that in the majority of classroom settings, the incentive to learn may not be as great as that which was exhibited in this experiment, nor could one expect that this high state of motivation would be maintained for an extended period of time. The role that motivation will play in this study is addressed in other sections of this document.

When objectives are utilized, the amount of learning time required by a student varies greatly. Mager and McCann, and Allen and McDonald (both reported by Mager and Clark, 1963) indicate that the use of instructional objectives will require overall less learning time. However, the latter study is confounded by a student control variable, thus making the interpretation tentative. Conversely, Merrill (1970) and Merrill and Towle (1971) report that students spent more total study time on the learning tasks when behavioral objectives are available. Smith (1970) reports no significant differences.

Based on the work of Dalis (1970), Huck and Long (1973), Lawson (1973) and Merrill (1970), objectives appear to be more valuable when they are used with material that lacks its own tightly-knit [illegible] structure. This statement supports the faith Duchastel and [illegible]rill (1973) place on the organizational abilities of objectives. Duchastel (1979) claims that objectives and text structure can each provide the learner with orientation to the printed material, but together they do not increase learning. Since organization makes it possible for subjects to employ efficient strategies for learning (Myers et al, 1973), the effects of the objectives upon organized learning material will be minimal. However, it should be noted that a printed document is not always structured in a manner that will lead to the successful completion of a particular instructor's learning objectives.

Despite the inconclusive evidence presented in this review, Duchastel and Merrill (1973) suggest that objectives could

1. direct student learning by discriminating between the relevant and incidental content;

2. provide organization of subject matter;
3. enable students to organize their time;
4. provide a measure which students could use to evaluate their progress; and
5. activate and maintain student reinforcement (pp.64-65).

In addition, Hartley and Davies (1976) suggest that objectives generally facilitate learning, irrespective of the grade level, length of instruction (10 minutes to many weeks), or the type of subject matter that make up the material to be learned.

Duchastel and Merrill (1973) indicate that certain non-significant results may have been caused by any one of the following reasons:

1. operational definitions of instructional objectives were inconsistent;
2. students may not have understood how to use objectives (see Brown, 1970);
3. the researchers may have employed too few or too many objectives; and
4. the study was poorly designed.

These points are similar to the ones encountered in the advance organizer literature review, therefore further elaboration is not warranted here.

Melton (1978) points out that there is a need to determine in greater detail the advantages and limits of instructional objectives; as well as the conditions under which they best function. Both Melton (1978) and Duchastel and Merrill (1973) agree that interactions among the main treatment, conditions and variables may yield more conclusive answers (also see Anderson and Fowler, 1978). Further, since the

majority of studies examined the effects of objectives on factual information skills, an investigation of objectives with respect to learning higher-order skills would appear to be appropriate. These two suggestions were incorporated into the design of this study. The study examined the interactions among the following variables: treatment, general cognitive ability, age, low- and high-order skills and criterion measures.

The overwhelming majority of instructional objective studies utilized written prose material. Many produced non-significant results. These results could be due to the fact that printed material under learner control has greater referability, and therefore permits the learner to review--to take more time to study what s/he finds difficult. (Levie and Dickie, 1973). Perhaps instructional objectives would enhance learning from fixed-paced, fixed-sequenced media which are not under learner control. Before one attempts to provide answers to this hypothesis, it is necessary to describe the characteristics of the learning material. The attributes may influence the manner in which the information is processed within the learner's cognitive structure.

Although there is little empirical work that has studied the use of advance organizers and instructional objectives in video or film programs, there has been a thorough investigation of the effects of adjunct questions on learning from motion pictures. The following studies provide evidence that the insertion of questions into films can lead to an increase in learning: Anderson (1970); Hoban and Van Ormer (1951); Kanter (1960); Lumsdaine, May and Hadsell (1958); Teather and Marchant (1974). Since the instructional material that will be used in this study will be presented via the non-print medium of television, an

examination of the characteristics and effectiveness of television in an instructional setting will be described in the next section of this literature review.

2.5 Instructional Television

2.51 Introduction

Instructional theorists imply that the successful completion of any instructional plan will depend on the attributes of the medium used to convey the learning material, as well as the specification of the learning outcomes, the characteristics of the learner and the use of attention-directing devices.

From the thousands of research studies that have been performed on media, the following statements can be made: "that all media can instruct" and "learners can learn from virtually all media" (Campeau, 1974; Chu and Schramm, 1967, 1974; Clark, 1975; Gagné, 1967, 1974(b); Jamison, Suppes and Wells, 1974; Lévie and Dickie, 1973; Moldstad, 1974; Salomon, 1978; Schramm, 1977). Moldstad (1974) concludes that the voluminous amount of research findings enables educational technology, if carefully selected and used, to make the following claims:

1. significantly greater learning often results when media are integrated into the traditional instructional program;
2. equal amounts of learning are often accomplished in significantly less time using instructional technology;
3. multimedia instructional programs based upon a "systematic approach" frequently facilitate student learning more effectively than traditional instruction; and
4. multimedia and/or audiotutorial instructional programs are usually preferred by students when compared with traditional instruction (Moldstad, 1974, p.390).

One additional item should be added to the above list. Based on the work of Briggs, Campeau, Gagné and May (1966), Briggs (1968, 1970),

Salomon (1974b) and Aronson (1977), it can be stated that there is no one medium that is ideally suited for all types of desired outcomes and for all learners. The instructional effectiveness of any medium is increased by proper planning (instructional development) and the utilization of its key attributes.

It was clearly stated at the beginning of this study that the material to be learned in this research study would be presented via television, therefore the characteristics of television and its capability to promote learning in this study will now be discussed.

2.52 The Attributes of Television

Video-displayed material possesses characteristics which distinguish it from other media such as printed material. When used in the traditional classroom setting where the instruction is teacher- rather than learner-paced, video-displayed material is classified as being fixed-paced and fixed-sequenced. Under these conditions, the learner is not able to operate at a pace that is congruent with the individual's information-processing system, nor can the learner review certain aspects of the learning material to which s/he has been previously exposed. Therefore, the learner must be able to adapt to the rate of presentation either be using his/her own built-in learning strategies, or by using external prompts or cues to direct his/her attention. An indication of the successful use of these types of prompts is provided by Yarbus (1967). Yarbus asked subjects to determine the ages of people in a picture. The eye movement patterns revealed that subjects concentrated mainly on the people's faces and spent little time scanning the remainder of the picture. Thus it is possible that preinstructional strategies help the learner to quickly identify what is and is not

important in a visual image, and therefore to reduce the amount of visual scanning (see Guba et al., 1964).

Television, like other media, transmits its messages via signs. A sign is "a stimulus intentionally produced by a communicator for the purpose of making reference to some other object, event or concept" (Levie and Dickie, 1973, p.861). Like slide-tape presentations and film, television can present both iconic and digital information at the same time (see Levin et al., 1974). Iconic signs resemble the things they represent, for example, the picture of a hat, whereas digitals do not, for example, the word "hat". In terms of its digital characteristics, television is similar to textbooks since the precisely-sequenced order of words on a printed page can easily be portrayed on a video screen. Digital signs, such as words on a television screen or auditory messages, are believed to direct thought more narrowly and predictably (Salomon, 1974b) than iconic signs since iconic images present all the stimuli at once (see Knowlton, 1966; Levie and Levie, 1975). In addition, there is evidence that pictorial iconic recall is superior to verbal digital recall (Carpenter, 1953; Dale, 1954; Gibson, 1954; Gropper, 1963; Haber, 1970; Nickerson, 1965; Paivio and Foth, 1970; Paivio et al., 1968). Shepard (1967) claims that subjects can recall 98% of any combination of 612 pictures previously shown. Haber (1970) reports a 95% accuracy with the attempted recall of 2,560 photographic slides shown over a two- or four-day period. The potential for television to show a variety of pictorial images is not an exclusive characteristic. Flat-mounted pictures, overhead transparancies, slides and filmstrips also have this capacity.

What effect do the combined audio and visual images have upon the learner? One advantage of combined media is that those individuals who have been defined as visual or aural attenders (Ingersoll, 1970; Ingersoll and Di Vesta, 1972) will not be at a disadvantage providing that information in both channels is similar (Baldwin, 1968; Hsia, 1968; Levie and Dickie, 1973). When both pictorial and verbal material are combined, the learner is able to form longer verbal chains and use more sophisticated technical language (Gropper, 1966). The above statements are further supported by Fleming and Levie (1978), Hoban and Van Omer (1950), and May and Lunsdaine (1958) who claim that audiovisual presentations such as motion pictures enhance learning. Nelson and Moll (1950) tested two films in which the visuals were dominant. They report that neither the audio nor the visual portion was better (see James, 1962; Schulz, 1969). The greatest learning occurred when both film elements were used. However, it becomes difficult for the audience to follow mixed media at high rates of presentation because the learners have to rapidly switch their attention from one medium to another. Information and continuity from both media may be lost since switching takes time. How much time is involved is not known. This detrimental effect of combining media is most apparent when messages from the combined media are different (see Black, 1962; Travers, 1967).

Television programs by themselves, like many other media, do not usually elicit overt responses and do not provide the learner with the immediate feedback that some learning theorists believe to be an essential component of effective instruction (see Allen, 1957). However, when attempts are made to enable the audience to interact directly with the television teachers (Wolgamuth, 1961), few students

make use of these features. After a careful survey of the literature, Levie and Dickie (1973) stated that overt responding facilitates learning only:

1. when the response is not in the learner's vocabulary;
2. when recall of new technical terms, foreign language, vocabulary, or motor skills must be learned;
3. when difficult material is being presented to an unsophisticated audience; and
4. when long programs are being presented.

Except for the situations listed above, Levie and Dickie report that covert responses are just as effective as overt responses and are more efficient since they require less time. Since the learning material and procedure used in this study did not fit into one of the four above listed conditions, this researcher did not provide for interactive or overt feedback during the presentation of the video-displayed program. Further, from a cognitive perspective, it is possible for a student to learn without practice or reinforcement of overt behavior (Wittrock and Lumsdaine, 1977). However, this study did employ a form of feedback called the delayed-retention effect (Sassenrath and Yonge, 1968, 1969; Surber and Anderson, 1975; Wittrock and Lumsdaine, 1977; Sheridan, 1980) which aids in retention. Retention is improved when the feedback following an immediate test is delayed for at least a 24 hour period (More, 1969; Sturges, 1976). By providing the students with their scores one day after completing the criterion test, and sometime before they received the delayed-retention test, it was hoped that the instructive effect of the preinstructional strategies would increase (see Rothkopf, 1971).

Both television and film have two attributes that distinguish them from other media. They have the capacity to show motion and continuous change, and special visual effects. Silverman (1958) states that there is no difference between motion or static presentation in the learning situation, unless the concept to be learned deals with motion. Conversely, Allen and Weintraub (1968) claim that regardless of age, sex, ability and specific knowledge, motion in film facilitates learning. This conclusion could be based on the fact that when an individual sees motion, many nerve cells in the visual cortex respond with a burst of energy (Hubel and Wiesel, 1962). Since this nerve activity attracts attention (Neisser, 1967), an individual becomes cognizant of the image's existence and therefore is more likely to remember it (see Regan et al., 1979). The motion employed in the media program used in this study provided an attention-directing device as well as information necessary to understand the concepts in the video-displayed material.

The alteration of perception due to the use of special visual effects (e.g. superimposition, split-screens and animation) is not known with any certainty (Goldstein, 1975). Therefore, the video-displayed material selected for this study only contained images that could be perceived in the world of nature without the use of special equipment such as a microscope. However, one should note that the selected instructional material contained an eight second slow-motion image of a wolf runing through snow. During the pre-pilot assessment, students were asked whether they noticed anything odd or peculiar about that particular segment of the program. Despite the fact that their attention had been directed to this portion of the film, only 6 out of 26 students were aware that slow motion was used.

Although television and film bear similar characteristics, they differ with respect to the size of their projected image. The size of the image affects not only the seating arrangement, but how students view the media. Film can have a larger, clearer image than television so that the learner may find it difficult to focus on a particular feature or to have a view of the entire scene. By using techniques such as shading, progressive development and "zooming in" (Fleming and Levie, 1978), the film audience can see an identical image to that which can be seen by subjects who watch an instructional television program.

The major drawbacks to the use of television (and films) are:

1. The continuous flow of pictorial images allows for a wide variety of culturally specific interpretations (Berry, 1966; Jahoda et al., 1976; Mangan, 1978; Pettersson, 1982).
2. An abundance of stimuli is supplied by the combined images, especially detailed and coloured visual images (Allen, 1975; Borg and Schuller, 1979; Booth and Miller, 1974; Chute, 1979, 1980; Cox, 1976; Dwyer, 1970, 1971, 1972, 1976; Franzwa, 1973; Gorman, 1973; Kanner, 1968; Katzman and Nyenhuis, 1972; VanderMeer, 1952). These stimuli may overload the capacity of the learner's information-processing system (Broadbent, 1965, 1970; Clark, 1978; Knowlton, 1964; Travers, 1970; Treisman, 1969), and thereby impede the learning process.

The design of this study took both of the above mentioned problems into consideration. It was difficult to assess the learner's ability to interpret a fixed-sequenced, fixed-paced, integrated audio and iconic message. It has been stated that North American children watch an average of two to four hours of television per day (Huston-Stein and

Wright, 1979), and that the average high school student has spent more time watching television than s/he has spent in the classroom (Lesser, 1974). This does not mean that they can meaningfully interpret the television message, but it does indicate that they are familiar with this medium. To ensure that students had been exposed to integrated audiovisual messages in an instructional setting, only those classes which had used television and/or film to promote intentional learning were utilized in this study.

Television does present the learner with a large number of stimuli at one time. If students are to learn efficiently and effectively from this medium, they must be directed to accomplish specific learning tasks that enable them to consolidate their new learning into their existing cognitive structure. It is hypothesized that advance organizers and instructional objectives can be used to increase the learning from the video-displayed material.

During the thirty year history of instructional television, extensive research has been compiled on the comparison of the relative effectiveness of instructional television versus face-to-face lecture instruction. In 1958, Hoban stated that:

> There is every reason to expect that there should be less learning in a television class. There is an absence of intellectual give and take believed to characterize some of the most effective teaching. There is little opportunity to adjust to individual differences, rates and needs. The student wouldn't so readily feed back his responses, or signal his lack of understanding, or clear things up with a question. There is indeed good reason to expect that conditions would make for a less favourable outcome and a less well-informed student. However, there is as much learning taking place in a television class as in a non-television class (p.165).

Summaries of comparison studies of television versus face-to-face instruction have been performed by Holmes (1959), Kumata (1956),

MacLennan and Reid (1963), and Schramm (1962). Schramm (1962) conducted a major study that was corroborated by Allen (1971) and Semple (1976). Since they obtained similar results, Schramm's findings will be reviewed in detail.

Schramm took a detailed and impartial look at 393 studies which involved a comparison of learning via television and via actual teachers in the classroom. He found that "... in 65 percent of the studies, there was no significant difference. In 21 percent (of the studies) students learned significantly more (by television), in 14 percent, they learned significantly less from television" (Schramm, 1962, pp.84-86). However, it is possible that one method of teaching may be favoured by the subject matter, grade level, or research design.

The conclusions drawn by testers, school administrators, teachers and students has been that the average student can most likely learn about as much from a television class as from an ordinary classroom method. Schramm states that all types of students profit from the use of instructional television.

Variation in the effectiveness of television teaching according to subject matter is also revealed by Schramm. Those subject areas which had outstanding success for the groups tested were mathematics, sciences, and social studies. Humanities and literature have had the least success.

A further clarification of Schramm's findings has been made by Stickell (1963). He believes that many research studies are invalidated by an inadequate control of variables. Thus he set stringent requirements for his comparison studies and then carefully examined 250 studies. Of these, 217 were classified as uninterpretable, 23 as

partially interpretable and 10 as interpretable. Of the remaining 10, all showed no significant difference (NSD) in learning at the 0.05 level of significance between face-to-face and televised instruction.

It is apparent that in general, there is no significant difference between students taught by television and those by conventional methods. However, the assumption which is implicit but never questioned in these types of studies, according to Schramm, is that the "present conventional teaching methods produce the optimum possible in the teaching situation and therefore provided an adequate base for comparison" (Schramm, 1960, p.178).

It should also be noted that results obtained in studies involving retention tests are the same for immediate information gain tests, no significant differences are found when compared with conventional lecture formats. This result is obtained whether the retention test lasts for 30 to 45 days, a year, or three years (Schramm, 1960, p.181).

There are a number of distinct advantages in using instructional television. From the outset, it must be clearly stated that individuals can learn from instructional television (ITV). According to Cassirer (1960) and Gordon (1970), ITV can be successfully employed in teaching any subject material involving one-way communication. It can also be used for enrichment, co-operative, team and total teaching.

Costello and Gordon (1965) state that television is a medium which has the potential to bring together all of the audiovisual artifacts, such as films, filmstrips, slides, records and other prepared audio-visual aids. The audio and visual elements of these sources can be combined to increase the amount of meaning to be communicated. The sound may complement the video or the video may complement the sound.

In education, according to Gordon (1970), sound is accepted as having the overriding intellectual stimulation (Gordon, 1970, p.132). However in science, especially biology, the pictorial representation is essential.

Television is a means by which the same quality and content can be viewed by numerous students and teachers. Since television cameras can take close-ups of objects and people, the intimacy that is frequently missing in the real lecture hall can be transmitted (Costello and Gordon, 1965). Close-ups permit each member of the television audience to have a front row seat. The television camera can be used to clarify, enlarge or isolate biological specimens, charts and graphs within their surrounding field. The view given to the student may be better than "front row"--contingent upon the skill of the lecturer and the attention of the viewer. If the former possesses the talent to evoke and stimulate interest, a well-designed TV program cannot dampen it (Costello and Gordon, 1965, p.31).

The present study involved classes at different periods throughout the day. Is it possible that the video-displayed material was less effective during the afternoon classes as compared to the morning classes? Armirian (1963), Dietmeier (1962), and Kraft (1961) indicate that the time of day has no effect on the ability to learn from television.

Obviously, television is not the only medium that could have been used in this study. Film has similar attributes. Although film and television are almost identical (Lumsdaine and May, 1965), they have minor differences which have been found to affect the final product. Glaser (1962) states that the differences between television and film

> ... lie more in the philosophy and practice of production than in any inherent differences characteristic of the media. Aside from minor differences in grain or resolution, the television lesson, kinescope recording (a process of recording television images on film) or videotape recording differ primarily from the sound picture in terms of screen size (p.253).

Although videotape has a rougher image texture than film, the roughness is virtually unnoticeable if both videotape and film are shown with the same image size and the observer is a few feet in front of it (Gordon, 1970, p.57). The screen size of television is found to have no consequence on learning as long as the student can clearly see the screen (Chu and Schramm, 1967; Gordon, 1970; Haney and Ullmer, 1970).

It is possible that the television screen size is preferable to the large film image that is normally used in the classroom. Goldstein (1975) indicates that only crude information can be taken in by the individual when the visual image is large. The ability of the eye to process information generally improves when the subject is able to focus on an object. Since the angle of viewing which provides a clear focus is small, individuals must move the eye from one part of the picture to another. The maximum rate of these movements is two to four movements per second (Moray, 1970). The larger the image, the greater is the number of fixations that are required to view the entire picture, and thus the longer the exposure time needed. If the pictures are presented continuously, and if they are not under the control of the viewer, it is possible that there may be an inadequate amount of time to view the images, particularly large ones. This hypothesis is supported in part by Dwyer (1970) who found that students who received instruction via a 22-inch monitor (measured diagonally across the screen), achieved significantly higher scores on drawing and identification tests than

those who received identical instruction on larger screens (5 x 3 feet, and 6 x 4 feet). The study described in this document used a 22-inch monitor to present the videotaped material, therefore minimizing the time and movement involved in eye fixations.

According to W. Schramm,

> There can no longer be any doubt that students learn efficiently from instructional television. The fact has been demonstrated now in hundreds of schools, by thousands of students, in every part of the United States and in several other countries ...
>
> Instructional television is at least as effective as ordinary classroom instruction, when the results are measured by the usual final examination or by standardized test ... (And) employing the usual tests that schools use to measure progress of their students, we can say with considerable confidence that in 65 percent of a very large number of comparisons between televised and classroom teaching, there is no significant difference. In 21 percent, students learned significantly more, in 14 percent, they learned significantly less, from television (Schramm, 1962, p.49).

The ability of television to teach is exemplified by the establishment of the Public Broadcasting System in the United States and the Ontario Education Communication Authority in Canada. Further, television is used extensively by the Open University in England and Athabasca University in Canada.

Thus, this study is not concerned with whether instructional television could be as effective as face-to-face or conventional instruction. Students do learn from television quickly and efficiently (Schramm, 1962, p.66). Instead, this study was primarily concerned with whether learning from a video-displayed science program in an instructor-centered classroom is differentially affected by the use of advance organizers and instructional objectives. The evidence reviewed here stongly suggests that devices such as preinstructional strategies which are purported to orient and aid the learner in the processing of

external stimuli may improve learning from a medium such as television because:

1. group instruction via television is instructor rather than learner controlled, i.e., the rate of presentation is set, so the learner cannot review as in a computer-assisted instructional setting or when the learner is reading on his/her own, or dependently decide the order of the items in the instructional sequence (see Dwyer, 1970);
2. the learner must decide what is salient against a background of visual and auditory noise (see Knowlton, 1964; Yarbus, 1967); and
3. the combined media, especially the realistic iconic visuals, present an abundance of information cues which may overload the communication channels of students, particularly those of average and low ability (see Broadbent, 1958; Borg and Schuller, 1979; Knowlton, 1964; Triesman, 1969).

2.6 Statement of the Problem

The effectiveness of instructional television could be improved if one employs an instructional design that takes into account Rothkopf's (1971) theory of mathemagenic behaviors. This theory suggests that learning can be improved if activities in advance of the presentation of the learning material are performed by the learner. These activities are intended to modify a learner's orientation to the material and therefore may alter the manner in which the stimuli are read, heard and viewed. While there is considerable theoretical support for the use of preinstructional strategies, empirical reviews of the application of these strategies to printed materials have provided mixed support. (Barnes and Clawson, 1975; Duchastel and Merrill, 1973; Hartley and Davies, 1976; Novak, 1977; Melton, 1978; Kozlow and White, 1979; Mayer, 1979). It has been suggested by Mayer (1978, 1979), Kozlow and White (1979), Nugent, Tipton and Brooks (1980a, 1980b) that preinstructional strategies may be best suited for multi-media learning materials that are used in an instructor-centered environment. Under these conditions where the learner has no control over the sequence or the rate at which s/he progresses through the material (Clark, 1978; Knowlton, 1964); it would appear that mathemagenic activities may be ideally suited for aiding the learner in focussing his/her attention on certain aspects of the learning material. Further, with the increasing use of fixed-paced, fixed-sequenced media (FPFSM) which contain combined audio and visual images, there is a need to find ways in which learning can be improved without the use of the interactive feedback or individualization that is thought to foster learning in the traditional classroom. Since a television or video-displayed program is created by a producer who will not

know the precise objectives of the instructor who may use the finished product, an instructor could use preinstructional strategies to provide a structure that is more consistent with his/her course goals.

In this study, advance organizers and instructional objectives were considered to be mathemagenic activities. Advance organizers, supported by Ausubel's (1963) theory of meaningful verbal learning, are general inclusive ideas written at an abstract level relative to the instructional material (Ausubel, 1968, 1978). Advance organizers are catalysts that promote the creation of cognitive structures that can efficiently store and relate incoming information to previously acquired knowledge (Ausubel, 1980; Ausubel and Robinson, 1969). Instructional objectives are statements of instructional intent which are purported to assist the learner by guiding the learner in his/her selection and arrangement of incoming stimuli. By using instructional objectives, the student will be able to select efficiently the salient material while attending minimally to extraneous material (Bovy, 1981; Mager, 1962; Popham and Baker, 1970).

The primary aim of this study was to examine the effect of advance organizers and instructional objectives on learning from fixed-paced, fixed-sequenced media. As suggested by Cronbach and Snow (1977), Salomon (1979), and Melton (1978), the interaction of the treatments with personal characteristics such as age and intelligence quotient was also examined. These interactions may have provided evidence that preinstructional strategies can act as supplantation devices (Ausburn and Ausburn, 1978; Salomon, 1979). Finally, this study was designed to investigate the possible differential effect of preinstructional strategies on the acquiring of knowledge and on the learning of higher-order

skills such as application, analysis, synthesis and evaluation. This division of Bloom's taxonomy was based on Sprague's (1977) distinction between "knowing that" and "knowing how." Unlike the majority of previous studies (e.g. Dayton and Schwier, 1979; Nugent, Tipton and Brooks, 1980) this study focussed on delayed-retention test scores.

It has been suggested by Dayton (1977) and others that instructional development studies should consider incidental and intentional learning as research variables. However, if one employs a systematic approach to learning which involves the basic principles of instruction and media selection, a teacher will select instructional procedures and materials that are directly related to his/her curricular goals (Briggs, Campeau, Dick and Carey, 1978; Gagné and May, 1966; Gagné and Briggs, 1979; Gerlach, 1966; Tosti and Ball, 1969). Under these conditions, intentional learning is far more important than incidental learning. Therefore, only intentional learning was considered in this study.

2.7 The Hypotheses

This study will attempt to test the hypotheses listed below at the $p \leq 0.01$ level of significance. Although both immediate and delayed posttests were considered in each hypothesis, the emphasis was placed on the analysis of the delayed-retention scores which were not prone to instant recall (Lawton and Wanska, 1977). The latter criterion test measured long-term learning which can be defined as a relatively permanent change in a learner's behavior over a period of time (Gagné, 1970).

Hypothesis One

There will be no significant difference among scores obtained on an immediate and on a delayed-retention test by students who receive one of three specified treatments--an advance organizer, instructional objectives and a placebo.

If the study results reveal that mathemagenic activities such as instructional objectives and/or an advance organizer facilitate learning, support for Rothkopf's (1971) theory of mathemagenic behaviors would be provided. In addition, if the advance organizer proved to be effective, Ausubel's (1963) theory of meaningful verbal learning would also be supported.

Hypothesis Two

There will be no significant interactions among treatments, age (grade) and general cognitive ability (IQ) on an immediate and on a [illegible] criterion measure.

Acc[illegible] Cronbach and Snow (1977), one may not find a significant ef[illegible] among the treatment variables unless the characteristics of the

learners are considered. Further, Allen (1969), Ausubel and Fitzgerald (1962), Chaudhari and Buddhisagar (1981), Dawson (1965), Duchastel and Merrill (1973) and Melton (1978) indicate that preinstructional strategies may be successfully employed by certain types of learners, but not by others. For example, a young student, such as those in grade 7 who tend to be in the concrete-operational stage of mental development (Piaget, cited by Brainerd, 1978 and Sund, 1976), may find it difficult to deal with the abstract nature of an advance organizer, or the higher-order skills which can be specified by instructional objectives. Conversely, older students in grade 11 who tend to be formal-operational thinkers may be better able to operate effectively with advance organizers. The abstract nature of advance organizers may be more suitable for students with a high level of intelligence than those possessing a lower IQ. However, one could also hypothesize that because of the lack of ability, lower IQ groups would benefit from the use of any aid which enables them to deal more effectively with the learning material. The lower IQ subgroups of the students who receive preinstructional strategies may perform better than the comparable subgroups of the control students.

Hypothesis Three

There will be no significant differences among student scores on either the low or high cognitive level portion of an immediate and a delayed-retention test by students who not only differ in age and general cognitive ability, but also receive one of three specified treatments--an advance organizer, instructional objectives and a placebo.

The latter hypothesis is based on the work of Ausubel (1978), Kozlow and White (1979) and Mayer (1979) who suggest that preinstructional strategies may be particularly effective for higher-order cognitive skills of Bloom's (1956) taxonomy. Knowledge of information may be easily forgotten (McDonald, 1965), but the knowledge of structure or higher level skills may persist over an extended period of time, especially if the individual is exposed to preinstructional strategies that promote the development of an organized cognitive structure.

CHAPTER III

METHOD

3.1 Subjects

A total of 695 students in grades 7 and 11 from an urban-suburban school district took part in the study. Data derived from 85 of these students were not utilized because:

1. the students were not present for the entire study;
2. it was impossible to obtain their IQ scores;
3. their answer sheets were incorrectly completed; and
4. they had previously seen the video-displayed program used in the study.

In order to obtain equal cell sizes in the 18 cell research design, a further 160 students were dropped from the analysis leaving 450 students (225 in each grade).

The study population was characterized by a mixture of socio-economic backgrounds. Since it has been suggested that the socio-economic background affects a student's past experience and therefore affects what s/he brings to bear on the learning situation (Broom and Selznick, 1969, cited by Rich, 1979), a diversified research population was desirable.

To ensure that students have been exposed to integrated audiovisual messages in an instructional setting, only those classes which have used television and/or film to promote intentional learning were utilized in this study. This procedure minimized the occurrence of the novelty effect. Further, based on the television viewing habits of North American children (Huston-Stein and Wright, 1979; Lesser, 1974), one could presume that the students were familiar with the interpretation of combined audio and visual images.

3.2 Instruments

3.21 Preinstructional Strategies

A pre-pilot test assessment verified that the preinstructional strategies described below were written at a comprehensible reading level for the junior and senior high school subjects. Copies of the three strategies can be found in Appendix A.

By distributing a written from of preinstructional strategies or placebo, each containing an identical number of words, one was assured that:

1. a standardized content and format was given to all members of the experimental groups;
2. variables which could be introduced if the strategies were presented orally by an instructor were eliminated; and
3. each group of students received the same length of treatment and thereby enabled one to comment on the efficiency of the instructional variables of the study without considering the confounding variable of different exposure times (Carver, 1972; Dayton and Schwier, 1979; Mayer, 1979).

Advance Organizer

The advance organizer was a 166-word prose passage that:

1. was a general statement of the theme of the material to be learned;
2. was written at a higher level of abstraction than the to-be-learned material;
3. enabled one through analogy or other means to determine the relationships in the to-be-learned material;

4. contained words and phrases that are understandable by the learner;
5. was presented prior to the to-be-learned material; and
6. did not contain information that could be used directly to answer a test question.

The above descriptions of an advance organizer was based on a synthesis of the advance organizer research studies of Mayer (1979, p.392), Ausubel (1960), and Ausubel and Fitzgerald (1962).

Three judges--a junior high school teacher, a senior high teacher and an education professor--agreed on the form of the advance organizer.

Instructional Objectives

The instructional objectives were nine statements of instructional intent which were expressed in terms of observable performance of the learner. The objectives had the following components: identification of the learner, indication of the performance expected, specification of the conditions under which the learning task was to be performed, and indication of the criterion of success (see Mager, 1962; Gronlund, 1973, 1978).

This preinstructional strategy consisted of 166 words and yielded an objective/program ratio (number of objectives per minute of presentation) of 0.6:1 or 9:15. Three judges--a junior high school teacher, a senior high teacher and an education professor--agreed that the items were correctly stated instructional objectives.

Placebo

The placebo consisted of a 166-word prose passage describing a Canadian scientist who is known as a producer of educational programs similar to the one viewed by the subjects. This written science

material provided the control group with the same experiences as the experimental treatment groups, and ensured that each student was occupied for the same amount of time (after Dayton and Schwaer, 1979; Mayer, 1979).

3.22 Video-displayed Material

The video-displayed material was an instructional videotape that focussed on the ecology of wolves. The social structure of a wolf pack, the fundamental processes of its life, and its interaction with the biotic and abiotic factors within its environment were presented.

The instructional material was coloured, fixed-paced, and fixed-sequenced. It presented a variety of iconic images and a supportive audio message. The visual portion of the program employed motion which was an integral part of its content. The running length of the program was fifteen minutes.

In order to verify that the television program was appropriate for accomplishing the specified goals of instruction, and that it was comprehensible to the target audience, a series of pilot tests and evaluations was conducted using students and teachers from grade seven and eleven.

A detailed description of the selection procedure and the actual program used in the pilot study can be found in Appendix B.

3.23 Tests of General Cognitive Ability

Scores from standardized general cognitive ability tests were obtained (with the school board's approval) from the students' cumulative records. Students in grade 7 completed the Canadian Cognitive Abilities Test (Thorndike et al, 1974) in the fall of the year previous to the research study. Scores from the Canadian Lorge-Thorndike

Intelligence Test (Lorge et al, 1967) taken by the grade 11 students in grade 9 were procured. Since both tests have been standardized, they have a mean of 100 and a standard deviation of 16. Both tests measure the ability of an individual to work with ideas and with the relationship among ideas.

Canadian Cognitive Abilities Test

The Canadian Cognitive Abilities Test (1974) is a revision of the Canadian Lorge-Thorndike Intelligence Test. Outdated items have been removed. It has a length of 143 minutes and is given in three sittings. Three new subtests have been added. They are Quantitative Relations, Equation Building and Figure Synthesis. Ten subtests are assembled into three separate batteries to yield three IQ scores--Verbal, Quantitative, and Nonverbal. The Verbal Battery is designed to appraise relational thinking when the relationships are formulated in verbal terms. The Quantitative Battery is designed to assess ability for perception of a relationship among concepts and for flexibility in using quantitative concepts. The Non-verbal Battery emphasizes discovery of and flexibility in manipulating relationships expressed in figural symbols or patterns.

Canadian Lorge-Thorndike Intelligence Test

The Canadian Lorge-Thorndike Intelligence Test (1967) consists of a verbal and non-verbal battery of questions which requires two sessions of 62 minutes to complete. Verbal, non-verbal and composite scores can be determined. These scores are comparable to those obtained on the Canadian Cognitive Abilities Test since the majority of test items are identical.

This test is almost identical to the well-known Lorge-Thorndike Test (1954). Only two items from the original test were altered to insure that the test was suitable for Canada. Canadians generally obtain scores that are slightly higher than their American counterparts.

3.24 Criterion Test

The purpose of this measuring device was to provide an indicator of the effectiveness of the treatments. It was not designed to predict the actual placement of an individual as a standardized test would, but was intended to show the trend that one would expect with a group of students who exhibit characteristics similar to the experimental population.

Based on the instructional objectives of the learning experience, and the test construction guidelines provided by Hedges (1968) and Gronlund (1973, 1977, 1981), a twenty-four item multiple-choice test was constructed. It was primarily divided into two subtests of equal length. The first subtest contained knowledge questions based on the specific facts presented in the program. The second subtest consisted of application, analysis, synthesis and evaluation questions based on the concepts illustrated in the video-taped material.

After a series of pilot tests and modifications (see Appendix D for details), the measuring device demonstrated good item homogeneity (0.75) and test-retest reliability (0.75; based on the Kuder-Richardson KR-20). Based on the results of the pilot item analysis, six questions were modified or changed. During the main research study (N=610), the homogeneity and test-retest reliability was 0.60 and 0.65 respectively. The KR-20 yields high values if the items on the test measure approximately the same attribute and have high intercorrelations. Since the items on

this test were not intended to measure the same attribute, the homogeneity value was not expected to be high. Further, a longer test would have yielded higher values. The test-retest measure was anticipated to be low because the treatment effects were expected to alter the distribution of scores and because the sample was characterized by a broader range of cognitive ability than exhibited in the pilot testing.

One of the desirable features of the measuring device was that the mean of the immediate posttest (13.61; N=610) of the main study was located approximately midway between the minimum and maximum value of 0 and 24. Thus, the effect of the preinstructional strategies was easily revealed since there was allowance for the upward or downward movement of scores on the delayed-retention test.

The criterion test was used both as an immediate posttest and as a delayed-retention test. The emphasis in this study was upon the delayed, retained knowledge of the subjects and not upon the immediate posttest scores which are prone to short-term memory recall. A posttest was included in this study because it has been consistently demonstrated that tests following instruction tend to consolidate learning so that performance is improved on successive tests (Anderson and Myrow, 1971; Kulhavy and Anderson, 1972; Roderick and Anderson, 1968; Rothkopf, 1966). Further, it was possible that post-hoc analysis of the posttest scores would reveal certain functions of the advance organizers and instructional objectives that would not be eludicated by examining only the retention test scores.

Appendix C contains a copy of the criterion test, an answer key and the correlation between the instructional objectives, advance organizer and test questions. Detailed analysis of the pilot measuring device and

the criterion test used in this research study are located in Appendices D and E.

3.25 Questionnaires

Two questionnaires were designed to produce additional information which could not be obtained by the criterion measuring device. A copy of these questionnaires can be found in Appendix G.

Student Questionnaire

A series of seven short answer questions was designed to provide evidence of the comprehensibility and usefulness of the video-displayed material, and to indicate how the preinstructional strategies were used by the students. An indication of the students' experience with television and film in a formal instructional setting was also requested.

Teachers' Questionnaire

In order to ascertain the teachers' use of television and film in their science classes, and to provide evidence of the appropriateness of the video-displayed material for instructional purposes, an eight-item questionnaire was prepared. The teachers were also requested to respond to queries that dealt with the application of preinstructional strategies to actual classroom settings, and to note difficulties that students may have experienced while completing the research activities.

3.3 Procedure

For a detailed account of the teachers' instructions and student activities, refer to Appendix F.

Some of the studies which have employed advance organizers (Ausubel, 1970; Ausubel and Fitzgerald, 1961; Ausubel and Youssef, 1963; Merrill and Stolurow, 1965; Grotelueschen and Sjogren, 1968) indicate that comprehension is increased when the advance organizer is presented before the learning material. The grade seven students received randomly arranged sheets containing the pi[illegible]o or ecology-oriented preinstructional strategies one day prior to viewing the video-displayed material. The grade eleven students received the sheets two days before the presentation. The teachers read a prepared announcement and collected the sheets after the students were given two minutes to read the printed material.

One or two days later, depending on the grade of the subjects, students received the identical printed sheets that they had received during the first stage of the study. After the instructor read a prepared announcement, the students read the sheets for two minutes, saw the video-displayed material and completed the teacher administered criterion test.

Since it is debatable as to whether school students are highly motivated towards learning, a procedure to maximize the ego-involvement of the subjects was employed (after Ausubel, 1960). Before the students completed the criterion test, the students were informed that their individual scores, as well as their class results would be displayed on the day following the testing period.

Two weeks after seeing the learning material, the students completed the delayed-retention test and the Student Questionnaire. The students were not forewarned about the delayed-retention test. This procedure reduced the chance of any outside study that could be performed between the exposure to the video-displayed material and the delayed-retention test, and lessen the test anxiety that could affect test achievement (Bauer, 1975; Grannum, 1976; Martin and Meyers, 1974; Morris and Liebert, 1970; Runkel, 1959; Souch, 1966; Wine, 1971; Young and Brown, 1973). The teachers provided answers to the Teachers' Questionnaire.

The researcher checked each of the test answer sheets for completeness and provided an identification number for each sheet. The results of the previously administered intelli[illegible]e test were obtained from the school records. The data collected from all students who took part in all stages of the study were analyzed.

3.4 The Research Design

A factorial experimental design with repeated measures was utilized in this study (Campbell and Stanley, 1963). Since this design included a control group which had all the experiences that the experimental groups encountered, the design took into consideration history, maturation and regression. A control group was included in order to determine the magnitude of the difference that may be obtained when preinstructional strategies are employed. By randomizing the subjects across the three treatment groups, both selection and mortality were controlled.

The primary data analysis was a four-factor analysis of variance (ANOVA) test with the fourth factor being a repeated measure. The factors were grade (2 levels--grade 7 and 11), treatment (3 levels--advance organizer, instructional objectives and placebo), cognitive ability (3 levels--low, average and high) and criterion test (2 levels --immediate and delayed posttests). These factors lead to the production of two eighteen cell matrices; one for each of the posttests.

The cognitive ability level of the subjects was determined by arranging the obtained IQ scores for each grade in ascending order. Using a joint frequency distribution, the boundary between each cognitive ability level was established by determining the class limits that would lead to the highest number of students in each of the 18 cells of the data matrix. Subjects were randomly dropped from each cell with more than twenty-five subjects to equalize frequencies across all 18 cells. The cut-off scores for the three cognitive ability groups were 102 or below for low cognitive ability; 103 to 112 for average cognitive ability; 113 and higher for high cognitive ability.

Of secondary importance to this study was an examination of the low and high cognitive level questions contained in the posttests. Since the criterion measure was divided into two subtests, it was not possible to consider the levels of the criterion measure as two non-correlated dependent variables, nor to state that their underlying matrices were identical. Therefore, a valid statistical analysis could not be performed; a qualitative analysis of the data was performed. An ANOVA for each of the following data sets was conducted: total test scores, knowledge subtest scores, and higher-level cognitive subtest scores. The results of these three analyses of variance were compared and contrasted. The focus of this analysis was the interaction of the type of test questions on the delayed-retention test with the remaining factors.

CHAPTER IV

RESULTS

4.1 Overview

The analysis of variance (ANOVA) test for significant differences was used to examine the data. The assumptions underlying its use were taken into consideration (see Ferguson, 1976). Equal matrix cell sizes (N=25) were employed to ensure the robustness of the ANOVA, and to enable the researcher to treat the variables as being independent of each other. In order to determine whether there were significant differences between cell means, the following level of significance was used: $p < 0.01$. Although more conservative, the Scheffé multiple-comparison test was utilized because it is more robust with respect to the assumptions of normality and homogeneity.

Six hundred and ten students (315 grade 7, and 295 grade 11) comprised the total sample population. A crosstabulation of the characteristics of this population is presented in Table 1.

Table 1: Crosstabulation of Total Sample Population (N=610)

Grade	Treatment	General Cognitive Ability (IQ) Low	Average	High
7	AO	41 (6.7%)	38 (6.2%)	29 (4.8%)
	IO	41 (6.7%)	37 (6.1%)	33 (5.4%)
	P	38 (6.2%)	32 (5.2%)	26 (4.3%)
11	AO	25 (4.1%)	25 (4.1%)	48 (7.9%)
	IO	30 (4.9%)	34 (5.6%)	32 (5.2%)
	P	28 (4.6%)	38 (4.6%)	45 (7.4%)

Note 1. For this and all future tables: AO = advance organizer; IO = instructional objective; P = placebo; IQ = intelligence, a measure of general cognitive ability.

2. The number in parentheses represents the percentage of the total population falling into each cell.

Table 1 illustrates that a larger portion of the grade 7 subjects was classified as low and average ability while the grade 11 subjects contained a larger portion of high ability subjects. Further, the smallest cell size was 25. By randomly dropping data in excess of 25 from each cell, an equal sized cell matrix was produced with N=450. Although the subjects were dropped randomly within groups, due to the unequal number in each cell, they were dropped differentially between groups. The acceptance or rejection of the null hypotheses was based on data derived from this equal cell sized matrix.

An important caution regarding the interpretation of the data derived from the equal cell sized matrix must be noted. The procedure utilized to produce the maximum number of subjects in each cell distorted the true classification of low, average and high ability for each grade level. Table 1 is based upon the premise that low cognitive ability students received an intelligence quotient of 102 or below; average cognitive ability possessed scores of 103 to 112; high cognitive ability had 113 or higher. If the classification of the subjects were based on the division of the grade 7 and 11 sample population into equal thirds, one would obtain the cut-off scores illustrated in Table 2.

Table 2: Cut-off Scores for Each Cognitive Ability Level by Grade (N=610)

Grade	Cognitive Ability Low	Average	High
7	70-100.8	100.9-110.3	110.4-136
11	80-105.1	105.2-116.6	116.7-143
Scores used in study	74-102	103-112	113-140

Therefore, the cut-off scores used in this study were higher for the grade 7 students, and lower for the grade 11 students than those scores that actually describe the sample population for each grade.

In order to provide an overview of the study results, Table 3 illustrates the means obtained for each subtest and testing period. Table 4 reflects the effects of the treatments. Although the null hypotheses were treated on the data derived from 450 students, the total sample population (N=610) data are provided in parentheses for the purposes of comparison. Note also that there are slight discrepancies in the tables when one attempts to add subtests data in order to reveal total test performances. These discrepancies are due to rounding-off the digits used in the preparation of this table.

Table 3 reveals that the grade 11 students obtained generally higher scores than the grade 7 subjects. In addition, the means for the knowledge subtests are higher than the higher-level cognitive subtest for both immediate and delayed tests. Although the knowledge subtest scores decreased slightly on the delayed test for the grade 7 subjects, and increased for the grade 11 students, the higher-level cognitive scores for the combined grades increased noticeably (from 6.1 to 6.6). Therefore, the scores obtained on the delayed test were generally higher than those recorded for the immediate test. The standard deviations indicate that the test scores were not distributed widely. Further, the standard errors are small, and therefore suggest that the sample population mean is a good representation of means that could be obtained if other randomly drawn samples were selected from the grade 7 and 11 student population.

In order to obtain equal cell sizes, subjects were dropped randomly within groups and dropped differentially between groups from each grade-ability level. Based on the contents of Table 3, there does not appear to be a substantial difference between the means obtained by the equal

Table 3: Immediate and Delayed Test Results for all Grade 7 and 11 Subjects

Subtest	Number of Test Items	Grade 7		Grade 11		Grade 7 and 11 Scores Combined				
							Standard Deviation		Standard Error	
		Immed.	Delayed	Immed.	Delayed	Immed.	Delayed	Immed.	Delayed	Immed.	Delayed
Knowledge	12	7.1 (7.0)	6.9 (6.8)	8.1 (8.2)	8.3 (8.3)	7.6 (7.6)	7.6 (7.6)	1.7	1.8	1.5	1.5
Higher Cognitive	12	5.0 (4.9)	5.7 (5.4)	7.2 (7.3)	7.6 (7.6)	6.1 (6.1)	6.6 (6.5)	2.3	2.3	1.5	1.5
Total Test	24	12.2 (11.9)	12.5 (12.2)	15.4 (15.5)	15.9 (15.9)	13.8 (13.6)	14.2 (14.0)	3.7 (3.8)	3.5 (3.6)	2.4 (2.1)	2.3 (2.1)

Note 1. This table is based on N=450. However, for purposes of comparison, the data derived from the total *sample population of 610 are provided in parentheses.*
2. Immed. is the abbreviation for the immediate posttest.

Table 4: Matrix Cell Means Based on Total Test Scores (N=450)

Grade	Treatment	Low IQ		Average IQ		High IQ	
		Immed.	Delayed	Immed.	Delayed	Immed.	Delayed
7	AO	10.0 (2.0)	10.2 (2.7)	12.2 (2.6)	12.4 (1.9)	13.8 (2.9)	14.9 (2.7)
	IO	11.6 (2.6)	11.9 (2.8)	12.4 (2.8)	13.2 (3.0)	15.0 (2.9)	15.2 (2.7)
	P	9.2 (2.8)	9.0 (2.8)	11.4 (3.0)	12.2 (3.0)	14.1 (2.0)	13.8 (2.9)
11	AO	14.9 (2.5)	15.8 (2.7)	15.0 (2.1)	15.3 (2.8)	17.4 (1.9)	18.9 (1.9)
	IO	14.6 (2.9)	15.1 (3.0)	15.7 (2.4)	16.6 (2.8)	16.5 (2.5)	17.4 (1.8)
	P	13.1 (2.5)	12.9 (2.3)	15.5 (1.7)	15.5 (1.7)	15.6 (2.0)	16.0 (2.1)

Note 1. The standard deviation for each cell mean is in parentheses.
2. Immed. = immediate posttest

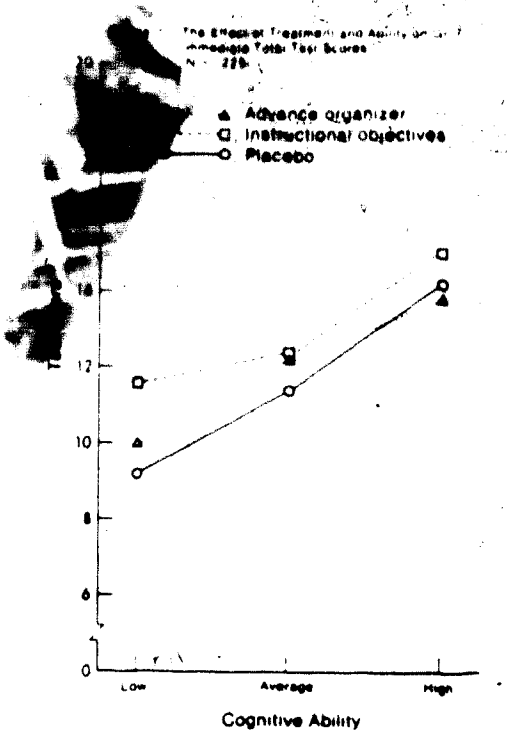
cell sized sample (N=450), and that of the total sample population (N=610). Therefore, one may conclude that the equal cell sized sample is a good representation of the total sample population.

Table 4 indicates that the experimental treatment groups yielded generally higher total test scores than their respective placebo treated subjects. Instructional objectives appeared to be more effective than other treatment groups when they were utilized by grade 7 subjects. The grade 11 advance organizer students, who were classified as possessing a low or high cognitive ability, achieved higher scores than those received by grade 11 students who were exposed to the instructional objectives or a placebo. The high IQ grade 11 students who completed the delayed test received the highest score of any group. Students who were designated as grade 11 average IQ also received high scores when they were exposed to instructional objectives.

Irrespective of the type of treatment, or the age of the subjects, high IQ students performed better than average IQ subjects who received higher scores than low IQ students. As illustrated in Table 3, Table 4 also reflects the general, but slight, rise in scores over time. The relationships described above are clearly illustrated in Figures 1 to 4. Each figure presents data for either the immediate- or delayed-test scores for each grade level.

The data in Table 4 and the results of the ANOVA supported two assumptions made by the researcher:

1. The grade 11 students' scores will be higher than the grade 7 scores.
2. The higher ability students, irrespective of grade, will yield higher test scores than lower ability students.



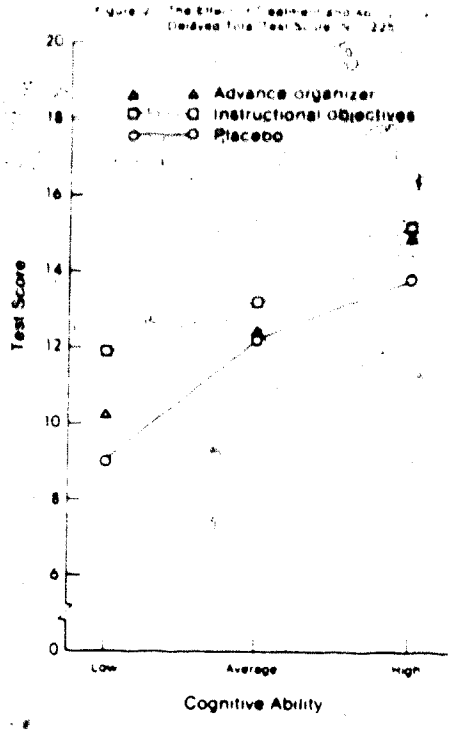


Figure 3 The Effect of Treatment and Ability on Gr 11 Immediate Total Test Scores (N = 225)

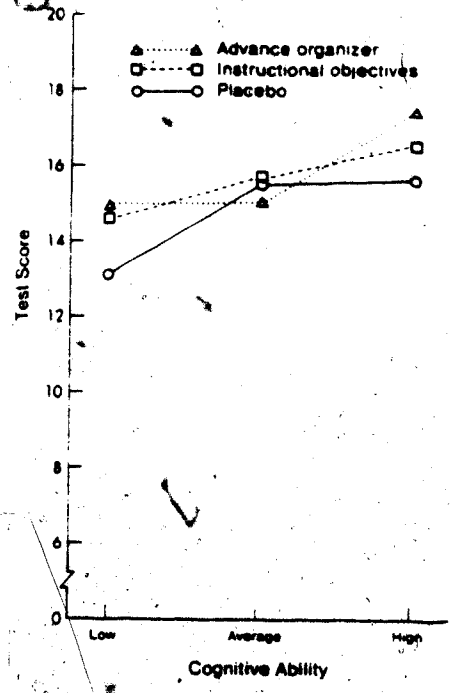
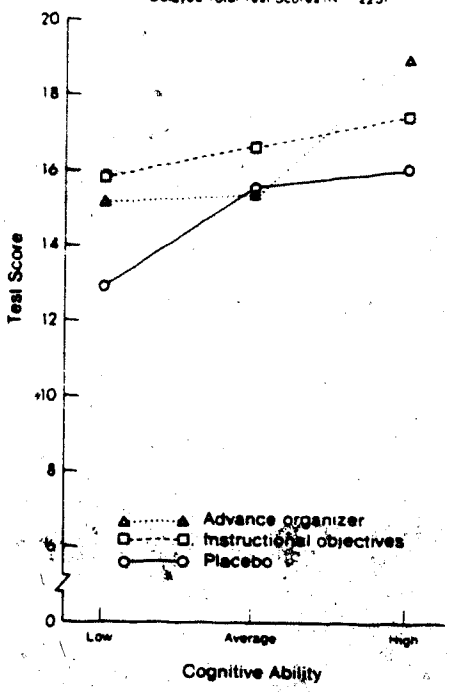


Figure 4 The Effect of Treatment and Ability on Gr 11 Delayed Total Test Scores (N = 225)



Both of these assumptions were verified at the $p < 0.01$ level of probability (see Table 6). By using the Scheffé multiple-comparison test, it was possible to state that the high ability students performed significantly better than the average group who yielded significantly higher scores than the low ability subjects, $F(2, 432) = 18.45, 22.79, 82.26$, $p < 0.01$.

Table 5: Scheffé Comparison of Differences Among Total Test Means for the Three Ability Groups

		General Cognitive Ability		
		Low	Average	High
General Cognitive Ability	Low	--	18.45**	82.26**
	Average		--	22.79**
	High			--

** $p < 0.01$

4.2 The Hypotheses

Hypothesis One

There will be no significant difference among scores obtained on an immediate and on a delayed-retention test by students who receive one of three specified treatments--an advance organizer, instructional objectives and a placebo.

Table 6 represents the results obtained from a four-factor ANOVA with the fourth factor being repeated. The effect of the treatments was significant at $p \leq 0.01$, $F\ (2, 432) = 15.69$. The Scheffé multiple-comparison test (see Table 7) revealed that the students who received instructional objectives performed significantly better than those who received the placebo, $F\ (1, 432) = 14.37$. However, the advance organizer group did not achieve significantly better results than the instructional objectives group, and only obtained a significance level of $p \leq 0.05$, $F\ (2, 432) = 8.25$, when compared to the placebo subjects.

Table 6: Analysis of Variance with Repeated Measure Based on Total Criterion Scores (N=450)

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
Grade (A)	2440.33	1.	2440.33	238.05	0.00
Treatment (B)	321.58	2.	160.79	15.69	0.00
AB	53.22	2.	26.61	2.60	0.08
Ability (C)	1691.60	2.	845.80	82.51	0.00
AC	93.65	2.	46.83	4.57	0.01
BC	97.95	4.	24.49	2.39	0.05
ABC	76.47	4.	19.12	1.87	0.12
S-Within	4428.50	432.	10.25		
Time (D)	49.02	1.	49.02	19.46	0.00
AD	2.73	1.	2.73	1.09	0.30
BD	16.21	2.	8.11	3.22	0.04
ABD	1.56	2.	0.78	0.31	0.73
CD	5.18	2.	2.59	1.03	0.36
ACD	7.32	2.	3.66	1.45	0.24
BCD	17.09	4.	4.27	1.70	0.15
ABCD	3.42	4.	0.85	0.34	0.85
DS-Within	1088.44	432.	2.52		

Table 7: Scheffé Comparison of Differences Among Total Treatment Means

		Treatment		
		P	AO	IO
Treatment	P	--	8.25*	14.37**
	AO		--	0.85
	IO			--

* $p \leq 0.05$ ** $p \leq 0.01$

There were no significant treatment interactions at $p \leq 0.01$. The treatments did not differentially affect either immediate or delayed tests. The main effect of the treatment variable applied to both testing periods. However, it should be noted that the delayed-test scores were significantly higher than the immediate-test scores, $F(1, 432) = 49.02$, $p \leq 0.01$; and, the treatment x ability interaction yielded a probability of 0.05. These latter findings are also reflected in Figures 1-4.

Hypothesis One was rejected. The instructional objectives yielded significantly ($p \leq 0.01$) higher scores than the placebo.

Hypothesis Two

There will be no significant interactions among treatments, age (grade) and general cognitive ability (IQ) on an immediate or on a delayed-criterion measure.

Only the grade x ability interaction (AC in Table 6) was significant, $F(2, 432) = 4.57$ at the $p \leq 0.01$ level. The Scheffé multiple-comparison test revealed that the difference between grade levels was significantly greater for low ability groups than for high ability groups, $F(2, 432) = 18.22$, $p \leq 0.01$. However, there were no significant interactions among treatment, age or cognitive ability. The main

effects appear to explain the overall results of the study. Although the possibility exists that additional interactions did not materialize because subjects were dropped differentially from each treatment-ability group, Table 3 appears to negate this possibility.

Hypothesis Two was rejected. There was a significant ($p < 0.01$) grade x ability interaction.

Hypothesis Three

> There will be no significant differences among student scores on either the low or high cognitive level portion of an immediate and a delayed-retention test by students who not only differ in age and general cognitive ability, but also receive one of three specified treatments--an advance organizer, instructional objectives and a placebo.

This analysis involved a qualitative comparison of the results of three analyses of variance. Each ANOVA was based on the means of the total test, the knowledge subtest, and the high-cognitive subtest (see Appendix E). Since the results of these analyses are not statistically comparable, the F ratio for each comparison will not be quoted.

Table 8 reveals that the total test and subtests means reflect significant main effects--grade, treatment and ability. However, each test produced different significant interactions. The interactions with the treatments were the primary focus of Hypothesis Three.

Table 8: Significant Main Effects and Interactions for the Means of the Knowledge Subtest, Higher Cognitive Subtest and Total Test

Main Effect or Interaction	Knowledge Subtest	Higher Cognitive Subtest	Total Test
Grade (A)	X	X	X
Treatment (B)	X	X	X
A x B		X	
Ability (C)	X	X	X
A x C	X		X
B x C			
A x B x C			
Time (D)		X	X
A x D	X		
B x D			
A x B x D	X		
C x D			
A x C x D			
B x C x D			
A x B x C x D			

Note 1. This Table is based on the analysis of variance summary tables which are in Appendix E.

2. Only the main effects and interactions which achieved a $p \leq 0.01$ level of significance are shown.

The knowledge subtest yielded three significant interactions--grade x ability, grade x time, grade x treatment x time. These interactions are plotted in Figures 5, 6 and 7. Figure 5 reveals that the difference between the scores obtained by the grade 7 and 11 subjects decreased as the ability of the students increased. Since the grade 11 delayed scores increased slightly while the grade 7 scores dropped, the difference between test means was greater on the delayed test than on the immediate test (see Figure 6).

The grade x treatment x time interaction illustrated in Figure 7 clearly shows the differential effect of the experimental treatments upon the different ages of the subjects. Both the advance organizer and instructional objectives improve retention over time for the grade 11 subjects, but do not appear to improve retention by the grade 7 students. However, both experimental treatments resulted in higher test scores than the placebo treatment irrespective of time or grade level. If an instructor wishes to increase his/her students' knowledge scores, instructional objectives may be helpful for both grade 7 and 11.

The higher cognitive subtest produced only one significant interaction. Figure 8 illustrates the grade x treatment interaction. The advance organizer and the placebo treatments yielded almost identical results when the mean of both the immediate and delayed grade 7 test results were considered. The instructional objective treatment appeared to be best for the grade 7 students--a finding which is similar to the knowledge subtest results.

The grade 11 higher cognitive subtest results suggested a different pattern of treatment effectiveness. The subjects who received an advance organizer produced higher test results than those students who

Figure 5. Knowledge Subtest Grade X Ability Interaction (N = 450)

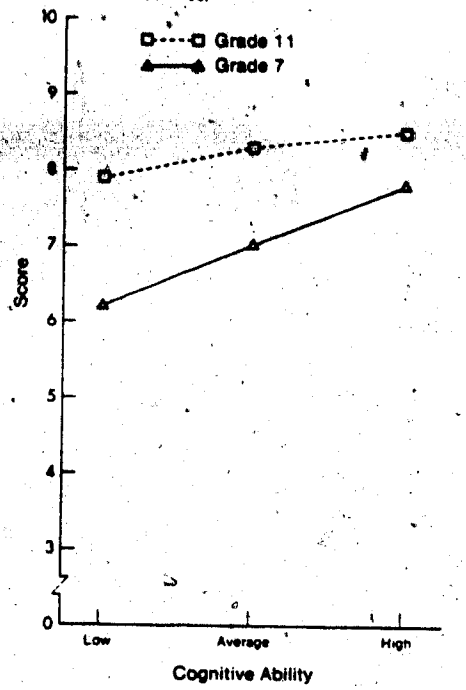


Figure 6. Knowledge Subtest Grade X Time Interaction (N = 450)

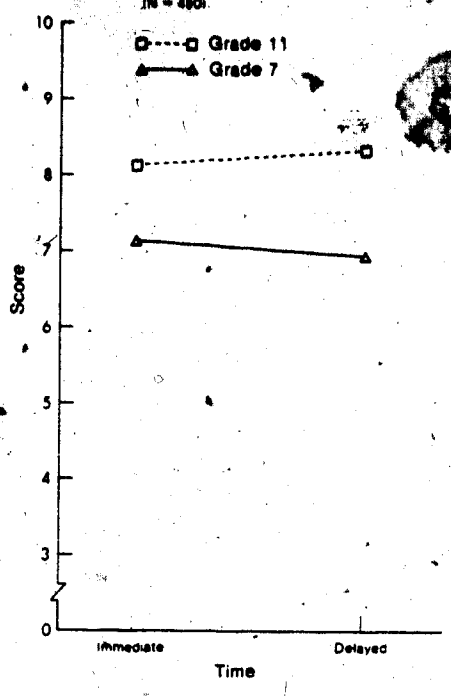


Figure 7. Knowledge Subtest Grade X Treatment X Time Interaction (N = 450)

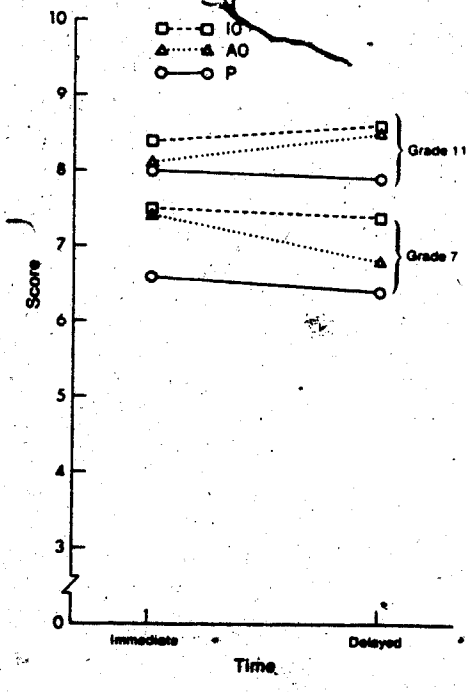
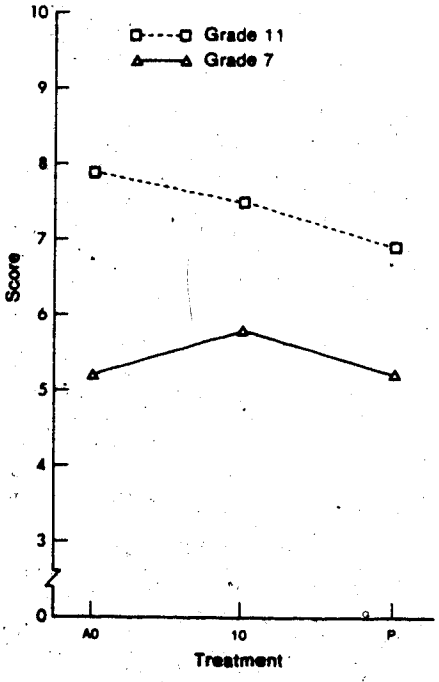


Figure 8. Higher Cognitive Subtest Grade X Treatment Interaction (N = 450)



received instructional objectives. The latter treatment was more effective than the placebo.

Due to the different significant interactions that were produced by the knowledge and higher cognitive subtests, it is possible to conclude that the effectiveness of a particular preinstructional strategy will depend primarily on the grade and the level of the required cognitive skill, as well as the ability of the student. Instructional objectives appeared to benefit grade 7 students irrespective of the level of cognitive skill, and the ability of the student. The advance organizer functioned best for the high ability grade 11 students when higher cognitive skills were required. Instructional objectives were slightly more effective than advance organizers for promoting the learning of knowledge by grade 11 students.

Hypothesis Three was rejected. There were significant differences among student scores on the low and high cognitive level portions of the criterion measure.

4.3 The Questionnaire

The results of the Student and Teacher Questionnaires are located in Appendices H and I. Since the purpose of these questionnaires was to produce additional information to explain the ANOVA findings, and to suggest ways of implementing the study results, the responses to the questionnaires will be referred to in the discussion that follows.

CHAPTER V

DISCUSSION AND CONCLUSIONS

5.1 Assumptions

The following assumptions must be considered in the interpretation of the data:

Assumption 1: The sample population was representative of the total population of students registered in the following courses: grade 7 General Science and grade 11 Biology 20.

A large number (N=695) of randomly assigned subjects were tested from ten schools within an urban-suburban school district. In addition, the standard error for the mean of the criterion measure was small, 2.3. Therefore, it was concluded that the sample study population was a good representation of the total student population.

Assumption 2: The teachers were representative of the total teacher population.

In the study, fourteen teachers were required to fulfill clearly defined roles as classroom managers. This procedure was intended to standardize testing procedures, and to minimize the effect of the instructors' personalities upon the subject. Hence, the teachers were not taken into account during the data analyses.

Assumption 3: The Canadian Cognitive Abilities Test and the Canadian Lorge-Thorndike Intelligence Test are representative measures of general ability.

It is debatable as to whether these standardized tests measure general cognitive ability. However, the two school boards that were involved in the study use the test scores as one source in the assessment of the students' mental capabilities.

Assumption 4: The scores obtained on the criterion measure could differentiate among the different ages (grade) and cognitive abilities of the students.

Since it is impossible to see the activities or changes in the cognitive structure which define an individual's mental age and cognitive abilities, it was inferred that the higher the criterion test score, the greater was the learning. The data in Tables 3 and 4, and the ANOVA provide some support for this inference. As one might expect, the grade 11 students received significantly ($p \leq 0.01$) higher scores than the grade 7 students. In addition, students who were designated as low, average and high ability received significantly ($p \leq 0.01$) different scores irrespective of their grade level. These findings suggest that the measuring device did differentiate among the different ages and cognitive abilities of the students.

Assumption 5: The preinstructional strategies were understandable by the learners.

Kozlow and White (1979) and others indicate that studies involving advance organizers will not be successful unless the preinstructional strategy is understandable by the learner. To ensure that the strategies were understandable, the following procedures were followed:

1. Three judges--a junior high school teacher, a senior high teacher and an education professor--reviewed the content and form of the preinstructional strategies before they were used in the study.
2. The preinstructional strategies were pilot tested on two occasions prior to the main study. During these pilots, students were asked to identify items that they found difficult to understand. Alterations to the strategies were then made.

3. Based on the responses to the Teacher Questionnaire (see Appendix I), two of the seven grade 7 teachers, and none of the grade 11 instructors indicated that the students had difficulty in understanding the preinstructional strategies. One teacher stated that although the students could comprehend the written material, they did not know what was expected of them, i.e., how the strategies were to be used.

Assumption 6: Students were familiar with the interpretation of fixed-sequenced, fixed-paced combined audio and visual images in an instructional setting.

The questionnaires provided support for this assumption (see Appendix H). Sixty-one percent of the grade 7 students and 64% of the grade 11 students indicated that they had seen 10 or more instructional films and video programs in their classes during the school year. Further, the Teacher Questionnaire (see Appendix I) revealed that 57% of the grade 7 science teachers had shown 10-12 films or television programs to the classes involved in the study. Since the grade 11 students started their courses two to four weeks before the study was conducted, only 43% of the grade 11 students had seen 7-9 films or television programs in their Biology 20 course.

Assumption 7: The television program was understandable and appropriate for the subjects.

The literature review suggested the possibility that non-significant findings of preinstructional strategies studies may have been due to the use of learning material that was inappropriate for the audience. This researcher attempted to find learning material that was appropriate for the grade 7 and 11 curricula (see Appendix B). In addition, the

responses to the Teacher Questionnaire (see Appendix I) confirmed that the program had an instructional value, fitted within the provincial curriculum guidelines and was appropriate for the teachers' course outlines. Further, all grade 7 and 11 teachers indicated that the students did not have difficulty in understanding the television program (see Appendix I).

5.2 Discussion

A significance level of $p \leq 0.01$ was chosen to evaluate the null hypotheses of this study. Although educational research normally employs a $p \leq 0.05$ level of significance, the researcher used a more stringent value for the following reasons:

1. The smaller significance value would partially compensate for the modest test-retest reliability of 0.75 and 0.65 which were obtained respectively from the item analysis of the pilot and main study criterion measures.
2. The value of 0.01 reduced the chance of incurring a Type I error (an alternative hypothesis may be accepted when the null hypothesis is true).
3. Since educators may wish to use the findings of this research, the researcher wanted to ensure that he could recommend his findings beyond any reasonable doubt.

Hypothesis One

There will be no significant difference among scores obtained on an immediate and on a delayed-retention test by students who receive one of three specified treatments--an advance organizer, instructional objectives and a placebo.

Since the instructional objectives yielded significantly ($p \leq 0.01$) higher scores than the placebo, Hypothesis One was rejected (see Table 6). This finding provides support for Rothkopf's (1971) theory of mathemagenic behaviors; preinstructional strategies can modify a learner's attention-directing and processing skills. The result indicates that the learners were better able to select and retain salient information as compared to the control group (those who received

a placebo). Hence, this study presented findings that were in agreement with Frase (1967, 1968, 1975) who used prequestions, and Rothkopf and Kaplan (1972, 1974) who used instructional objectives to test the theory of mathemagenic behavior with written learning material.

Although the students who received an advance organizer did not obtain a significantly ($p \leq 0.01$) higher score than the placebo group, this finding did not provide sufficient grounds to reject Ausubel's (1963) theory of meaningful verbal learning even though the advance organizer group was able to obtain only a 0.05 level of probability (see Table 6). The literature review provided evidence that the advance organizer would be successful only with learning material that dealt with higher-level cognitive skills that were not based primarily on recall (Ausubel, 1978; Mayer, 1979). Since Hypothesis One was based on the total test scores which included responses to knowledge and higher-level cognitive questions, a definitive statement on the successful application of advance organizers cannot be made. However, Hypothesis Three which dealt with different levels of cognitive skills may provide further insight into the effectiveness of advance organizers. Further, since the data analysis of this hypothesis utilized total score means from both the grade 7 and 11 students, any apparent facilitative effect of the advance organizer would be suppressed in this analysis. The work of Piaget (see Brainerd, 1978) reveals that young learners, such as those in grade 7 would most likely have difficulty with this strategy, but the older students who could deal with abstractions should be able to cope with the abstract nature of advance organizers. Since Hypothesis Two deals with the effect of age on the treatments, perhaps the advance organizer will be shown to have significance with the grade 11 students.

Similar to the findings of Hartley and Davies (1976), the treatments, especially the instructional objectives, were effective for both the immediate and delayed tests, irrespective of grade level. It should be noted that the delayed-test scores were significantly ($p \leq 0.01$) higher than the immediate scores. One would have expected that all test scores would have dropped on the delayed test (see MacDonald, 1965). However, since 90.9% of the students enjoyed the program they were able to recall a great deal of information because they attended to it (see Appendix D). In addition, test practice--taking the same test twice--only appears to explain part of this finding. A close examination of Table 4 reveals that the placebo groups' scores remained the same or dropped slightly, with the exception of the average IQ grade 7 students and the high IQ grade 11 students who were better able to retain the information. The significant increases in test scores are primarily due to the effects of the treatments. It would appear that the experimental treatment students had retained more information, and organized it in such a manner that they were able to make better judgments with regard to selecting the correct responses on the second exposure to the test. The responses to the Student Questionnaire (see Appendix H) support this explanation.

Six of the 18 groups (see Table 4) appeared to make notable total test score increases over time. These groups were: the high IQ advance organizer grade 7 (13.8 to 14.9); the average IQ instructional objectives grade 7 (12.4 to 13.2), the low IQ advance organizer grade 11 (14.9 to 15.8); the high IQ advance organizer grade 11 (17.4 to 18.9); the average IQ instructional objectives grade 11 (15.7 to 16.6); and, the high IQ instructional objectives grade 11 (16.5 to 17.4). These

findings strongly support the theory of mathemagenic behaviors since all of these groups received a preinstructional strategy. Since most of the large increases occurred with the grade 11 students, it appears that they could remember and use the preinstructional strategies more effectively. The high IQ students in both grade levels profited most from the use of these strategies. This latter statement confirms the findings of Kanner and Rosenstein (1960) and Kraft (1961) who state that students of high ability learn more than students of low ability, regardless of the method of instruction or mode of presentation.

It is unclear as to why the low IQ grade 11 students who received an advance organizer would make a notable gain over time (i.e., 14.9 to 15.8). Perhaps the advance organizer acted as a supplantation device (Ausburn and Ausburn, 1978; Salomon, 1979) i.e., the advance organizer enabled the students to do something that they were unable to do for themselves--organize the incoming stimuli. However, since all groups, irrespective of the treatments, performed according to their general cognitive ability, evidence which strongly supports supplantation was not found in this study.

Hypothesis Two

There will be no significant interactions among treatments, age (grade) and general cognitive ability (IQ) on an immediate and on a delayed-criterion measure.

General researchers and reviewers such as Chaudhari and Buddhisagar (1981), and Cronbach and Snow (1977) have stated or implied that there may not be significant differences among treatment variables unless the characteristics of the learners were considered. In this study, there were significant differences between treatments at $p \leq 0.01$ level of

significance, but there were no significant interactions between the treatments and the specified variables. The main effects accounted for the majority of significant differences in the study. If a significant level of $p \leq 0.05$ had been utilized, there would have been a significant treatment x ability interaction, and a significant treatment x time interaction. These possible interactions may have led one to suspect that different abilities respond differentially to the treatments (see Cronbach and Snow, 1977), and that the treatments were more effective on the delayed-test than on the immediate test (see Ausubel, 1963). However by using a significance level of $p \leq 0.01$, one can only state that the instructional objectives performed better than the other two treatments, regardless of the ability level of the student and the time of testing.

Since the grade 7 students are generally regarded as being in the concrete-operational stage of cognitive development (Sund, 1976), it was not expected that they could effectively employ advance organizers which are abstract, and therefore more suitable to the formal-operational capability of grade 11 subjects. The literature review indicated that instructional objectives would probably be best for grade 7 students, and the advance organizer would be successfully employed by grade 11 subjects. The data did not support this supposition in its entirety. Instructional objectives, stated at various levels of Bloom's (1956) taxonomy, appeared to facilitate learning by all students (see Figures 1 - 4). Perhaps this result was due to the directness of the instructional objectives as opposed to the abstraction of the advance organizer. However, the data in Table 4 indicate that the high IQ grade 11 students who received an advance organizer obtained scores that were higher than those who received instructional objectives, and were

substantially higher than those who received a placebo and possessed similar characteristics (total delayed-test score means from Table 4: AO = 18.9; IO = 17.4; P = 16.0). Further, the students who were designated as low IQ grade 11 students and received an advance organizer, performed better than those who received instructional objectives or a placebo (total delayed test means from Table 4: AO = 15.8; IO = 15.1; P = 12.9), but the differences were not as great as those achieved by the high IQ grade 11 students.

The above fits with the research of Ausubel and his associates who found that advance organizers could be successfully employed by college students. If one were to consider that the high IQ grade 11 students are closer to being similar to college students than other groups in the study, then the findings of this study would substantiate Ausubel's (1960, 1963, 1968) claim that advance organizers can effectively promote learning.

There was a significant grade x ability interaction (AC in Table 6). The difference between grade levels was significantly ($p \leq 0.01$) greater for low ability students than for high ability students. This finding was contrary to that which was hypothesized, i.e. due to the lack of ability, lower IQ groups would benefit most from the use of any aid which enabled them to deal more effectively with the learning material. Although the preinstructional strategies did assist the lower IQ students, it was suggested in one teacher's response to the questionnaire (see Appendix I), that although students could read and understand the preinstructional strategies, they needed to be instructed on how to use them effectively. Conversely, the high ability students were better able to use these strategies. Further, Kanner and Rosenstein (1960) and

Kraft (1961) state that high ability students perform well under any conditions. Hence, one should not expect that the difference between the high ability students in each grade and the corresponding low ability students to be identical. In addition, even though the cut-off points for ability were identical for each grade (see Table 2), Tables 1 and 2 indicate that there were lower IQ scores in the low ability grade 7 group as compared to the low ability grade 11 group.

Hypothesis Three

> There will be no significant difference among student scores on either the low or high cognitive level portion of an immediate and a delayed-retention test by students who not only differ in age and general cognitive ability, but also receive one of three specified treatments--an advance organizer, instructional objectives and a placebo.

The data revealed that different variables differentially affected scores obtained on the low- and high-level cognitive portions of the criterion test. As expected, knowledge subtest scores of the placebo groups for both grades, and the grade 7 students who received preinstructional strategies also decreased over time. This finding is similar to those suggested by McDonald (1965). However, those grade 11 students who received preinstructional strategies increased their knowledge scores. The plot of the significant grade x time interaction (see Figure 6) also reveals this pattern. The implication was that the grade 7 students have a greater difficulty in retaining information than the grade 11 students whose cognitive structures were more developed (see Brainerd, 1978).

Probably the most significant finding is that irrespective of age, grade and the time of testing, the instructional objectives appear to be more effective with knowledge skills than either of the other two treatments. Perhaps the specificity of the knowledge-level instructional objectives, as opposed to the generality of the advance organizer, enables students to focus on and retain knowledge. Instructional objectives do appear to act as attention-directing devices (see Bovy, 1981; Hartley and Davies, 1976; Melton, 1978; Rickards, 1979).

The analysis of the knowledge subtest scores also revealed that the difference between high ability groups of each grade is greater than between the low ability students (see Figure 5). This result reflected the identical finding in Hypothesis Two which was based on the total test score. The large difference between the low ability grade 7 and 11 students (see Figure 5) as opposed to the smaller difference between high ability students in each grade was due to the distribution of IQ scores in the two ability groups. The low ability grade 7 group had lower IQ scores than the low ability grade 11 group. Conversely, the high ability groups for each grade had scores that were more evenly distributed. As a result, the low ability grade 7 students achieved scores that were lower than their grade designation would indicate.

The data derived from the higher cognitive subtest (see Figure 6) strongly suggested that the advance organizer facilitated the greater learning by the grade 11 students, but this strategy was only slightly more effective than the placebo for the grade 7 subjects. The instructional objectives were less effective than the advance organizer for the grade 11 students, and most effective with the grade 7 students. Further there was a notable increase in the higher cognitive subtest

scores over time (see Table 3). The above findings are in agreement with Ausubel (1978), Kozlow and White (1979) and Mayer (1979) who suggest that preinstructional strategies, particularly advance organizers, may be effective for learning higher-order cognitive skills of Bloom's (1956) taxonomy by those who can deal effectively with the abstract nature of the advance organizer. Ausubel (1963) believes that due to a drive for economy, the learner loses specific information over a period of time. The essence of that information is stored in higher level concepts which are not easily forgotten. It is therefore possible that as the cognitive structure reorganizes the information within itself, it makes new connections which enable it to do things that it could not do previously. The advance organizer aids in this reorganization either by establishing an organizational center to which incoming information may adhere to, or pointing out differences between one concept and another. Consequently, those who receive an advance organizer and are expected to complete high-level cognitive tasks will perform better on a delayed measure than on an immediate test. Hypothesis Two appears to confirm this line of thought. Advance organizers are effective for learning higher-order cognitive skills and should be employed by students who can handle abstractions.

The above conclusion was also supported by responses to the Student Questionnaire (see Appendix H). Students, particularly those in grade 11, who received an advance organizer were better able to state how wolves interact with the biotic and abiotic components of the environment than those who received other treatments. The grade 11 students produced twice as many of these types of responses as compared to those grade 11 students who recieved either instructional objectives or a placebo.

5.3 The Generalizability of the Study

The overall aim of the study was to apply instructional theory to a classroom setting, and to provide information to instructors about how to improve the efficiency of learning from video-displayed material.

This study revealed that preinstructional strategies were effective under certain conditions. Teachers and instructional designers could use them to facilitate student learning from video-displayed learning material. The instructor will not need to edit or rearrange the contents of the learning material, nor will s/he be encouraged to eliminate the use of the material because it contains items that are inappropriate for the intended use. Instead, instructors can write preinstructional strategies that can direct the students' attention to what the teacher considers important, or adapt preinstructional strategies that could be supplied by the instructional media producers. Further, based on the results of this study, the use of written preinstructional strategies enables the teacher to:

1. individualize the instructor-centered classroom without the need to select different materials for each student, and without physically regrouping the students within the classroom. By distributing different written preinstructional strategies to each student, individualization can be accomplished. This procedure was used in this study.
2. quickly adapt the content of the learning material to his/her instructional intent by creating and distributing their own advance organizers and/or instructional objectives, or by adapting those provided by media producers.

3. easily alter his/her preinstructional strategies to suit the age and cognitive ability of the student by changing a few words for example.
4. select an appropriate preinstructional strategy to assist the student in the completion of different levels of cognitive tasks. For example, advance organizers facilitate learning of higher-order skills by grade 11 students, while instructional objectives aid in the completion of knowledge skills (see Figures 7 and 8).
5. provide an instructional tool that can be used by students who already possess reading skills. Since written materials in the form of science tests, laboratory guides and worksheets occupy a major portion of science instruction (Santiesteban and Koran, 1977), written instructional strategies could be employed without the necessity of teaching special interpretive skills.

From a practical viewpoint, inserting specific advance organizers or instructional objectives into a television program would limit its potential use by other classes. Therefore, written preinstructional strategies presented before actual instruction can provide the instructor with flexibility that could not be obtained by other means. In addition, this study proved that preinstructional strategies do not have to be in the same form as the learning material, nor do they have to be an integral part of the material in order to be successful.

Although it has been stated that films or other forms of media are usually introduced orally, this author sees no difficulty in using written preinstructional strategies within the classroom. In fact, the use of advance organizers and instructional objectives in the printed form may improve the consistency of the instructional process from class to class and from year to year.

The generalizability of this study can be accomplished only if the results of the investigation can be applied to instructional situations beyond the research conditions. Although no one study can be used as the basis for the instructional methods to be used by all teachers, the design of this study contained many features which would make it possible to apply the results to populations beyond the immediate research subjects. These features are identified below:

1. A large number of randomly assigned subjects was utilized. Approximately 695 students took part in this study.
2. The characteristics of the students were identified by the use of a standard grade designation (grades 7 and 11), and standardized general cognitive ability tests (the Canadian Cognitive Abilities Test and the Canadian Lorgne-Thorndike Intelligence Test).
3. This study was performed under actual instructor-centered classroom conditions. The teacher controlled the sequence and the rate of presentation. The students were not moved physically from their normal classroom, nor were they assigned to unfamiliar groups of students.
4. Since a pretest situation was not employed, the effect of the treatment was not contaminated by sensitization to the learning material. A control group which received a placebo was used as a standard against which other treatment groups were compared. Since this control group was randomly selected, and since a large number of students took part in the study, it was unlikely that there was a significant initial difference between the groups of students that were being compared.

5. Although it was not possible to select classes of students representing every possible type of school, attempts were made to obtain classes from several different schools within the urban-suburban area of the study.
6. It was hoped that the Hawthorne effect was minimized in the testing situation. In an effort to reduce this reactive effect of testing, teachers who normally instructed the science classes presented the study materials. Since the learning material was directly related to the course work of the students, it was hoped that the students did not become aware of the experimental nature of the study. Further, attempts were made to utilize all of the appropriate science classes taught by a particular teacher. This procedure reduced the probability that students would feel that they were being treated differently from other students.
7. It was possible that students involved in the study were experiencing a variety of other treatments within the school setting. However, the researcher was not aware of any in-school testing at the time of the study. Multiple-treatment interference can be minimized if the students are not tested at the following periods during the school year: within the first week of school, just before and after a holiday, before and during examinations and before any major social event. These time periods were avoided.
8. It is impossible to state that any learning material is truly representative of all instructional material. However, one can describe the characteristics of the material, and give some indication of its relation to other learning material. This description of the video-displayed learning material is provided in Appendix B.

9. The criterion measure did not purport to assess the capability of a specific individual so that s/he could be ranked with other students. It was designed to indicate the trend that one could expect with a group of students. For example, the performance of low ability students should indicate the predicted trend that one could expect if students were permitted to operate under the treatment conditions.

The above listed features should have increased the applicability of the study to other student populations.

5.4 Conclusions and Implications

This study rejected the three null hypotheses, and demonstrated the expectation that the retention-directing step of Gagné's (1970, 1978) instructional theory may be accomplished by the use of preinstructional strategies. In this study, these strategies were considered to have modified the students' attending behaviors, as well as assisted in the encoding and processing of external stimuli (see Bovy, 1981, Frase, 1970, 1973; Rothkopf, 1971; Wittrock and Lumsdaine, 1977). In order to use effectively these mathemagenic activities with fixed-paced, fixed-sequenced science media, the age and cognitive ability of the students must be considered (see Cronbach and Snow, 1977). Based on the research findings of this study, it is possible to suggest the grade and general cognitive ability groups which will benefit most from the use of an advance organizer or instructional objectives. Table 9 illustrates these suggestions. Since it is the delayed-test which actually measured learning--retention and manipulation of material over a period of time--Table 9 is based on the delayed-test scores. Also note that the type of preinstructional strategy that will best lead to the completion

Table 9: The Significant Findings of the Study: The Most Effective Treatments for Students Who Differ in Age and Cognitive Ability When Tested on Different Learning Tasks

Grade	Treatment	Cognitive Ability			Cognitive Task	
		Low	Average	High	Knowledge	Higher
7	AO IO P	X	X	X	X	X
11	AO IO P	X (X)	X	X	X	X

of different levels of cognitive tasks are also presented. Note that the pattern of effectiveness shown in Table 9 differs markedly from those suggested by the teachers involved in the study (see Appendix I). The instructional objectives appear to be the best overall strategy. However, the advance organizer aided the high IQ grade 11 students, particularly when they were completing higher-level questions. The advance organizer also appeared to aid the low ability grade 11 students, but there was not a large difference between the effect of the advance organizer and the instructional objectives with these low ability students. Thus, there is merit in the statements made by Ausubel (1978, 1980), Ausubel and Fitzgerald (1962), Chaudhari and Buddisagar (1980), Duchastel and Merrill (1973), Cronbach and Snow (1977), Kozlow and White (1979), Mayer (1979) and Melton (1978) that the effective use of preinstructional stretegies will depend on the type of learning task and the characteristic of the learner. They are not only effective with written material, but also with video-displayed learning material. In addition, the information presented in Table 9 could provide teachers and instructional designers with the means to select the appropriate strategy for a specified audience when fixed-sequenced, fixed-paced media and different levels of cognitive tasks are involved.

For those who favor individualized instruction, advance organizers and instructional objectives do not appear to be threatening. Since this study, nor any known to this author, has specifically stated that they have a negative effect on learning, the incorporation of organizers and objectives will aid those who can use them, but will not detract from those who cannot use them effectively. Thus, these tools could be implemented without lowering existing instructional expectancies. As

indicated by the responses to the Teacher Questionnaire (see Appendix I), teachers stated that if these strategies were found to be effective, they would use them provided that there were sufficient instructional time to use them properly. Further, the 76.6% of the students who received preinstructional strategies indicated that they would like to use similar instructional material in future classes (see Appendix H).

Although this study attempted to provide an extensive investigation of the use of advance organizers and instructional objectives on learning from fixed-paced, fixed-sequenced media, there are several areas which need further investigation:

1. A similar study should involve the instruction of the students as to the purpose of the preinstructional stretegies, and the use of the strategies with the same students over an extended period of time.
2. There needs to be an investigation of how the preinstructional strategies affect learning from the audio and visual messages which are found in combined media. The researcher had intentions of providing this information during this study (see Appendix D), but found it difficult to create valid criterion tests that could accurately measure visual knowledge and higher-level visual skills.
3. It has been suggested that individual cognitive styles affect the manner in which students learn (Ausburn and Ausburn, 1978; Greco and McClung, 1979; Jonassen, 1980). During the pilot test, the researcher attempted to determine the effect of field-dependence-independence upon student learning (see Appendix D). However, the pilot data revealed that general cognitive ability and field-dependency were not independent of each other; there was a strong

association between them. Therefore, only general cognitive ability was considered in the main study. Perhaps the effect of other cognitive styles upon student learning will be more fruitful (see Ausburn and Ausburn, 1978).

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APPENDIX A

THE PREINSTRUCTIONAL STRATEGIES

Key: AO = Advance Organizer

[illegible]structional Objectives

Placebo

AO = 1

SCHOOL_____TEACHER_____CLASS___NAME_____GRADE____

The videotape you will be viewing is about wolves and how they live in the wilderness. In order to survive, wolves like other animals need to produce young and to find food, water, and shelter. When animals are born they can do certain things without being taught, but must learn other things as they grow.

Like humans, no two wolves are exactly alike. They have characteristics which differ with their age, the season of the year, and the role they play within their family. They also differ in physical appearance and in their actions.

All animals, including wolves, depend on other animals and their environment. For example, all animals need to have food for survival. If there is little food, only those animals that are best able to find food will live. If a lot of food is available, more animals will be able to survive. Thus, a balance exists between the plants and animals that are eaten and those animals which do the eating.

IO = 2

SCHOOL_____TEACHER_____CLASS___NAME_____GRADE____

After seeing the television program, you should be able to complete the activities listed below. After the program you will be expected to get at least 12 questions correct on a 24 item multiple-choice test. You will be given 20 minutes to complete the test.

1. Describe the physical characteristic of adult wolves.
2. Describe the hunting and feeding habits of wolves.
3. List the activities male and female wolves must do from the time they mate to the birth of the pups.
4. State the factors that affect the birth and survival of the wolf pups.
5. Name the activities that wolf pups must be taught to do during different stages of their development.
6. Outline the differences between adult wolves and adult humans, and between wolf pups and human babies.
7. Explain how members of a wolf pack relate to each other as a family.
8. Explain the changes in the number of wolves in a pack over a period of time.
9. Relate wolves to plants, caribou, deer and other animals.

P = 3

SCHOOL_____TEACHER_____CLASS___NAME_____GRADE___

David Suzuki is well known to Canadians for his science programs on radio and television. He was born in 1936 in Vancouver. Suzuki attended high school in London, Ontario and won scholarships for Amherst College and the University of Chicago. He became a research assistant at the Oak Ridge National Laboratory in Tennessee. In 1962, he left America to go to the University of Alberta and, in 1963, took a position at the University of British Columbia where he began his work on fruit flies. These tiny flies are used in scientific studies because they can produce young very rapidly. In 1969 he received the top award for Canadian scientists.

In 1970, Suzuki created a series of science programs for the public. He felt that science was important and that all people should be more aware of how it affects their lives. His radio program, "Quirks and Quarks", and his television programs, "Science Magazine" and "The Nature of Things", can be heard and seen on CBC.

APPENDIX B

DESCRIPTION OF VIDEO-DISPLAYED PROGRAM

Description of Video-Displayed Material

A coloured television program which presents an ecological theme from the grade seven science and grade eleven biology programs was used in this study. The material had to meet the following criteria:

1. fixed-paced,
2. fixed-sequenced,
3. composed of iconic and verbal images,
4. devoid of any visual special effects,
5. designed without the inclusion of digital signs or animation after or before the title and production credits,
6. coloured realistically,
7. designed to include motion as an integral part of the content,
8. 15 to 20 minutes in length,
9. relevant to the provincial science curriculum guidelines and the instructors' course outlines, and
10. understandable to students in grades 7 and 11.

A total of twenty-seven biology films and videotapes were viewed. Each was fixed-paced, fixed-sequenced, and composed of iconic and verbal images. However, all but five learning materials were eliminated because they did not meet all the remaining criteria. The five films were shown to instructors at the two grade levels. Based on their comments regarding the applicability of the learning material to their particular courses, one film was selected which met all of the criteria.

Since the title and production credits were inconsequential to the intended instruction, they were eliminated. Their removal enabled the film to fit easily into the instructional time slot without the loss of pertinent information.

Both verbal and iconic images were presented via the learning material. Since these images were similar and therefore supportive of one another, the interference that occurred due to the disparity between the two images was minimized (Fleming and Levie, 1978). The videotape that will be used in this study has a verbal:iconic ratio of 1:2. This compares favourably with the twenty-seven nature films and videotapes which were previewed. They had ratios varying from 0.6:2 (3:10) to 1.7:2 (17:20). Restated, these ratios varied from 0.6 minutes of audio for every 2 minutes of visual images to 1.7 minutes of audio for every 2 minutes of visual images.

Motion was an integral part of the instructional presentation that was shown to the experimental subjects. It helped to portray the differences among wolves and aided in the depiction of their way of life. If motion did not contribute to the understanding of the content presented in the videotape, a slide-tape presentation or film-strip could have been used to promote learning.

The actual length of the video-displayed material was determined by the practicability of performing this study within one class period. A fifteen minute television program was used. It is interesting to note that Dayton (1977) and Greco and McClung (1979) respectively used a 14.5 and an 11 minute slide-tape program, and Nugent, Tipton and Brooks (1980) utilized a 2.5 minute videotape to draw their conclusions about the effect of mathemagenic activities on learning from fixed-paced, fixed-sequenced audiovisual presentations.

When compared to other instructional films and videotapes, a length of 15 minutes was not abnormal. Fifty-one ecologically orientated films and videotapes were extracted from the instructional media catalogues of

an urban public school board and from the listings of two major educational film producers. These instructional materials varied in length from 9 to 30 minutes. The median and mean were 16 and 17.5 minutes respectively. If the results of this study are to be applicable to the existing world of the classroom, inclusion of a program longer than 30 minutes would have been impractical.

Although it has been suggested that advance organizers are most useful if the reading material is long and complex (Kozlow and White, 1979; Mayer, 1979), there is no known guideline suggested for audio-visual presentations. Following a review of empirical studies that investigated facilitative effects of instructional objectives on prose material, Hartley and Davies (1976, p.251) state that objectives generally facilitate learning irrespective of the length of instruction whether it is ten minutes or several weeks. This finding was also supported by Hershberger and Terry (1965) who found no significant difference in learning as a result of varying passage length when questions were inserted into printed material. Thus is was concluded that no definite time length of material to-be-learned has been found to be optimum.

The video-displayed material was judged to be congruent with the grade seven science curriculum which indicates that the following objectives should be attained in the general science course:

1. Living things carry on fundamental processes to sustain and perpetuate life.

2. All living things interact with and are interdependent with each other and their environment. (Alberta Education, 1978 a, p.36)

The learning material was also appropriate for the senior high school Biology 20 curriculum. According to this curriculum, the course

should "... develop an understanding of the principles of ecology" (Alberta Education, 1978 b, p.194) and should cover the interaction between biotic and abiotic factors, food chains, food webs, factors influencing populations, characteristics of populations, population changes and many more related topics.

Since the above mentioned curriculum guidelines were designed to encourage the development of cognitive skills rather than changes in affective behavior, the learning material that was selected approached the study of a particular environment from a cognitive point of view. It presented the following key ideas:

1. Wolves exhibit major characteristics that distinguish them from other animals but also demonstrate minor characteristics that distinguish them from other wolves.
2. Wolves perform fundamental processes that sustain and perpetuate life.
3. Wolves interact with their environment and are dependent on its biotic and abiotic interactions.

The characteristics of the video-displayed program that was used in the study are summarized below:

1. The material was fixed-paced and fixed-sequenced.
2. Verbal and iconic images presented the to-be-learned information.
3. Ratio of verbal to iconic images was 1:2.
4. No printed words or other digital sign types such as diagrams were present.
5. Iconic images did not contain special visual effects that could be seen by the naked eye.

6. No animation was present.
7. Realistically coloured iconic images were shown.
8. Visual images were presented by a 19 or 22 inch video screen, although other screen sizes were possible.
9. Motion was an integral part of the presentation.
10. Program length was 15 minutes.
11. The program was congruent with the provincial science curriculum guidelines and was relevant to the instructor course outline.
12. It was confirmed by instructors and students that the program is comprehensible for both grades seven and eleven students. (Refer to the questionnaire results in the Discussion Chapter.)
13. It presented three basic biological concepts.
14. It approached the topics from a cognitive rather than affective or psycho-motor point of view.

APPENDIX C

THE CRITERION MEASURES

1. Pilot Criterion Measure and Answer Key
2. a) Final Criterion Measure and Answer Key
   b) Correlation Between Instructional Objectives and Advance Organizers with Test Questions

The Pilot Test

THE WOLF

Instructions

1. You will be given twenty minutes to complete this twenty-four item multiple-choice test.

2. You should have 6 pages in the test. If you are missing any pages, please advise your teacher.

3. Print your name, sex, grade and birthdate on the left side of the multiple-choice answer sheet. Only use the pencil that was provided.

4. a) Read each question carefully and select the best answer.
   b) On the separate answer sheet, make a heavy black mark with the pencils provided, on the letter of your choice.
   c) DO NOT mark the test paper.
   d) There is only one right answer for each question and each question is worth one mark.

   For example:

   What animal was described in the film?

   A. A horse
   B. A cat
   C. A cow
   D. A wolf
   E. A lion

   The correct answer is D. The circle underneath the D would be blackened on the answer sheet as shown below:

   A B C D E
   1 ① ② ③ ● ⑤

5. When you have completed the test, hand in the test, answer sheet and pencil.

DO NOT TURN THE PAGE!

PLEASE WAIT UNTIL YOU ARE TOLD TO DO SO

T.2

1. Which activity must wolves be taught to do?

   A. Mate at certain times each year
   B. Take milk from their mother
   C. Catch small animals
   D. Play with other wolves
   E. Move their young from one den to another

2. Which pups are <u>most</u> <u>likely</u> to survive?

   A. The ones that drink milk first
   B. The ones that are darker in colour
   C. The ones that hunt caribou first
   D. The ones that leave the den early
   E. The ones that open their eyes first

3. During the summer months, if there is only a small amount of food available, which animal or animals eat(s) first?

   A. The wolf pups
   B. The oldest wolf
   C. The most powerful wolf
   D. The largest wolf
   E. The male leader

4. What characteristic indicates which wolf has the most authority in the pack?

   A. The colour of the wolf
   B. The size of the teeth
   C. The age of the wolf
   D. The height of the tail
   E. The size of the wolf

5. The number of pups born in a pack each year depends mainly on

   A. the number of healthy female wolves.
   B. the number of caribou eaten in the winter.
   C. the amount of food brought to the mother in the den.
   D. the number of wolves that mate at the same time.
   E. the number of caribou caught in the summer.

6. The mother moves the wolf pups from one den to another because

   A. the second den is closer to the other members of the wolf pack.
   B. as they grow, the pups need a larger den.
   C. the first den is too far from their fresh food supply.
   D. the move will make it more difficult for their enemies to find the young.
   E. the pups must learn to live in another environment.

... CONTINUED ON THE NEXT PAGE ...

7. Most adult wolves have coloured fur which

   A. changes with the seasons.
   B. is darker for males and lighter for females.
   C. is usually darker on their back than on their belly.
   D. matches their summer and fall environments.
   E. determines their role in the pack.

8. What is the length of an adult wolf measured from the tip of the nose to the end of the tail?

   A. 1.0 m
   B. 1.5 m
   C. 2.0 m
   D. 2.5 m
   E. 3.0 m

9. A hungry pack of wolves have spotted a herd of caribou. What will most likely happen next?

   A. The wolves will kill at least one caribou.
   B. The wolves will wait until dark before attacking.
   C. The wolves will rest before they attack.
   D. The wolves will stay hidden until they can surprise the caribou.
   E. The wolves will mingle with the herd before they attack.

10. Just before the birth of the pups, a female wolf will look for a den. If she finds that the first den is not suitable she may

   A. enlarge the den by digging with her paws.
   B. use dead trees and leaves to make a shelter.
   C. have the wolf pack find another den.
   D. give birth to the pups in dense shrubs.
   E. delay the birth until a suitable den can be found.

11. If a superior wolf such as the male leader is eating, what event will occur?

   A. The male leader will permit another wolf to eat at the same time.
   B. The male leader will fight with the other wolf.
   C. The male leader will stop eating until the other wolf goes away.
   D. The male leader will move the food to another place.
   E. The male leader will show its teeth, but will not fight.

... CONTINUED ON THE NEXT PAGE ...

T.2

12. Which characteristic is common for all of the animals killed by wolves?

A. They are larger than a wolf.
B. They are meat-eaters.
C. They can run faster than a wolf.
D. They are covered with fur.
E. They live in the grasslands.

13. What is the sign that the wolf pups are ready to be born?

A. The female stores food caught by the other members of the pack.
B. The female finds a den to get protection from the winter cold.
C. The wolf pack stops following the caribou.
D. The male leader mates with another female.
E. The female hunts for additional food.

14. A wolf pack consists of four female and four male wolves. The leading or dominant female has four pups. Eleven months later, just before the new pups are born, how many wolves would <u>most likely</u> be in the pack?

A. 4
B. 5
C. 9
D. 12
E. 16

15. Caribou are <u>prey</u> because they are eaten by wolves. In which pair below would the wolf pups be <u>prey</u>?

A. Wolf pups and beavers
B. Wolf pups and hawks
C. Wolf pups and deer
D. Wolf pups and foxes
E. Wolf pups and badgers

16. Which characteristic is <u>not</u> shared by two-month old wolves and six-month old humans?

A. They develop several tiny milk teeth.
B. They can take food from their mothers.
C. They can not survive without adults.
D. They eat food that was stored in an adult's stomach.
E. They need protection from the outside world.

... CONTINUED ON THE NEXT PAGE ...

T.2

17. Which characteristic is not shared by adult wolves and adult humans?

A. Usually both wolf parents help to raise their young.
B. Wolves usually mate for life.
C. Wolves usually hunt the sick and the aged.
D. Wolves form family units.
E. Each wolf has a different character.

18. "Wolves make 'ideal' parents." Which fact below supports this statement?

A. The parents allow their young to hunt.
B. They move in a group from one place to another.
C. Only the parents provide food for the young.
D. The young are fed milk until they can obtain their own food.
E. The parents protect their young.

19. A wolf can be classified as a mammal. Which characteristic below is shared by all mammals?

A. More than one baby is born at a time.
B. The female can produce milk.
C. They use four limbs to travel on land.
D. They all eat meat.
E. Fur protects the body from the cold.

20. The survival of the wolf does not depend on

A. the death of another animal.
B. the mating of all females.
C. the size of the pack.
D. the season of the year.
E. the availability of plant food.

21. For many years a pack of 10 wolves and a herd of caribou lived on an isolated island. In 1975 the wolf pack increased to 15. At the end of the year 1995, what would have happened?

A. There would be more than 15 wolves. The number of caribou would remain the same.
B. There would be more than 15 wolves. The number of caribou would also increase.
C. There would be 15 wolves. The number of caribou would remain the same.
D. There would be fewer than 15 wolves. The number of caribou would remain the same.
E. There would be fewer than 15 wolves. The number of caribou would also decrease.

... CONTINUED ON THE NEXT PAGE ...

T.2

For the next three questions (numbers 22, 23 and 24), use the following information:

> A population of caribou and wolves live in a National Park in the Arctic where hunting and trapping are not normally permitted. In 1940, fur trappers were permitted to kill only the wolves. By 1970, only a few unhealthy caribou remained. No wolves had been seen since 1963.

22. The caribou population decreased greatly between 1960 and 1970. Why do you think this happened?

A. Other animals ate the caribou's food.
B. The number of wolves increased.
C. The caribou did not have enough food.
D. The healthy caribou were killed by hunters.
E. The trappers killed both caribou and wolves.

23. In 1970, park employees noticed a decrease in the animal populations. In 1970, what would have been the best solution to the problem?

A. A pack of wolves from another park could be brought in.
B. Hunters could be allowed to reduce the number of caribou to the original number in 1930.
C. The sick caribou could be replaced with healthy deer.
D. The sick caribou could be killed and a new pack of wolves could be allowed into the park.
E. Trappers could be prevented from trapping wolves in the park.

24. What important role did the wolves play in the life of the caribou?

A. The wolves ate the healthy caribou so many sick animals survived.
B. The wolves and caribou were competing for the same food source.
C. The wolves protected the healthy caribou from its meat-eating enemies.
D. The wolves forced the caribou to move from one feeding area to another.
E. The wolves kept the caribou population down so the caribou could obtain enough food.

THE END

Please check your work. Make sure that you have marked only one answer for each question.

Are the answer circles blackened completely?

Is your name, sex and grade on the answer sheet?

Pilot Test Answer Key

Knowledge Subtest			Higher Cognitive Level Subtest		
Audio:	1	C	Audio:	13	A
	2	A		14	C
	3	E		15	B
	4	D		16	D
	5	B		17	C
	6	D		18	E
Iconic:	7	C	Combined Audio and Iconic	19	B
	8	B		20	B
	9	E		21	D
	10	A		22	C
	11	E		23	A
	12	D		24	E

THE FINAL TEST
THE WOLF

Instructions

1. You will be given twenty minutes to complete the twenty-four items in this multiple-choice test.

2. You should have 6 pages in the test. If you are missing any pages, please tell your teacher.

3. PRINT your name, sex, grade and birthdate on the left side of the answer sheet. PRINT the name of your school above your name. Use only the pencil provided.

4. a) Read each question carefully and choose the best answer.
   b) On the separate answer sheet, make a heavy black mark with the pencils provided, on the letter of your choice.
   c) DO NOT mark the test paper.
   d) There is only one right answer for each question.
   e) Each question is worth one mark.

   For example:

   What animal was described in the film?

   A. A horse
   B. A cat
   C. A cow
   D. A wolf
   E. A lion

   The correct answer is D. The circle underneath the D would be blackened on the answer sheet as shown below:

   

5. When you have completed the test, hand in the test, answer sheet and pencil.

DO NOT TURN THE PAGE!

PLEASE WAIT UNTIL YOU ARE TOLD TO DO SO.

1. Which activity must wolves be taught to do?

   A. Mate at certain times each year
   B. Take milk from their mother
   C. Catch small animals
   D. Take food from the mouth of an adult wolf
   E. Move their young from one den to another

2. The pups that are most likely to survive are the ones that

   A. drink milk first.
   B. are darker in colour.
   C. hunt caribou first.
   D. leave the den early.
   E. open their eyes first.

3. During the fall while the wolf pups are growing which animal(s) eat first?

   A. The wolf pups
   B. The hungriest wolf
   C. The most powerful wolf
   D. The wolf that catches the food
   E. The male leader

4. Just before the birth of the pups, a female wolf will look for a den. If she finds that the first den is not suitable, she may

   A. make the den larger by digging with her paws.
   B. use dead trees and leaves to make a shelter.
   C. give birth wherever she happens to be.
   D. give birth to the pups in dense shrubs.
   E. delay the birth until a suitable den can be found.

5. A wolf can be classified as a mammal. Which characteristic below is shared by all mammals?

   A. More than one baby is born at a time.
   B. The female can produce milk.
   C. They all live in groups.
   D. They all eat meat.
   E. Fur protects the body from the cold.

6. Which characteristic is not shared by two-month old wolves and six-month old humans?

   A. They develop several tiny milk teeth.
   B. They can take food from their mothers.
   C. They cannot survive without adults.
   D. They eat food that was stored in an adult's stomach.
   E. They need protection from the outside world.

...continued on the next page...

7. A superior wolf such as the male leader is eating. If another wolf comes to eat at the same time, what will the male leader do?

   A. Permit the other wolf to eat at the same time
   B. Fight with the other wolf
   C. Stop eating until the other wolf goes away
   D. Move the food to another place
   E. Show its teeth, but will not fight

8. If a wolf pup was born in early spring, by the middle of the summer it would be able to

   A. mate with other wolves.
   B. successfully hunt deer.
   C. travel long distances.
   D. catch small animals.
   E. attack and kill caribou.

9. Caribou are <u>prey</u> because they are eaten by wolves. In which pair below would the wolf pups be <u>prey</u>?

   A. Wolf pups and beavers
   B. Wolf pups and hawks
   C. Wolf pups and deer
   D. Wolf pups and foxes
   E. Wolf pups and badgers

10. A wolf has spotted a deer. According to the film, what will <u>most</u> <u>likely</u> happen next?

   A. The wolf will wait for the leader's signal to attack.
   B. The wolf will get close enough to be seen by the deer before attacking.
   C. The wolf will hide until it can make a surprise attack.
   D. The wolf will wait until dark and then attack.
   E. The wolf will attack immediately.

11. Which characteristic is <u>not</u> shared by adult wolves and adult humans?

   A. Usually both wolf parents help to raise their young.
   B. Wolves usually mate for life.
   C. Wolves usually hunt the sick and the aged.
   D. Wolves form family units.
   E. Each wolf has a different character.

...continued on the next page...

12. During and soon after the birth of the wolf pups, which does not occur?

A. The pups are wet and dark in colour.
B. The mother leaves the den to get food.
C. The eyes of the wolf pups are closed.
D. The mother provides the pups with food.
E. The mother licks the pups.

13. Which of the following is the best reason why wolves make "ideal" parents?

A. The parents allow their young to hunt.
B. They move in a group from one place to another.
C. Only the parents provide food for the young.
D. The young are fed milk until they can obtain their own food.
E. The parents protect their young.

14. What characteristic indicates which wolf has the most authority in the pack?

A. The colour of the wolf
B. The size of the teeth
C. The age of the wolf
D. The height of the tail
E. The size of the wolf

15. A hungry pack of wolves has spotted a herd of caribou. What will the wolves probably do next?

A. Kill at least one caribou
B. Attack right away
C. Rest before they attack
D. Stay hidden until they can surprise the caribou
E. Mingle with the herd before they attack

16. The number of pups born in a pack each year depends mainly on

A. the number of healthy female wolves.
B. the number of caribou eaten in the winter.
C. the amount of food brought to the mother in the den.
D. the number of wolves that mate at the same time.
E. the number of caribou caught in the summer.

...continued on the next page...

17. Which statement gives the least evidence that the wolf pack acts as a family?

A. They hunt small animals all year long.
B. They use the same den every year.
C. The leading male and female usually mate for life.
D. Each wolf has a different character.
E. The leading male and female rule the pack.

18. A wolf pack consists of four female and four male wolves. The leading or dominant female has four pups. Eleven months later, just before the new pups are born, how many wolves would most likely be in the pack?

A. 4
B. 5
C. 6
D. 9
E. 12

19. Most adult wolves have coloured fur which

A. changes with the seasons.
B. is usually darker on their back than on their belly.
C. is darker for males and lighter for females.
D. matches their summer and fall surroundings.
E. determines their role in the pack.

20. If wolves stopped hunting caribou, which situation would most likely happen at the end of a two year period?

A. The caribou population would remain the same.
B. The number of wolves would increase.
C. The caribou would not move to a new feeding area.
D. The deer population would decrease.
E. The number of plants would increase.

21. For many years a pack of 18 wolves and a herd of caribou lived on an isolated island. In 1950 most of the wolf pups survived. The wolf pack increased to 23. After 50 years, how many wolves would you expect to find in the pack.

A. 11-13
B. 14-16
C. 17-19
D. 20-22
E. 23-25

...continued on the next page...

For the next three questions (numbers 22,23 and 24), use the following information:

> A population of caribou and wolves live in a National Park in the Arctic where hunting and trapping are not normally permitted. In 1940, fur trappers were permitted to kill only the wolves. By 1970, most of the remaining caribou were unhealthy. No wolves have been seen since 1963.

22. The caribou population decreased greatly between 1960 and 1970. Why do you think this happened?

A. Other animals ate the caribou's food.
B. The number of wolves increased.
C. The caribou did not have enough food.
D. The healthy caribou were killed by hunters.
E. The trappers killed both caribou and wolves.

23. In 1970, park employees noticed a decrease in the animal populations. In 1970, what would have been the best solution to the problem?

A. A pack of wolves from another park could have been brought in.
B. Hunters could have been allowed to reduce the number of caribou to the original number in 1930.
C. The sick caribou could have been replaced with healthy deer.
D. The sick caribou could have been killed and a new pack of wolves could have been allowed into the park.
E. Trappers could have been prevented from trapping wolves in the park.

24. What important role did the wolves play in the life of the caribou?

A. The wolves ate the healthy caribou so many sick animals survived.
B. The wolves and caribou were competing for the same food source.
C. The wolves protected the healthy caribou from its meat-eating enemies.
D. The wolves forced the caribou to move from one feeding area to another.
E. The wolves kept the caribou population down so the caribou could obtain enough food.

THE END

1. Please check your work. Make sure that you have marked only one answer for each question.
2. Are the answer circles blackened completely?
3. Is your name, sex, grade and school on the answer sheet?

Final Test Answer Key

1	C	7	E	13	E	19	B
2	A	8	D	14	D	20	D
3	E	9	B	15	E	21	C
4	A	10	C	16	B	22	C
5	B	11	C	17	A	23	A
6	D	12	B	18	D	24	E

Subtest Breakdown of Final Test

Knowledge Subtest

Audio:	1	C	
	2	A	
	3	E	
	14	D	
	15	E	
	16	B	
Iconic:	4	A	
	7	E	
	8	D	
	10	C	
	12	B	
	19	B	

Higher Cognitive Level Subtest

Audio:	6	D	analysis
	9	B	application
	11	C	analysis
	13	E	evaluation
	17	A	evaluation
	18	D	synthesis
Combined Audio and Iconic:	5	B	analysis
	20	D	synthesis
	21	C	synthesis
	22	C	evaluation
	23	A	evaluation
	24	E	analysis

Correlation Between Instructional Objectives and Final Criterion Test Questions

	Instructional Objectives	Question Number	Level of Cognitive Skill
1.	Describe the physical characteristic of adult wolves.	14, 19	knowledge
2.	Describe the hunting and feeding habits of wolves.	3, 7, 10, 15	knowledge
3.	List the activities male and female wolves must do from the time they mate to the birth of the pups.	4, 12	knowledge
4.	State the factors that affect the birth and survival of the wolf pups.	2, 16	knowledge
5.	Name the activities that wolf pups must be taught to do during different stages of their development.	1, 8	knowledge
6.	Outline the differences between adult wolves and adult humans, and between wolf pups and human babies.	6, 11	analysis

	Instructional Objectives	Question Number	Level of Cognitive Skill
7.	Explain how members of a wolf pack relate to each other as a family.	13, 17	evaluation
8.	Explain the changes in the number of wolves in a pack over a period of time.	18, 21	synthesis
9.	Relate wolves to plants, caribou, deer and other animals	5	analysis
		9	application
		20, 24	synthesis
		22, 23	evaluation

Correlation Between Advance Organizer and Final Criterion Test Questions

Advance Organizer	Question Number
The videotape you will be viewing is about wolves and how they live in the wilderness. In order to survive, wolves like other animals need to produce young and to find food, water, and shelter. When animals are born they can do certain things without being taught, but must learn other things as they grow.	1, 2, 3, 4, 7, 8, 10, 12, 15, 16
Like humans, no two wolves are exactly alike. They have characteristics which differ with their age, the season of the year, and the role they play within their family. They also differ in physical appearance and in their actions.	6, 11, 13, 14, 17, 19
All animals, including wolves, depend on other animals and their environment. For example, all animals need to have food for survival. If there is little food, only those animals that are best able to find food will live. If a lot of food is available, more animals will be able to survive. Thus, a balance exists between the plants and animals that are eaten and those animals which do the eating.	5, 9, 18, 20, 21, 22, 23, 24

APPENDIX D

ANALYSIS OF PILOT CRITERION TEST

Analysis of Pilot Criterion Test

Note: Any discrepancies in table totals are due to "rounding off" digits.

Table 1: Outline of Pilot Criterion Test

Subtest	Description of Content	Questions
1	Audio knowledge	1 - 6
2	Iconic knowledge	7 - 12
3	Higher cognitive level (comprehension, application, analysis, synthesis and evaluation) questions based on audio content.	13 - 18
4	Higher cognitive level questions based on the combined audio and iconic images.	19 - 24

Table 2: Pilot Study--Item Homogeneity and Test-Retest Reliability for Subtests and Total Test (N=98)

Measurement	Subtests 1	2	3	4	Total Test
Item Homogeneity	0.5	0.2	0.5	0.4	0.7
Test-Retest Reliability	0.7	0.5	0.7	0.6	0.7

Note: These test parameters were based on the total sample population and not on the placebo group. The Kuder-Richardson formula (KR-20) was used to determine the values of the parameters.

As illustrated in Table 3 and 4, the inter-subtest correlations indicated that the items measured the same general attribute, but they also exhibited some independence from each other. Higher values would have indicated that the items measured a single attribute.

Table 3: Pilot Study--Subtest Correlations (Pearson Correlation Coefficients) for the Immediate Test Scores

Subtest	1	2	3	4
Subtest 1	1.0			
2	0.3	1.0		
3	0.6	0.4	1.0	
4	0.3	0.3	0.6	1.0

Table 4: Pilot Study--Subtest Correlations (Pearson Correlation Coefficients) for the Delayed Test Scores

Subtest	1	2	3	4
Subtest 1	1.0			
2	0.5	1.0		
3	0.5	0.5	1.0	
4	0.5	0.3	0.6	1.0

Subtests 3 and 4 showed a reasonably high correlation between each other on both immediate and delayed tests. This result was expected since both subtests involved high-order questions based on the audio component of the video-displayed material. The relationships between the iconic knowledge subtest on the delayed test and other subtests was acceptable. Since it would share a close relationship to the higher-order audio subtests, their correlation was lower than the others.

One of the desirable features of the measuring device can be seen in Table 5. The means of each subtest were located approximately midway between the minimum and maximum values of 0 and 6. Thus, the effect of the preinstructional strategies can easily be revealed on the delayed test where there is an allowance for the upward or downward movement of the scores. An upward movement of the scores on the delayed test would indicate that the preinstructional stretegies improved the effectiveness

of the instruction. The immediate subtest 1 score was slightly high, however it must be remembered that it was a measure of audio knowledge which is based primarily on memory. One could expect that its value would be reduced on the delayed test because the content of subtest 1 would be more susceptible to forgetting than higher level skills.

Table 5: Pilot Study--Means for Subtests on the Immediate and Delayed Tests

	Immediate Test	Delayed Test
Subtest 1	4.0	3.9
2	2.9	2.9
3	3.0	3.1
4	11.9	12.2

Since the measuring device was administered to both grade 7 and 11 students, and was used both as an immediate posttest and as a delayed-retention test, an examination of all test results was required. The following criteria were used as a guide:

Difficulty--The acceptable range was between 0.2 and 0.8. Values higher than 0.8 would mean that the question was too easy.

Point-Biserial Correlation or RPB--The acceptable range was between 0.2 and 0.8. Values lower than 0.2 indicated that the item had a poor correlation with the total test score.

Discriminating Power--The acceptable range was 0.2 to 0.8. Values lower than 0.2 indicated that the particular item under study did not discriminate well between those who achieved high scores on the total test and those who did not.

The minimum values indicated above may at first appear to be low, however it must be realized that the test was designed for both grade 7

and 11 students. These guidelines were used during the modifidation of the pilot test.

The pilot study involved the use of untested material and procedures, utilizing a small, possibly biased sample. The testing occurred at the end of the term, as opposed to the suggested trial period at the beginning of the course. In addition, there was only a one-week instead of a planned two-week interval between the immediate- and the delayed-retention test. Consequently, these factors were considered in the interpretation of the data.

As can be clearly seen in Tables 11 and 12, the general characteristics of the test were consistent for both the immediate- and delayed-testing situations. The KR-20 reliability of the measuring device was 0.75. The test means had an approximate value of 12 which was one-half of the maximum value of 24. No major differences between the immediate and delayed test results were detected.

Table 6: Pilot Study--Immediate and Delayed Test Results for All Grade 7 and 11 Subjects

Measure	Immediate Test	Delayed Test
N	98	94
Mean	11.92	12.23
Standard Deviation	4.25	4.26
KR-20 Reliability	0.75	0.75
S.E. of Measurement	2.12	2.13

Table 7: Pilot Study--Treatment Results for All Grade 7 and 11 Subjects

	Immediate Test Mean		Delayed Test Mean	
Grade	7	11	7	11
Advance organizer	7.5	15.0	8.5	15.2
Instructional Objectives	10.0	14.8	10.4	15.4
Placebo	10.8	14.2	11.0	14.7

The effects of the characteristics of the learner upon the test results are illustrated in Tables 8 and 10.

A crosstabulation of intelligence (IQ) and field dependence-independence as measured by the Group Embedded Figures Test (GEFT) is presented in Table 8. This table includes an itemization of the characteristics of all experimental subjects who completed the Canadian Cognitive Abilities Test and the GEFT. It should be noted that although the categories for levels of intelligence were based on the same quantities, the field-dependency dimension involved separate median points for the designation of field-dependent and field-independent individuals in grade 7 and grade 11.

Table 8: Pilot Study--Crosstabulation of IQ by Field Dependency for All Grade 7 and 11 Subjects

		Field Dependency				
		Field-Dependent		Field-Independent		
IQ	Low	24	(27.9%)	6	(7.0%)	30
	Average	15	(17.4%)	13	(15.1%)	28
	High	6	(7.0%)	22	(25.6%)	28
		45		41		86

The grade 7 students were designated as field-dependent if they received a score below 8.5 on the GEFT while the grade 11 students were classed as field-dependent if they obtained a score below 13.25 on the GEFT.

In order to determine whether the variables of intelligence and field-dependency were independent of each other, the chi square test of independence was administered. This test yielded a value of 19.94 with 2 degrees of freedom. The calculated value of chi square was significant ($p < .001$). This proved that there was a strong association between intelligence and field-dependency so these variables were not

independent of each other. Hence, only one of these variables needed to be considered in the main study; general cognitive ability was kept as a variable.

Based on their intelligence quotient (IQ) scores, students were dividied into three groups--low, average and high ability. Intelligence quotients could not be obtained for one class of grade 7 students and a few of the grade 11 students. Consequently an alternative method was utilized. Instructional class grades and comments were used to classify a number of the subjects. Thus equal group sizes were not produced. This situation was rectified in the main study because students were included only if their IQ scores were accessible.

Since interval data for all subjects was not available, it was not possible to complete a Pearson product moment correlation coefficient, which describes the degree of relation between intelligence and field-dependency.

The scores attained by the low, average and high intelligence sub-groups are illustrated in Tables 9 and 10.

Table 9: Pilot Test Means by IQ for Grade 7 Subjects

		Immediate Test Mean	Delayed Test Mean
IQ	Low (N=19)	6.7	7.7
	Average (N=16)	8.9	9.5
	High (N=13)	13.5	13.4

Table 10: Pilot Test Means by IQ for Grade 11 Subjects

		Immediate Test Mean	Delayed Test Mean
IQ	Low (N=11)	13.1	13.1
	Average (N=11)	14.0	15.0
	High (N=14)	16.4	16.7

These tables reveal that the cognitive ability of the subjects was positively related to their performance on the criterion measures. The high ability students obtained higher grades irrespective of the time of the test and the grade level of the student.

A summary of the pilot test results is outlined below:

1. The measuring device consisted of four subtests that exhibited acceptable levels of homogeneity, inter-correlations and a test-retest reliability of 0.75.
2. No overall differences between the immediate and delayed test results were detected.
3. Most students who were classified as being in the high IQ group were also designated as being field-independent.
4. High IQ students performed consistently better than lower IQ students in all testing situations.
5. Field-independent students received higher scores than other groups in all testing situations.
6. There was a slight increase in test scores over time in the majority of cases.

The above statements were based on the entire pilot subject population.

APPENDIX E

ANALYSIS OF FINAL CRITERION TEST

Analysis of Final Criterion Test

Note: Any discrepancies in table totals are due to "rounding off" digits.

Table 1: Outline of Final Criterion Test

	Subtest	Description of Content	Questions
1	Knowledge	Questions based on both	
		audio knowledge	1, 2, 3, 14, 15, 16
		iconic knowledge	4, 7, 8, 10, 12, 19
2	Higher	Higher cognitive level subtest with questions based on application, analysis, synthesis and evaluation	
		audio high	6, 9, 11, 13 17, 18
		combined audio and iconic high	5, 20, 21, 22, 23, 24

Table 2: Main Study--Item Homogeneity and Test-Retest Reliability for Subtests and Total Test (N=610)

Measurement	Subtests 1	2	Total Test
Item Homogeneity	0.3	0.6	0.6
Test-Retest Reliability	0.3	0.6	0.7

Note: These test parameters were based on the total sample population of 610 students and not on the placebo group. If the placebo only results were used, the figures in the table would be higher. The figures reflect the effects of the treatments. The Kuder-Richardson formula (KR-20) was used to determine the values of the parameters.

Final Criterion Test

Table 3: Main Study--Subtest Correlations (Pearson Correlation Coefficients) for the Immediate Test Scores (N=450)

	Total Test	Subtest 1	Subtest 2
Total Test	1.0		
Subtest 1	0.3	1.0	
Subtest 2	0.8	0.9	1.0

Table 4: Main Study--Subtest Correlations (Pearson Correlation Coefficients) for the Delayed Test Scores (N=450)

	Total Test	Subtest 1	Subtest 2
Total Test	1.0		
Subtest 1	0.4	1.0	
Subtest 2	0.8	0.9	1.0

Table 5: Main Study--Means, Standard Deviations, and Standard Errors Derived from the Immediate and Delayed Tests (N=450)

	Immediate Test			Delayed Test		
Test	Mean	SD	SE	Mean	SD	SE
Subtest 1	7.6	1.7	1.5	7.5	1.8	1.5
Subtest 2	6.1	2.3	1.5	6.7	2.3	1.5
Total Test	13.7	3.3	2.4	14.2	3.5	2.3

Final Criterion Test

Table 6: Main Study--Analysis of Variance with Repeated Measure Based on Total Criterion Scores

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
Grade (A)	2440.33	1.	2440.33	238.05	0.00
Treatment (B)	321.58	2.	160.79	15.69	0.00
AB	53.22	2.	26.61	2.60	0.08
Ability (C)	1691.60	2.	845.80	82.51	0.00
AC	93.65	2.	46.83	4.57	0.01
BC	97.95	4.	24.49	2.39	0.05
ABC	76.47	4.	19.12	1.87	0.12
S-Within	4428.50	432.	10.25		
Time (D)	49.02	1.	49.02	19.46	0.00
AD	2.73	1.	2.73	1.09	0.30
BD	16.21	2.	8.11	3.22	0.04
ABD	1.56	2.	0.78	0.31	0.73
CD	5.18	2.	2.59	1.03	0.36
ACD	7.32	2.	3.66	1.45	0.24
BCD	17.09	4.	4.27	1.70	0.15
ABCD	3.42	4.	0.85	0.34	0.85
DS-Within	1088.44	432.	2.52		

Final Criterion Test

Table 7: Main Study--Analysis of Variance with Repeated Measure Based on Knowledge Subtest Scores

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
Grade (A)	337.34	1.	337.34	87.88	0.00
Treatment (B)	89.90	2.	44.95	11.71	0.00
AB	6.63	2.	3.31	0.86	0.42
Ability (C)	183.63	2.	91.82	23.92	0.00
AC	34.17	2.	17.09	4.45	0.01
BC	24.93	4.	6.23	1.62	0.17
ABC	18.41	4.	4.60	1.20	0.31
S-Within	1658.20	432.	3.84		
Time (D)	0.59	1.	0.59	0.52	0.47
AD	11.33	1.	11.33	10.10	0.00
BD	2.55	2.	1.28	1.14	0.32
ABD	10.43	2.	5.21	4.64	0.01
CD	5.11	2.	2.55	2.28	0.10
ACD	3.95	2.	1.97	1.76	0.17
BCD	7.83	4.	1.96	1.74	0.14
ABCD	7.84	4.	1.96	1.75	0.14
DS-Within	484.88	432.	1.12		

Final Criterion Test

Table 8: Main Study--Analysis of Variance with Repeated Measure Based on Higher Level Cognitive Subtest Scores

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Probability
Grade (A)	963.07	1.	963.07	195.27	0.00
Treatment (B)	73.94	2.	36.97	7.50	0.00
AB	48.68	2.	24.34	4.94	0.01
Ability (C)	766.74	2.	383.37	77.73	0.00
AC	14.78	2.	7.39	1.50	0.23
BC	28.06	4.	7.01	1.42	0.23
ABC	27.70	4.	6.92	1.40	0.23
S-Within	2130.66	432.	4.93		
Time (D)	60.32	1.	60.32	39.94	0.00
AD	2.89	1.	2.89	1.91	0.17
BD	8.41	2.	4.20	2.78	0.06
ABD	5.13	2.	2.56	1.70	0.18
CD	2.94	2.	1.47	0.97	0.38
ACD	0.73	2.	0.36	0.24	0.79
BCD	10.28	4.	2.57	1.70	0.15
ABCD	1.33	4.	0.33	0.22	0.93
DS-Within	652.48	432.	1.51		

Final Criterion Test

Table 9: Matrix Cell Means on Knowledge Subtest Scores (N=450)

Grade	Treatment	Low IQ		Average IQ		High IQ	
		Immed.	Delayed	Immed.	Delayed	Immed.	Delayed
7	AO	6.6	5.8	7.5	6.8	8.0	7.8
	IO	7.1	6.9	6.9	7.4	8.4	7.9
	P	5.6	5.2	6.6	6.9	7.5	7.0
11	AO	8.0	8.4	7.7	8.1	8.5	9.0
	IO	8.2	7.9	8.3	9.0	8.6	8.8
	P	7.5	7.2	8.6	8.0	7.9	8.2

Note: Immed. = Immediate Test

Table 10: Matrix Cell Means on High-level Cognitive Subtest (N=450)

Grade	Treatment	Low IQ		Average IQ		High IQ	
		Immed.	Delayed	Immed.	Delayed	Immed.	Delayed
7	AO	3.4	4.4	4.8	5.6	5.8	7.2
	IO	4.5	5.0	5.4	5.8	6.6	7.2
	P	3.6	3.8	4.7	5.2	6.6	6.8
11	AO	7.0	7.3	7.3	7.2	8.9	9.9
	IO	6.3	7.2	7.4	7.6	8.0	8.6
	P	5.6	5.7	6.9	7.4	7.6	7.8

Note: Immed. = Immediate Test

APPENDIX F

TEACHERS' INSTRUCTIONS (AND STUDENT ACTIVITIES)

TEACHERS' INSTRUCTIONS

DAY 1

(Time allotment 5 min.)

1. Tell the students not to turn over or read their sheets until they are told to do so.

2. Distribute preinstructional strategy sheets (face down) to all students.

3. Read the following statement:

   I would like you to read what I am handing out. Don't worry if your neighbour has a different sheet than you. It is not important. What is important is that you read the sheets carefully. They may help you to understand the television program that you are going to see in a couple of days.

   You have only two and a half minutes to read it, so get started.

4. Give the students 2 minutes to read their sheets.

5. After 2 minutes ask the students to print their school, teacher, class, name and grade in the space provided. They must then turn their sheets face down.

6. Collect the printed sheets. Ensure that each sheet has the student's name, grade and class written at the top of each sheet.

Thanks! Without you this project could not have materialized.

TEACHERS' INSTRUCTIONS

DAY 2

(Time allotment 40 min.)

1. Tell the students not to turn over or read their [illegible] they are told to do so.

2. Distribute the preinstructional strategy sheets (face down). Ensure that students receive the sheets that have their name on it.

3. Read the following statement:

   Today we are going to see a television program on ecology. The information on the printed sheets may help you to understand the program.

   At the end of the program, you will be given a twenty-four question multiple-choice test. The scores that you receive on the test will be posted but will not be included in your final course grade. However, basic information presented in the television program will be included in your final class tests. It is expected that you will do your best.

   You have only two and a half minutes to read the printed sheets before we see the television program. Please read carefully.

4. Give the students 2 minutes to read their sheets.

5. At the end of 2 minutes have the students place their sheets face down.

6. Collect the printed sheets.

7. Start the videocassette player which has been set up by the researcher.

8. At the end of the television program, distribute a multiple-choice test, answer sheet and pencil to each student. Ask the students to read the instructions on page one. They must not start the test until they are told to do so.

9. Review the test instructions on page one. Ensure that all students understand the instructions. Tell the students to begin.

10. While students are completing the test, ensure that they have their name, sex, grade and birthdate printed on the left side of the answer sheet.

11. After 20 minutes, instruct the students to stop working and collect their answer sheets, test papers and pencils.

Thank you for your cooperation.

TEACHERS' INSTRUCTIONS

DAY 3

(Time allotment 40 min.)

1. Distribute a multiple-choice test, answer sheet and pencil to each student. Ask the students to read the instructions on page one. They must not start until they are told to do so.

2. Review the test instructions on page one.

3. Read the following statement:

   > This is a short test that will enable me to determine what you have learned about ecology. This test will not be counted towards your final mark, however your scores will be posted.
   >
   > You have exactly twenty minutes to complete this test.

4. While students are completing the test, ensure that they have their name, sex, grade and birthdate printed on the left side of the answer sheet.

5. After 20 minutes, tell the students to stop working and collect their answer sheets, test papers and pencils.

6. Distribute the Student Questionnaire. Ask the students to fill in the questionnaire as completely as possible. They must not write in the column on the right side of the sheet. They may write on the back of the sheet if they need more space.

7. After the students have completed the questionnaire, collect all sheets. Ensure that they have printed their school, teacher, name, grade and class in the pace provided at the top of the sheet.

Your assistance in this project is greatly appreciated.

APPENDIX G

STUDENT AND TEACHER QUESTIONNAIRES

STUDENT QUESTIONNAIRE

SCHOOL_____ TEACHER_____ CLASS___ NAME_____ GRADE___

DO NOT WRITE IN THIS SPACE

1. What was the title of the written material that you saw before the film?

   AO_____ IO_____ P _____ 1_____1

2. Since September, how many films or television programs have you seen in all of your courses?

   0___1-3___4-6___7-9___10-12___more than 12___ 2_____2

3. Did you see this television program before?

   Yes___No___ 3_____3

4. Did you enjoy the program? Yes___No___ 4_____4

5. a) What did you like about the program? 5a_____5

   b) What two points do you remember most clearly? 5b_____6

6. What were the main ideas in the program? 6_____7

7. You received some printed information before you viewed the television program.

   a) Did it help you to understand the television program? Yes___No___ 7a_____8

   b) Did it help you to answer the test questions? Yes___No___ 7b_____9

   c) Would you like to use similar material with other lessons? Yes___No___ 7c_____10

TEACHER QUESTIONNAIRE.

SCHOOL_____ CLASSES_____ NAME_____ GRADE_____

DO NOT WRITE IN THIS SPACE

1. a) How many times has this class seen an instructional film or television program in this course?

   0___ 1-3___ 4-6___ 7-9___ 10-12___ more than 12___ | 1a_____1

   b) How many films or television programs do you plan to use in this course?

   0___ 1-3___ 4-6___ 7-9___ 10-12___ more than 12___ | 1b_____2

2. a) Have you used this program in your class before? Yes___ No___ | 2a_____3

   b) Now that you have seen it, would you use it with future classes? Yes___ No___ | 2b_____4

3. a) Does the program have an instructional value? Yes___ No___ | 3a_____5

   b) Does the program fit within the provincial curriculum guidelines? Yes___ No___ | 3b_____6

   c) Does the program fit into your course outline? Yes___ No___ | 3c_____7

4. What do you feel were the main concepts presented in the program? | 4_____8

5. In general, do you think that written preinstructional strategies would be beneficial for a class setting? Yes___ No___ | 5_____9

6. For the grade level that you teach, which ability level(s) of students would benefit most from the use of:

	Ability	
advance organizers(AO):	low___ average___ high___	6a_____10
instructional objectives (IO):	low___ average___ high___	6b_____11
placebo (P):	low___ average___ high___	6c_____12

7. a) If the preinstructional strategies were found to improve student learning, would you use them? Yes___ No___ | 7a_____13

   b) If these strategies were provided with each piece of instructional material, would you use them? Yes___ No___ | 7b_____14

8. Did you think that students in your class had difficulty in understanding the:

   a) television program? Yes___ No___ | 8a_____15
   b) preinstructional strategies? Yes___ No___ | 8b_____16
   c) test? Yes___ No___ | 8c_____17
   d) questionnaire? Yes___ No___ | 8d_____18

   If you indicated no to any of the above, please explain.

APPENDIX H

RESPONSES TO STUDENT QUESTIONNAIRE

RESPONSES TO STUDENT QUESTIONNAIRE

Question		Grade 7 AO (n=75)	Grade 7 IO (n=75)	Grade 7 P (n=75)	Grade 7 Mean (n=225)	Grade 11 AO (n=75)	Grade 11 IO (n=75)	Grade 11 P (n=75)	Grade 11 Mean (n=225)
1. What was the title of the written material that you saw?		100%	100%	100%	---	100%	100%	100%	---
2. Since September, how many films or television programs have you seen in all your courses?	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	1-3	5.3%	4.0%	4.0%	4.4%	5.3%	9.3%	5.3%	6.6%
	4-6	13.3%	6.7%	14.7%	11.6%	8.0%	12.0%	18.7%	12.9%
	7-9	20.0%	16.0%	20.0%	18.7%	17.3%	17.3%	13.3%	16.0%
	10-12	18.7%	26.7%	13.3%	19.6%	17.3%	20.0%	17.3%	18.2%
	more than 12	42.7%	46.7%	48.0%	45.8%	52.0%	41.3%	45.3%	46.2%
3. Did you see this television program before?	yes	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	no	100%	100%	100%	100%	100%	100%	100%	100%
4. Did you enjoy the program?	yes	86.7%	85.3%	88.0%	86.7%	96.0%	93.3%	96.0%	95.1%
	no	13.3%	14.7%	12.0%	13.3%	4.0%	6.7%	4.0%	4.9%

STUDENT QUESTIONNAIRE

Questions 5 and 6

A selection committee and the researcher determined the key ideas presented in the video-displayed program. These key concepts were used to classify the students' written responses to questions 5 and 6. The columns to the right indicate the number of students who wrote responses similar to the ones noted on the left. The three treatment groups are identified by the symbols AO, IO and P which represent respectively the advance organizer, instructional objectives and placebo. Each treatment group consisted of 75 subjects.

STUDENT QUESTIONNAIRE

Question 5a: What Did You Like About the Program?

Comments Associated with Key Ideas	Frequency of Response Grade 7 AO	IO	P	TOTAL	Grade 11 AO	IO	P	TOTAL
1. Wolves exhibit major characteristics that distinguish them from other animals but also demonstrate minor characteristics that distinguish them from other wolves.								
Wolves' lifestyle/behaviors/habits	8	0	2	10	11	10	8	29
Wolf pups/pups are cute	13	14	12	39	3	7	4	14
Wolves	5	7	5	17	0	1	0	1
Similarities wolves share with humans	0	0	0	0	1	1	1	3
Role of leader	0	0	1	1	0	1	0	1
How wolves move from one place to another	0	0	1	1	0	0	0	0
2. Wolves perform fundamental processes that sustain and perpetuate life.								
Raising/caring for pups	3	5	3	11	3	3	1	7
- mating	1	3	1	5	1	1	0	2
- birth of pups	1	5	5	11	0	0	0	0
- mother protecting pups	2	3	2	7	0	0	0	0
- mother moving pups	0	4	4	8	0	0	0	0
- pup carrying leg of animal	2	3	2	7	0	0	0	0
- pups playing	0	4	4	8	0	0	0	0
- teaching the pups	1	0	0	1	0	1	0	1
Building/cleaning the den	0	0	0	0	1	1	1	3
The way the wolves hunt and kill their prey	5	8	9	22	0	6	0	6
Explains why wolves kill	0	0	1	1	0	1	0	1
How wolves survive	1	1	3	5	0	0	2	2
Wolves need to think to survive	0	0	0	0	1	1	0	2
3. Wolves interact with their environment and are dependent on its biotic and abiotic interactions.								
Relationship among wolves, caribou, nature and photographer	0	0	0	0	1	0	1	2
Wolves adapt to surroundings	0	0	0	0	0	0	1	1

STUDENT QUESTIONNAIRE

Question 5a Continued

Comments Associated with Key Ideas	Frequency of Response Grade 7 AO	IO	P	TOTAL	Grade 11 AO	IO	P	TOTAL
4. Other								
Informative/educational	12	13	10	35	23	24	23	70
- easy to understand	1	1	1	3	1	3	3	7
Interesting/enjoyable/entertaining	12	7	4	23	19	16	20	55
Good filming/photography	1	3	0	4	7	4	3	14
- filmed in natural surroundings, not a zoo	3	0	1	4	9	2	4	15
- the scenes	0	1	1	2	2	0	3	5
- the closeness of the wolves	0	0	0	0	1	3	2	6
Everything	0	2	0	2	3	1	2	6
The reality of their lifestyles clear away the myths	2	1	0	3	3	0	0	3
I like wolves	14	2	4	20	5	4	2	11
How free wolves are	0	0	0	0	1	0	1	2
I like animal/wildlife films	3	3	3	9	2	3	5	10
Tests how we listen	0	1	0	1	0	0	0	0
Wolves having dinner were disgusting	0	0	1	1	0	1	0	1
I didn't like the program/nothing/ waste of time	2	1	1	4	0	2	2	4
I missed science	2	1	2	5	0	0	0	0
I don't know	0	1	0	1	0	0	0	0
Poorly directed production	0	0	0	0	1	0	0	1

STUDENT QUESTIONNAIRE

Question 5b: What Two Points Do You Remember Most?

Comments Associated with Key Ideas	Frequency of Response Grade 7 AO	IO	P	TOTAL	Grade 11 AO	IO	P	TOTAL
1. Wolves exhibit major characteristics that distinguish them from other animals but also demonstrate minor characteristics that distinguish them from other wolves.								
Lifestyle/behaviour of wolves	1	2	1	4	3	2	1	6
Social structure of pack wolf	0	3	2	5	7	2	2	11
- wolves stick together	2	0	0	2	0	1	1	2
- they run in packs	5	4	2	11	0	1	0	1
Role of leader(s)	1	5	4	10	13	9	3	25
- tail of male leader is high	6	8	4	18	10	10	9	29
- dominant leader is male	0	1	1	2	0	2	3	5
- leader and mate eat first	10	5	7	22	12	6	5	23
- only leaders mate (for life)	2	0	0	2	7	7	11	25
The pups	9	5	7	21	8	4	2	14
- newborn pups can't see for a few days	2	1	0	3	0	0	0	0
Similarity to other animals e.g. dogs	1	0	0	1	0	1	0	1
Similarity to humans	0	0	0	0	0	0	1	1
Wolves are intelligent	0	0	0	0	0	0	1	1
Wolves are good parents	0	0	1	1	0	0	0	0
Male shows jealousy	0	0	0	0	0	0	1	1
What wolves look and sound like	2	1	4	7	0	0	0	0
Wolves don't hibernate	1	1	0	2	0	0	0	0
Wolves mark their territory	1	0	0	1	0	2	0	2
When they are running in the woods	5	4	2	11	0	1	0	1
2. Wolves perform fundamental processes that sustain and perpetuate life.								
Stalking and hunting caribou and deer/getting food	27	23	24	74	32	33	38	103
- hunting in a group	1	1	0	2	1	0	0	1
- feeding on deer	1	2	1	4	4	1	2	7
- dead animals	0	1	0	1	0	0	0	0
- pups killing beaver	1	1	0	2	0	0	0	0
- wolves let prey know they are there	1	0	0	1	0	1	0	1
- wolves are killers	1	0	0	1	0	0	0	0
Raising/caring of pups	3	6	8	17	9	8	10	27
- mating	5	8	4	17	3	2	4	9
- mating one time of the year	2	0	0	2	0	0	2	2
- birth of pups	10	18	16	44	15	7	18	40

STUDENT QUESTIONNAIRE

Question 5b: What Two Points Do You Remember Most?

Comments Associated with Key Ideas	Frequency of Response Grade 7 AO	IO	P	TOTAL	Grade 11 AO	IO	P	TOTAL
- more than one pup is born at a time	0	1	0	1	0	0	0	0
- pups and mother in den	2	3	3	8	5	8	4	17
- pups that get milk first survive	3	0	3	6	0	1	0	1
- mother taking care of pups	0	3	0	3	2	4	1	7
- mother/father supply regurgitated food	3	3	0	6	5	4	2	11
- mother doesn't leave den to get food	1	0	0	1	0	0	0	0
- other wolves bring food to mother	4	0	0	4	0	1	1	2
- moving pups from den to den/ pups left behind	4	2	10	16	3	3	4	10
- last pup to leave den will probably die	0	0	1	1	0	0	0	0
- pups are young for a short time	0	0	0	0	0	1	0	1
- pups feeding (with leg of an animal)	1	1	2	4	2	1	2	5
- pups playing around	0	2	0	2	2	3	2	7
- teaching pups to hunt	3	1	4	8	1	4	1	6
- teaching pups the rules of the pack	0	0	0	0	0	1	1	2
- 3 out of 5 pups survive	4	2	2	8	5	2	3	10
Cleaning/making their den/home	7	5	7	19	1	4	1	6
- they return to the same den each year	0	0	0	0	0	0	1	1
Predators kill wolf pups	0	0	0	0	1	0	1	2
Survival of the wolves	1	0	0	1	1	1	1	3
3. Wolves interact with their environment and are dependent on its biotic and abiotic interactions.								
Wolves' environment	0	1	0	1	1	0	2	3
Snow and winter affect wolves	1	1	3	5	2	0	0	2
Wolves are functional units of the ecosystem	0	0	0	0	1	0	1	2
Wolves keep caribou healthy	1	0	0	1	0	0	0	0
- wolves eat sick animals	0	0	1	1	0	0	0	0
Wolves are not all bad	0	1	0	1	0	1	0	1
4. Other.								
Missed science	0	0	1	1	0	0	0	0
I don't remember anything	1	0	0	1	0	0	0	0

STUDENT QUESTIONNAIRE

Question 6: What Were the Main Ideas in the Program?

Comments Associated with Key Ideas	Frequency of Response Grade 7 AO	IO	P	TOTAL	Grade 11 AO	IO	P	TOTAL
1. Wolves exhibit major characteristics that distinguish them from other animals, but also demonstrate minor characteristics that distinguish them from other wolves.								
Social structure/behavioral patterns of pack	3	4	3	10	9	7	9	25
- roles of members of the pack	1	1	0	2	3	1	2	6
- live as family unit/help each other	0	0	0	0	4	3	2	9
- pups	2	4	4	10	0	0	0	0
- individuality of wolves	1	0	0	1	1	2	0	3
- leader has authority	1	0	0	1	3	3	0	6
- description of leader	0	0	0	0	1	3	0	4
- responsibility of leader	0	0	0	0	0	1	1	2
- male domination	0	0	0	0	2	0	1	3
Habits of wolves	0	0	2	3	10	6	6	22
- lifestyle/lifecycle/how they live	20	22	15	57	17	12	20	49
- instinctive, distinctive behavior	1	0	0	1	4	0	1	5
- everyday habits of wolves	1	0	2	3	2	4	4	10
- how they live in wilderness	2	2	5	9	2	8	1	11
- wolves can think	0	0	0	0	0	1	0	1
- wolves can communicate	0	0	0	0	0	1	0	1
Wolves are like humans	0	3	0	3	6	8	1	15
Shows gentle and vicious sides	0	0	0	0	0	0	1	1
2. Wolves perform fundamental processes that sustain and perpetuate life.								
Survival of the fittest/learning to survive	20	23	21	64	28	27	21	76
- competition	0	0	0	0	3	1	2	6
Hunting/need to kill in order to survive	8	8	11	27	15	15	13	43
- feeding habits/obtaining food	12	7	6	25	9	5	5	19
- pups getting beaver	1	0	0	1	0	0	0	0
Reproduction and growth	0	3	1	4	0	1	2	3
- mating	6	12	3	21	10	15	12	37
- gestation	0	0	0	0	0	0	1	1
- birth of pups	2	5	2	9	5	2	4	11

STUDENT QUESTIONNAIRE

Question 6 - continued

Comments Associated with Key Ideas	Frequency of Response Grade 7 AO	IO	P	TOTAL	Grade 11 AO	IO	P	TOTAL
- caring, raising and growth of pups	13	10	10	33	10	13	10	33
- protecting pups	0	0	0	0	5	0	0	5
- teaching pups	0	0	0	0	2	0	0	2
- only a few pups survive	0	0	0	0	0	1	1	2
Habitat								
- where they live/living conditions	1	2	3	6	0	3	0	3
- making a den	4	2	2	8	0	1	1	2
- move from place to place	0	0	1	1	2	0	0	2
Laws wolves live by	0	0	0	0	0	1	1	2
Adapting to environment	0	1	0	1	0	0	1	1
3. Wolves interact with their environment and are dependent on its biotic and abiotic interactions.								
Interaction with animals and plants	2	4	1	7	5	0	3	8
Balance in nature	1	0	0	1	6	2	3	11
- control of population	0	0	0	0	0	1	3	4
- there are a few wolves	1	0	0	1	0	0	0	0
- wolf population decreasing	0	0	1	1	0	0	0	0
- caribou population decreasing	0	0	1	1	0	0	0	0
Importance of wolves in nature	0	1	0	1	5	0	0	5
- wolves part of food chain	0	0	0	0	0	1	1	2
- wolves eat sick and weak caribou	0	0	1	1	0	1	0	1
Environmental conditions affect wolves	1	1	0	2	5	2	0	7
- survival in winter and summer	0	0	3	3	2	1	1	4
- natural surroundings of wolves	1	0	1	2	3	2	0	5
Problems wolves have	0	0	0	0	0	0	1	1
4. Other.								
Help us to learn about wolves/make people more aware of wolves	4	2	2	8	1	1	2	4
A legend was dismissed - wolves don't attack humans	0	1	0	1	1	1	1	3
Wolves are dangerous creatures	0	0	0	0	0	0	1	1
Wildlife	1	0	0	1	0	0	0	0
To see if I can remember	1	0	1	2	0	0	0	0
I can't remember	2	0	0	2	0	0	0	0

STUDENT QUESTIONNAIRE

ANALYSIS OF RESPONSES TO QUESTIONS 5a, 5b and 6

QUESTION 5a What did you like about the program?

1. As expected, the grade 11 students were more articulate in their responses. In addition, they produced a wide variety of responses.
2. Based on the combined responses of the two grades, the video-displayed program was regarded as being informative, educational, interesting and enjoyable.
3. A number of grade 11 and 7 students liked the program because they liked the wolves and the description of their life style.
4. Grade 11 subjects were also interested in the film because the photography and natural surrounding of the wolves impressed them.
5. Grade 7 students were particularly attracted by the cuteness of the wolf pups.

QUESTION 5b What two points do you remember most?

1. A wide variety of factual information was produced in response to this question.
2. The primary focus of the students' attention was directed to the topics listed below (in descending order of importance);
   a. stalking and hunting caribou and deer,
   b. birth and the raising of pups, and
   c. role of the leader.
3. Only a few high cognitive level responses were given. Those that were, were primarily those that concerned the interaction of the wolves to the environment.

4. The AO and IO treatments created a larger variety of responses than the placebo treatment for the grade 11 subjects.
5. All treatments yielded roughly the same variety of responses for the grade 7 students.

QUESTION 6 What were the main ideas in the program?

1. The main ideas of the program were clearly defined by the students in both grades. They are written below (in order of descending importance):
   a. life style/cycle of wolves,
   b. survival of the fittest,
   c. hunting and feeding habits,
   d. caring and raising of the young, and
   e. mating.
2. The students in both grades who received an advance organizer were better able to state how wolves interact with the biotic and abiotic components. The grade 11 students produced twice as many of these kind of responses than either the IO or P group. This finding is in agreement with the test scores which demonstrated that the advance organizer appeared to foster the development of higher concepts. For question 6c, these students indicated that the program covered (in order of importance):
   a. balance of nature,
   b. environmental conditions affect wolves, and
   c. interaction with animals and plants.

RESPONSES TO STUDENT QUESTIONNAIRE
(continued)

Question		Grade 7 AO (n=75)	Grade 7 IO (n=75)	Grade 7 P (n=75)	Grade 7 Mean (n=225)	Grade 11 AO (n=75)	Grade 11 IO (n=75)	Grade 11 P (n=75)	Grade 11 Mean (n=225)
7. You received some pointed information before you viewed the televison program.									
a) Did it help you to understand the television program?	yes	80.0%	62.7%	28.0%	---	80.0%	70.7%	1.3%	---
	no	20.0%	37.3%	72.0%	---	20.0%	29.3%	98.7%	---
b) Did it help you to answer the test questions?	yes	61.3%	62.7%	30.7%	---	68.0%	66.7%	2.7%	---
	no	38.7%	37.3%	69.3%	---	24.0%	32.0%	97.3%	---
c) Would you like to use similar material with other lessons?	yes	84.0%	64.0%	46.7%	---	80.0%	78.7%	29.3%	---
	no	16.0%	36.0%	53.3%	---	20.0%	21.3%	70.7%	---

APPENDIX I

RESPONSES TO TEACHER QUESTIONNAIRE

RESPONSES TO TEACHER QUESTIONAIRE

Note: Responses to question 6 are presented after question 8.

			Grade 7 (n=7)	Grade 11 (n=7)	Mean (n=14)
1.	a)	How many times has this class seen an instructional film or television program in this course? 1-3	42.9%	71.4%	57.2%
		4-6	57.1%	28.6%	42.9%
	b)	How many films or television programs do you plan to use in this course? 4-6	28.6%	14.3%	21.5%
		7-9	14.3%	42.9%	28.6%
		10-12	57.1%	0.0%	28.6%
		more than 12	0.0%	42.9%	21.5%
2.	a)	Did you use this program in previous classes? yes	14.3%	0.0%	7.2%
		no	85.7%	100%	92.9%
	b)	Now that you have seen it, would you use it with future classes? yes	85.7%	71.4%	78.6%
		no	14.3%	28.6%	21.5%
3.	a)	Does the program have an instructional value? yes	85.7%	100%	92.9%
		no	14.3%	0.0%	7.2%
	b)	Does the program fit within the provincial curriculum guidelines? yes	100%	71.4%	85.7%
		no	0.0%	28.6%	14.3%
	c)	Does the program fit into your course outline? yes	85.7%	71.4%	78.6%
		no	14.3%	28.6%	21.5%
4.		What do you feel were the main concepts presented in the program? (Note: A selection committee and the researcher determined the key ideas presented by the video-displayed program. These are listed below. The columns to the right indicate the portion of teachers who produced open-ended responses that were in agreement with the key ideas listed.)			
	a)	Wolves exhibit major characteristics that distinguish them from other animals but also demonstrate minor characteristics that distinguish them from other wolves.	57.1%	71.4%	64.3%

RESPONSES TO TEACHER QUESTIONAIRE

Note: Responses to question 6 are presented after question 8.

			Grade 7 (n=7)	Grade 11 (n=7)	Mean (n=14)
	b)	Wolves perform fundamental processes that sustain and perpetuate life.	57.1%	71.4%	64.3%
	c)	Wolves interact with their environment and are dependent on its biotic and abiotic interactions.	42.9%	85.7%	64.3%
		The concept written below was supplied by one teacher. It did not fit within the framework of three key ideas presented above.			
	d)	The wolf is very different from the popular myth.			
5.		In general, do you think that written preinstructional strategies would be beneficial for a class setting? yes	100%	100%	100%
		no	0.0%	0.0%	0.0%
7.	a)	If the preinstructional strategies were found to improve student learning, would you use them? yes	100%	100%	100%
		no	0.0%	0.0%	0.0%
	b)	If these strategies were provided with each piece of instructional material, would you use them? yes	100%	100%	100%
		no	0.0%	0.0%	0.0%
8.		Do you think that students in your class had difficulty in understanding the:			
	a)	television program? yes	0.0%	0.0%	0.0%
		no	100%	100%	100%
	b)	preinstructional strategies? yes	28.6%	0.0%	14.3%
		no	71.4%	100%	85.7%
	c)	test? yes	14.3%	0.0%	7.2%
		no	85.7%	100%	92.9%
	d)	questionnaire? yes	0.0%	0.0%	0.0%
		no	100%	100%	100%

TEACHER QUESTIONNAIRE

ADDITIONAL COMMENTS

Comments made in response to question 8 of the Teacher Questionnaire.

Grade 7 Teacher Responses

Teacher 1: Preinstructional strategies most likely had no effect on them. They are used to them, but in a much different manner.

Teacher 2: If there was any difficulty (in the study materials) it would be in receiving the preinstructional materials and not being entirely sure of what was expected of them as this was a fairly novel experience.

Grade 11 Teacher Responses

Teacher 3: Time is a major factor in the application of these strategies. There is not enough classroom time to use them.

Teacher 4: Students were confused about why they were reading the preinstructional strategy sheets, not the content therein.

Teacher 5: No, (the students understood the television program), but I use "Death of a Legend" which is longer and better in terms of information covered. (Note: "Death of a Legend" is a 58 minute film produced by the National Film Board of Canada. It covers not only the ecology of wolves, but also emphasizes man's fear of the animal, man's cruelty to wolves and the need to conserve the wolf population.)

Teacher 6: I think all items were all simple enough for grade 11 students.

TEACHER QUESTIONNAIRE

6. For the grade level that you teach, which ability level(s) of students would benefit most from the use of:

Grade 7 Response Frequencies

	Ability		
Advance organizer (AO):	low 5*	average 2	high 2
Instructional objectives (IO):	low 1	average 4	high 3
Placebo (P):	low 1	average 0	high 2

Grade 11 Response Frequencies

	Ability		
Advance organizer (AO):	low 0	average 2	high 3
Instructional objectives (IO):	low 3	average 5	high 1
Placebo (P):	low 0	average 1	high 1