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An Investigation of the Role of Quantitative and Qualitative Objectives and Delayed Feedback in Prose Learning

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AN INVESTIGATION OF THE ROLE OF
QUANTITATIVE AND QUALITATIVE OBJECTIVES
AND DELAYED FEEDBACK IN PROSE LEARNING

by

Lawrence A. Biro

A Dissertation Submitted to the Graduate Faculty
of the School of Education of Loyola University of Chicago
in Partial Fulfillment of the Requirements for the Degree of
Doctor of Education

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1981
The overall premise of the present investigation was that qualitative objectives presented to subjects prior to reading prose material would enhance learning and that the addition of quantitative objectives would further enhance learning. The subjects consisted of all students enrolled in two classes of a small school of practical nursing located in Chicago who were randomly assigned to four treatment groups (quantitative objectives only, qualitative objectives only, quantitative and qualitative objectives, and no objectives). Each treatment group was given one type of a combination of the objectives previously mentioned along with a prose passage. After reading the prose material all subjects took a posttest of comprehension. One half of each group then received feedback immediately on their test performance and the other half received feedback 24 hours later. It was hypothesized that there was a significant relationship between type of feedback, (immediate and delayed) and type of objectives (quantitative only, qualitative only, quantitative and qualitative, and no objectives).
tives) and the degree of relevant and incidental prose learning assessed by the posttest of retention. Specifically, it was hypothesized that delaying feedback would enhance learning prose material when used in conjunction with quantitative and qualitative objectives. Overall, the results indicated that the provision of quantitative and qualitative objectives improved learning of prose material. That is to say, that those subjects receiving both quantitative and qualitative objectives scored higher on a posttest of retention for relevant learning than those receiving qualitative, quantitative or no objectives. It is interesting to note that the second highest scorers on relevant learning were the qualitative objectives only group. However, there was no significant difference in incidental learning. On the other hand, there were significant differences between types of learning (relevant and incidental) with the combination of quantitative and qualitative objectives and qualitative objectives groups demonstrating significant differences between relative and incidental learning. There was also a significant interaction effect between type of learning and type of objective. These results are generally consistent with other studies which continue to show that instructional objectives are an effective aid to prose learning.

Unfortunately, the exploratory component of the experiment which investigated the effects of feedback on the
retention of prose material revealed no significant difference between the posttest of retention scores for those subjects in the delayed versus the immediate feedback subgroups. Perhaps this lack of significant findings was due to the fact that academic material unfamiliar to the subjects was used. Also, completion type questions were used in the posttest and the subjects could perhaps not fully process the information. Individual difference variables such as anxiety, sex, IQ, and achievement may have had an effect on the outcome of the feedback. Finally, the type of feedback provided may have been inappropriate for the type of learning task.
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VITA

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INTRODUCTION

A major area of interest to educational psychologists is investigating ways to improve classroom instruction. Educational psychologists who have worked in this area have investigated many different methods of instruction such as computer assisted instruction (Seltzer, 1971; Shurdak, 1967; Suppes, 1968; Suppes & Morningstar, 1969), programmed instructional television (Brown, Brown & Danielson, 1975; Chu & Schramm, 1967; Dublin & Hedley, 1969), and prose learning (Anderson & Myrow, 1971; Frase, 1969a, 1969b, 1972; Jenson & Anderson, 1970; Meyers, Pezdek & Coulson, 1973; Stolurow, 1973). Recently, prose learning has been the object of a great deal of research for several reasons. First, it is still one of the most widely used methods of instruction. Second, it is one of the most interesting and most easily studied methods of instruction because it capitalizes on already existing writing skills. Finally, it is fairly inexpensive and one of the easiest methods to implement in naturalistic educational settings.

Several variables have been investigated in an effort to facilitate learning from prose. For the most part, research has looked at such things as meaningfulness of prose material (Johnson, 1973), organization of the total passage
and paragraphs (Frase, 1969a, 1970, 1973; Gagnè & Rothkopf, 1975; Meyers et al., 1973), and use of questions and other ways of directing students' attention to the material to be learned (Ausubel, 1980; Blaney & McKie, 1969; Dalis, 1970; Faw & Waller, 1976; Hartley & Davies, 1976; Kaplan, 1974, 1976; Kaplan & Simmons, 1974; LaPorte & Nath, 1976; Mayer, 1979, 1980; Rothkopf & Kaplan, 1972). This directing, or mediating of student processes, goes beyond merely looking at the structure of instructional material, but also systematically examines the instructions or guidelines the student is given in using the material. One element of this type of research is the investigation of the use of objectives in conjunction with prose material to improve student comprehension. From this research with both quantitative and qualitative objectives, has come the general acceptance of the idea that objectives placed at the beginning of prose material "directs" the student to the relevant material within the passage.

The overall purpose of the present study was to investigate whether quantitative or qualitative objectives, or a combination of both would enhance prose learning and retention. A quantitative objective is an objective which states a goal to be met on a test of comprehension such as: "After you read this material, you should be able to get 18 out of 20 correct on a test". A qualitative objective is an objective that instructs the student to learn certain elements of
the instructional material. For example: "You will be able to list the 13 original colonies". In addition, the present study examined whether performance on retention was better if feedback on the objectives was immediate or delayed. Furthermore, for the purpose of identifying the learning related to objectives, the amount of learning was divided into two types: objective relevant learning and incidental learning. Objective relevant learning is material that is related directly to the stated qualitative objective (those items the student has been directed to learn). Incidental learning is any other material the student may learn but was not directed to do so by the stated qualitative objectives.

Specifically, the present study was designed to test the following informally stated hypotheses. First, will students who are given either quantitative or qualitative objectives or a combination of both learn more from prose material and thus perform better on a posttest of comprehension than those students who do not receive objectives? Second, will students who receive both quantitative and qualitative objectives perform better on a posttest of comprehension than those receiving only one type of objective? Third, will students who receive both quantitative and qualitative objectives exhibit both objective relevant and incidental learning? Fourth, do qualitative objectives facilitate learning by providing direction for that learning? Finally, will retention of material be greater when feedback
on accomplishment of objectives is delayed?

These hypotheses were tested by randomly dividing the subjects into four treatment groups. Each group was given a passage to read with one of the four treatments: (a) quantitative objectives only, (b) qualitative objectives only, (c) qualitative and quantitative objectives or (d) no objectives. The subjects were then given a test of comprehension and their results were compared as to the relative amount of objective relevant learning and incidental learning. Half of each group received immediate feedback of test results while the other half received results 24 hours later. Seven days later both groups responded to another test of retention.

The potential educational implications for this research are many. First, the original purpose of instructional psychology was to facilitate learning within the formal classroom setting. The identification of which type of objective (quantitative or qualitative) leads to better comprehension of the material should facilitate learning. Instructional materials could then be produced that incorporate the most efficient type of instructional objective. Students would then have another tool that would aid them in their acquisition of the material being presented. In addition, objectives could be used in a way that would allow the student to progress at his own pace since he would know whether or not he had obtained the objective relevant mate-
rial with the necessary scores. There also is the implication of ease and efficiency of instruction. If it is shown that students not only need qualitative goals but also quantitative goals, it would not be difficult or extremely complicated for a teacher to ensure that a student had a concrete quantitative goal to achieve for each block of subject matter he or she had to master. Finally, one could also facilitate retention of learned material if it could be determined when is the optimal time to inform the student of his or her level of comprehension of the material as measured through testing. If retention can be enhanced by delaying this feedback it would be relatively easy to use this method to help the student learn.

Generally, this research project attempted to further explain how students learn from prose material. Previous research has looked at content, organization, and how the prose material is presented to the student. The area to be investigated in the present study is to determine how objectives can best be used to facilitate the presentation of prose material to students to enhance school learning. More specifically, the primary focus of the present study is on what type of objective (quantitative or qualitative) most efficiently directs the student to the relevant material within the passage and thus results in improved performance on a posttest of comprehension. This study also examined whether immediate feedback or delayed feedback of objective
attainment was more effective. Hopefully, this study will yield results that will provide yet another tool that will improve the quality of time the student spends learning in the classroom.
REVIEW OF RELATED LITERATURE

In an effort to improve learning and retention of prose material, the instructional psychologist has traditionally looked at three elements: the content of the material, its organization, and its presentation to the learner. How prose material is presented to the learner has proven to be a very promising way to improve the quality of instructional material. This review of the literature focuses on this third element, the manner in which the material is presented to the learner, and more specifically on how the instructional objective, a statement made to the student telling him what knowledge he is to gain from an instructional experience, can be used to direct the student to relevant or important material. First of all, the literature which discusses research investigating the use of objectives to enhance school learning is reviewed. This section presents a general theoretical discussion related to the use of objectives in school learning situations. The second area to be presented focuses on relevant and incidental learning. Finally, the delayed-retention effect (DRE), as it relates to the use of objectives, is reviewed. In all instances, both theory and relevant research are systematically addressed.
Utilizing Objectives to Enhance School Learning and Retention

The use of objectives in instructional design to enhance learning evolved from the work of B. F. Skinner. In his book, *The Behavior of Organisms* (1938), Skinner proposed a formulation of behavior that could be applied systematically to the process of instructional design. The basic tenet of his approach was that complex behavior, thinking and problem solving, when properly analyzed, could be interpretable in terms of a complex interplay of fundamental learning concepts and principles (Hilgard & Bower, 1975).

From Skinner's basic theoretical framework, a movement to develop a technology of instructional design was developed. One of the first publications, *Teaching Machines and Programmed Learning* by Lumsdaine and Glaser, related to the behavioral investigation of instruction was published in 1960. This book presented a collection of articles dealing with the application of teaching machines to various learning situations and the programming of these machines. A follow-up volume, *Teaching Machines and Programmed Learning II, Data and Directions* edited by Glaser (1965), discussed the theory, technology and implementation of teaching machines and programmed learning.

More recently, several models have been developed for the design of instructional material. Anderson and Faust
(1973) identified six steps for the design of instructional material: (1) formulating educational goals as behavioral objectives, (2) analyzing the task implied in each objective into skills and concepts, (3) devising instruction, (4) teaching, (5) evaluating student performance, and (6) revising and reteaching material for students who did not meet the objectives. Popham (1970a) proposed a "goal referenced instructional model" that had four steps: (1) specification of objectives, (2) pre-assessment, (3) instruction, and (4) evaluation. Gilbert (1962a, 1962b) developed a system of program design which he named mathetics. The mathetics program began with a detailed analysis of what was to be taught. This analysis concentrated on student activity, not subject matter coverage. Mager (1962, 1968, 1973), Mager and Beach (1967), and Mager and McCann (1961) contributed a great deal of information on instructional design and instructional objectives. Mager's book, *Preparing Instructional Objectives* (1962), popularized the writing of behavioral objectives as we know it today. Gagne (1965), in an article in *Teaching Machines and Programmed Learning II* (1965), pointed out that the use of instructional objectives is extremely important in the behavioral science approach to instructional design. First, the objective revealed the nature of the terminal behavior. This determined final sequencing of the program. The objective also provided information to the instructional
designer as to which behaviors needed to be modified. Second, objectives specified the past learning behavior and stipulated the minimum behavior the student must perform. Third, objectives distinguished the varieties of behavior which were to be modified by instruction. A terminal behavior consisted of different classes of behavior such as discriminations or chains. Each class of behavior carried a specific set of implications for the conditions of learning for its establishment. Gilbert (1962a, 1962b), with the mathetics approach to instructional design, identified three major categories of behavior for which differential treatment needs to be prescribed: chains, multiple discriminations, and generalizations. Evans (1961) distinguishes two classifications for which learning techniques can be developed; classes of discrimination and functional relationship between these classes. Basically, the reason for defining objectives is to make them known to the learner so that they can carry out matching procedures involved in reinforcement. Objectives provide learners with the capability of programming their own activities.

Popham (1970b) perhaps best summarized the behavioral technologist's position on instructional objectives in his article reviewing the use of objectives from 1960-1970. Popham noted that the interest in objectives by educators grew because of the enthusiasm of those writing programmed instruction by insisting that objectives were an integral
part of instructional design. Writers of instructional material insisted on specificity in objectives. However, this demand for specificity of objectives has not been totally accepted. Atkin (1968) and Eisner (1967) have raised two main objections. First, it takes the flexibility out of our educational offerings. Second and probably more serious, objectives draw educators toward more easily operationalized objectives rather than higher level, difficult to measure, goals. During the sixties, objectives have weathered these criticisms rather well and their popularity in use has continued to grow.

Popham (1970b) closed by saying that the seventies would be a period of refinement in the use of instructional objectives. In the following sections the research on objectives is reviewed for the 1970's. Whether objectives met the expectations set for them by Popham and others or whether the criticisms and problems identified eventually reduced the importance of objectives will be systematically discussed.

The theory which articulates why one must specifically state what is expected of a student when he is given material to learn is perhaps best presented by Ernest Rothkopf (1970) and Richard Anderson (1970). Both have written articles that explain why it is important to state objectives. The following is a summation of their position on presenting instructional materials to the
Rothkopf (1970) was interested in the basic skills required to acquire knowledge. He refers to these skills as "mathemagenic behaviors". The term derived from two Greek words, mathemain— that which is learned and gignesthia— to be born, or literally, those behaviors that give birth to learning. The point Rothkopf makes is that the knowledge the student acquires from a learning situation will largely be determined by the activities in which the student has engaged. He feels that these activities must be viewed in terms of specified situations and with specified objectives. Rothkopf further points out that in learning from written material there are three components: the content of the instructional material, the organization, and what the student does with the piece of instructional material. If he does not use the instructional material properly, the other two factors will be completely negated. The concept of mathemagenic activities refers to those things the student does to insure that the first two components are used most efficiently.

Rothkopf views specified instructional objectives and specified situations as extremely important because he sees learning as an extremely complex process from which the learning consequences of an instructional sequence are difficult to determine. Any definition of a mathemagenic activity that takes in too many situations is too broad to
be useful. He further states that activities in any specific situation or place can be broken down into four categories that either aid learning (positive), hinder learning (negative), have no effect (neutral), or are unknown. These behaviors can be broken down into the following three classes:

Class I: Orientation. Getting the students into the vicinity of the instructional material and keeping them there. The mathemagenic behaviors in this class would be concerned with eliminating distractions from the instructional setting.

Class II: Object Acquisition. This includes the acquisition of instructional material. Again, the interest would be in controlling the student's activities, devising activities that would allow the student to select the appropriate instructional material and keeping the student interested in it.

Class III: Translation and Processing. This is the process of reading where the student internalizes the material. This can be broken into three parts: translation, sequencing, and processing. These activities can be controlled in two ways. Directly, by observing and controlling eye movements and indirectly, through use of directions and questions to guide the student to certain parts of the learning materials.

The significance of the whole concept of mathemagenic
activities is that, when preparing instructional material, we cannot look at only the written material itself but at the total learning environment. Research looking further into this area is still at the descriptive data collection stage. Most research dealing with prose is based on the propositions set forth in Rothkopf's article and becomes more readily apparent as relevant research is systematically reviewed.

Richard Anderson (1970) has also been very interested in this area of controlling the student mediating process during verbal learning and instruction. His hypothesis is very similar to Rothkopf's and is clearly outlined in an article written by Anderson (1970) which states that the instructor has to control the attention the student places on material during the learning process. Many problems with self-instructional materials are that the authors have failed to direct the attention of the student to important material. This hypothesis has been investigated several times with different types of instructional material including prompting in programmed instruction (Anderson & Faust, 1967; Faust, 1967; Royer, 1969), immediate feedback (Anderson, 1969; Anderson, Faust & Roderick, 1968; Anderson, Kulhavy & Andre, 1971; Brown, 1966), and retroactive inhibition (Kulhavy & Anderson, 1972; More, 1969; Newman, Williams & Hiller, 1974; Sassenrath, 1975; Sassenrath & Yonge, 1968, 1969; Sturges, 1969; Surber &
The present investigation is primarily concerned with how material is presented to the learner.

As previously stated, the hypotheses of both Anderson and Rothkopf and the work of behavioral instructional designers has generated a great deal of research which attempts to examine the process of mediating the student's attention to relevant material. Primary emphasis in the present review of the literature is given to the use of instructional objectives or the use of goals in mediating student attention to relevant instructional material. First, the use and effectiveness of instructional objectives in general will be examined and then, more specifically, studies utilizing objectives with prose material will be presented.

The Use of Objectives in General Educational Settings
The concept of clearly stated instructional objectives has been discussed in the academic community for the last 40 years. As stated previously, the real interest in instructional objectives began in the 1960's. Since then there has been a constant flow of articles advocating the use of instructional objectives. Although, it should be mentioned, there has also been considerable criticism of instructional objectives.

From this commentary have emerged three main instructional functions for objectives: first, they serve as a direction for teaching and curriculum development; second, they provide guidance and evaluation; and third, they
facilitate learning. This review is primarily concerned with the third function: the facilitation of learning.

There are many variables that can be considered when using objectives to facilitate learning. Three of these variables are discussed in a review by Duchastel and Merrill (1973). The first variable to consider is the specificity of the objectives. Researchers generally make a distinction between specific, general, and no objectives. It is important to have an operational definition of what type of objective one is using in trying to influence learning. The second variable is the type of learning one is trying to influence. The two categories of learning most frequently used in research on objectives are knowledge, usually considered as the learning of factual information, and comprehension, mainly considered as the learning of concepts and principles. The third variable of interest focuses on student characteristics. Do objectives work better with certain types of students? How do ability and socio-economic-status of learners affect the utilization of objectives? These three categories of variables must be considered when researching the effectiveness of objectives.

There have been several studies that have attempted to measure the effectiveness of instructional objectives. In this section studies which have dealt with the general effectiveness of objectives and characteristics of the learner are reviewed. Those dealing specifically with the
use of objectives with prose material are reviewed more comprehensively in the next section.  

Gagné (1965), in his review, cites several studies that support the effectiveness of objectives. Dressel (1961) summarized the experience of 13 different institutions of higher learning with the use of instructional objectives in various courses. Although quantitative data were not reported, Dressel observed a consistent interest by faculty to specify terminal behaviors as a way of improving achievement testing. French (1956) divided a group of 40 apprentice mechanics into two groups. One group received their instruction on the actual piece of equipment and the other on a teaching machine which presented specific behavioral objectives. Those training on the teaching machine were more proficient with the equipment after seven and one half days. Briggs and Besnard (1956) also had similar findings working with air force maintenance training programs. Those groups receiving objectives were more proficient at the tasks being taught. Several studies dealing with variables of programmed instruction also demonstrate the need for defined objectives (Gagné, 1962a, 1962b; Gagné & Paradise, 1961). These studies with various tasks of mathematics showed that objectives must be arranged in a hierarchical format and that accomplishment of subordinate objectives will increase the probability of the student achieving a higher level objective. Mager and
McCann (1961) trained a group of engineers using three different instructional strategies. With one group the instructor controlled the sequence of the instruction. With the second group, the students were permitted to select content in accordance with an importance and sequence they themselves assigned. The last group received a set of objectives and questions and could instruct themselves in any manner they wished. Through the use of objectives, training time was reduced as much as 65%. The conclusions were that objectives specify for the students what has to be learned. They compare these specifications with what they do know and fill in the knowledge gaps.

McNeil (1967) did a study which emphasized the importance of prior knowledge of behavioral objectives to acquisition. He worked with two groups of students and their student teachers. One group of student teachers was told that their grade depended upon their setting and achieving acceptable behavior objectives. The other group of teachers was told that their grade would depend on good lesson plans. Higher achievers were found in the group working with objectives. McNeil also found that a focus on specific objectives did not restrict the students to learning objective related material only.

Blaney and McKie (1969) conducted a study on the effects of providing behavioral objectives to a group of attendees at a conference. The attendees were divided into
three groups; those who received objectives, those who received a brief introduction, and a control group. They found a significant difference between the objective and introduction group, but no significant difference between either the introduction or objective group and the control group.

There have been studies which have measured the effect of specific and general objectives on learning of material. Tiemann (1968), working with college economics students, divided the class into two groups; those who received specific objectives and those who received general objectives for the course. He found no significant difference on a midterm examination but did find significant difference on a test given later for retention in favor of those given specific behavioral objectives. Other researchers have had similar results with specific objectives. Dalis (1970), working with tenth grade students studying growth and development, found a significant difference between those given specific objectives and vague objectives. Boardman (1970), working with college students in a remedial chemistry class, studied whether giving students listings of behavioral objectives and attendance at laboratory lecture sessions would improve their grades. He found no significant difference. In another study Bishop (1969) investigated the use of objectives in a ninth grade agricultural class. He had two groups, each comprised of 45
subjects. One group received objectives, the other group did not. He found no significant difference between the groups. Finally, studies by Engel (1968) and Lawrence (1970) supported the utilization of behavioral objectives with elementary education majors. Those that received objectives did significantly better on both post and retention tests.

A second group of studies focused on learner characteristics and the effectiveness of objectives. These studies are selectively summarized below. Cook (1969) investigated the use of objectives and outlines of learning hierarchies. His subjects were randomly assigned to four groups; a control group, an objective group, a hierarchy-outline group and an objective-hierarchy group. Subjects were also blocked according to their grade in a previous mathematics course. They were given a performance test immediately after each instructional unit and failed to show a significant difference between groups. However, a significant treatment by ability level interaction indicated that middle ability students profited most from the objective-hierarchy treatment.

Conlon (1970) investigated the effects of ability as measured by the College Aptitude Rating Test on usefulness of instructional objectives. Two seventh grade classes were blocked as to high, medium and low aptitude. The experimental group received objectives while the control group did
not. The results indicated that the achievement of those who did receive objectives was not significantly different.

Kueter (1970) investigated the interaction of student personality characteristics and behavioral objectives. Using the School Personality Inventory, subjects were blocked (high, medium, and low) on 14 personality traits. The subjects were then randomly assigned to either objective or non-objective groups. The groups were then shown a film on the monarch butterfly. Those who received objectives scored significantly higher than those without objectives. However, objectives were less effective with those subjects with personality traits of submissiveness, self-control, considerateness, and conscientiousness.

Etter (1969) concentrated on several individual differences related to the effectiveness of objectives. He chose to look at age, sex, socioeconomic-status, learner outcome preference, verbal ability, and life goals. The task was a 135 frame programmed lesson related to the functioning of the stock market. The subjects were placed in either specific, general, or no objective groups. No significant difference was found between groups, but it was found that males with a high socioeconomic background scored higher than others in the specific objective group.

As one can see from the above, the results of using objectives have been mixed. In the first group of studies where the general effectiveness of objectives was examined,
objectives in many cases proved to be effective in enhancing performance on posttests (Blaney & McKie, 1969; Dalis, 1970; Engel, 1968; Lawrence, 1970; Tiemann, 1968), while others did not find objectives to enhance performance on posttests (Bishop, 1969; Boardman, 1970; Conlon, 1970). It appears that objectives can facilitate learning in some instances, but it also appears difficult to consistently generalize these findings to other situations. However, the findings related to learner characteristics appear to be more conclusive in that there appears to be a considerable interaction between ability and the use of objectives. At times this interaction is not clear, as in the case of ability. Generally, the studies concerned with personality characteristics (Conlon, 1970; Kueter, 1970) have indicated that objectives are only effective with certain individuals under certain conditions.

Studies have also investigated the effect objectives have upon student behaviors other than achievement. Tiemann (1968), in a study of a videotaped college economics course, reported a more favorable attitude associated with the presentation of specific objectives. Staley (1978) found that the inclusion of objectives in a videotaped lecture improved the attitude of students toward such lectures. Hass (1977) found opposite results; objectives did not significantly change the student's attitude toward a principles of biology course or instruction.
DuBois et al. (1979), in their review on the influence of objectives, also considered efficiency of instruction. Mager and McCann (1961) in a study with engineers found that objectives reduced training time 65%. Duchastel and Merrill (1973), after reviewing several studies, concluded objectives increased study time. Staley and Wolf (1979) investigated the use of objectives with prose materials and concluded that objectives decrease study time. Staley and Wolf explain the difference between their results and Duchastel and Merrill's conclusion with the explanation that objectives influence study time as a function of type of learning task. If the task contains a great amount of non objective related material, then objectives will reduce study time.

Three recent studies have examined the conditions under which objectives facilitate learning. Royer (1977) found that adults attending lectures that contained specific objectives learned more than those attending lectures that did not have specific objectives. Staley (1978) demonstrated that the use of objectives facilitates the learning of memorization objectives, but not the learning of concepts from lecture. Main (1978) found that learning objectives facilitated the learning of objective relevant knowledge from a slide-tape presentation when the objectives were presented at the beginning of the presentation.

The interest in developing and using the behavioral
approach to instructional design, which included the use of instructional objectives that began in the 1960's, and continued into the 1970's. One primary source for articles on instructional objectives in the late seventies was *Educational Technology Magazine*. In 1977 this publication devoted two full issues comprised of 13 articles on the use of objectives. The reason for this special interest stated by Mariam B. Kapfer (1977a), the special issue editor, was that the use of objectives was at a turning point. Objectives are well developed in education, but, at the same time, there is a turning away from the use of objectives. Kapfer cites three problems with objectives. First, how can behavioral objectives better express outcomes regarding learning processes? Second, how can objectives better define the overall aims of education? Third, how can objectives be designed so that students can identify with them and be motivated by them? McAshan (1977), in the summary article of the first issue, concludes that the instructional objective movement still has a future. Controversy will continue over whether objectives should be specific or abstract. Competency-based education, that is prescribing a minimum standard for educational activities and performance-based education, will become synonymous with objectives. Several other articles (Dressel, 1977; Harrow, 1977; Kapfer, 1977; Piper, 1977) deals with the nature and role of objectives in instructional design and
their application in specific educational settings. Kapfer (1977b) summarizes the material presented in the articles with the following six points: (1) behavioral objectives represent one tool for systematic instructional design and validation; (2) behavioral objectives represent a significant step toward a more scientific approach to teaching and learning; (3) behavioral objectives may be written at a variety of levels to meet different needs; (4) highly specific behavioral objectives may be made meaningful by relating them to some type of variously labeled broader goal; (5) behavioral objectives may either expand or limit a learning environment; and (6) behavioral objectives may be shaped to meeting emerging educational needs. Kapfer closes on a positive note by stating she sees objectives being able to solve a variety of educational problems.

In summary, it appears that there is still no conclusive evidence suggesting that the use of instructional objectives facilitates learning in all situations. However, as Duchastel and Merrill (1973) point out in their review, objectives are sometimes helpful but never harmful. Therefore, if the provision of objectives is relatively inexpensive, they should be made available to the students. It is clear that additional research must be completed in this area. This research must determine what objectives actually do. When the actual function of objectives is better defined then they can be applied more uniformly.
Other Preinstructional Strategies. Other preinstructional strategies have been researched and reviewed extensively in the literature (Faw & Waller, 1976; Hartley & Davies, 1976). Hartley and Davies (1976) identified three preinstructional strategies other than objectives. One such strategy was pretests which are sets of related questions that are given prior to instruction that directly relates to the knowledge, skill or attitude to be acquired. The research on pretests has been mixed. Several studies found no difference when pretests were used (Apter, Boorer & Murgatroyd, 1971; Campbell & Stanley, 1963; Hartley, 1969; Rothkopf, 1966; Welch & Walberg, 1970). Other studies have found that pretest questions enhance learning (Berlyne, 1954; Lucas, 1972; Peeck, 1972; Samuels, 1969). Hartley and Davies (1976) conclude that further analysis would be necessary to determine the effectiveness of pretest questions.

Another preinstructional strategy that has been systematically researched is the overview. An overview serves to introduce students to new material by familiarizing them with the central argument. Hartley and Davies (1976) found little research on the overview and the results have been mixed (May & Lumsdaine, 1958; Northrup, 1952; Reynolds, 1966; Rosenshine & Furst, 1971; Weiss & Fine, 1956).

The last preinstructional strategy Hartley and Davies (1976) identified was the advance organizer. Mayer (1980)
summarizes the concept of advance organizers as developed by Ausubel (1968). Ausubel defined advance organizers as "appropriately relevant and inclusive introductory materials . . . introduced in advance of learning . . . and presented at a higher level of abstraction, generality, and inclusiveness" (p. 148). The function of the organizer was "to provide ideational scaffolding for the stable incorporation and retention of the more detailed and differentiated material that follows" (p. 148). This was accomplished by manipulating "the availability to the learner of relevant and proximately inclusive subsumers" (p. 136). Hartley and Davies (1976) stated that advance organizers are more complex than overviews and serve a different purpose than pretests or behavioral objectives. Advance organizers are meant to provide a conceptual framework that the student can use to clarify the task ahead. Advance organizers are not intended to give the students a synopsis of the material, but are process oriented. Ausubel (1969) has identified two broad types of advance organizers. The expository organizer is used when the material is new and the comparative organizer is used when the material is either not new or completely novel. Advance organizers can be used either in prose form or as visual displays (Weisberg, 1970).

Since the introduction of the concept, a large amount of research has been generated testing the effectiveness of
the advance organizers. This research has been reviewed extensively (Ausubel, 1980; Barnes & Clawson, 1975; Faw & Waller, 1976; Hartley & Davies, 1976; Lawton & Wanska, 1977; Mayer, 1979, 1980). There is continuing controversy as to the effectiveness of the advance organizer (Anderson, Spiro & Anderson, 1978; Ausubel, 1978, 1980; Barnes & Clawson, 1975; Faw & Waller, 1976; Hartley & Davies, 1976; Lawton & Wanska, 1977; Mayer, 1979). Barnes and Clawson (1975) reviewed 32 studies dealing with advance organizers. They analyzed these studies according to several variables such as length of treatment, ability level of students, subject area, grade level, types of organizers, and level of learning task. Their conclusion was that the efficacy of advance organizers had not been established. Of the 32 studies reviewed, 12 reported advance organizers enhanced learning and 20 advance organizers did not enhance learning. When the above discussed variables were analyzed, no clear patterns emerged. Barnes and Clawson (1975) closed their article by listing nine steps that should be taken methodologically in future experiments to insure more accurate studies. Hartley and Davies (1976) and Faw and Waller (1976) with limited reviews, draw the same conclusion as Barnes and Clawson (1975). There is no strong evidence that advance organizers enhance learning and there are methodological problems which must be resolved. Lawton and Wanska (1977) replied to the Barnes and Clawson (1975) evaluation. They
cited several limitations of the Barnes and Clawson review. First, they did not limit themselves to published articles and second, some of the articles were misinterpreted. Lawton and Wanska (1977) concluded by providing their list of 12 points that need to be considered when constructing experiments that deal with the effectiveness of advance organizers.

Ausubel (1978) also published a reply to the Barnes and Clawson (1975) and Hartley and Davies (1976) critiques. Ausubel has responded to the general criticism that advance organizers are a vague concept in that there is exhaustive and explicit general discussion of the definition, nature, and effects of an organizer in various publications (Ausubel, 1960; Ausubel & Fitzgerald, 1961, 1962; Ausubel & Youssef, 1963; Fitzgerald & Ausubel, 1963). Ausubel stated that there is a specific description on how to construct an advance organizer for a particular topic (Ausubel, 1968). He cited two studies (Lawton, 1977; Lawton & Wanska, 1977) that show that advance organizers enhance learning. Mayer (1979) also replied to the criticism of Barnes and Clawson (1975). Mayer reviewed several theories of why advance organizers do work. Anderson, Spiro, and Anderson (1978) in their research, again questioned the usefulness of advance organizers. Anderson et al. stated that Ausubel's assimilation theory of meaningful learning and retention is too vague. They also stated advance organizers are a few vaguely
worded sentences intended to facilitate textual learning directly rather than through modifying the learners cognitive structure. Overall, research of advance organizers has been inconclusive. Ausubel (1980) replies that these conclusions are a misrepresentation of published material. Luiten, Ames, and Ackerson (1980) conducted a meta-analysis of the effects of advance organizers on learning and retention. They examined 135 published and unpublished studies, examining influencing variables such as grade level and subject studied. They concluded that advance organizers have a facilitative effect on both learning and retention.

Probably because of the above controversy, advance organizers continue to generate much research. Mayer and Bromage (1980) examined the effects of providing the advance organizer before or after the reading. They found that the group receiving the advance organizer before the reading recalled more conceptual idea units, recalled more material appropriate to posed questions and made more novel inferences. The group receiving the advance organizer after the reading recalled more technical idea units, remembered less question related material and produced vague summaries. Lawton and Wanska (1979) investigated the effect of the type of advance organizer presented to elementary school children. The three types of advance organizers were subject organizers, process organizers, and a combination of both
subject and process organizers. A subject organizer is what its name implies; it presents an overview of the organization of the material. Process organizers present general ideas of ways subject matter concepts might be arranged in some sort of hierarchical classification. Subject/process organizers were the most effective. The second most effective was the process organizer followed by the subject organizer and then the control group.

Mayer (1977, 1978, 1979) has completed a great deal of research that has served to articulate Ausubel's theory of advance organizers. Mayer (1978) investigated the role of advance organizers in learning from a text. It was hypothesized by both Ausubel (1968) and Mayer (1975) that advance organizers may be especially helpful in learning technical, unfamiliar, or poorly organized material. Advance organizers are helpful because they provide a meaningful context for which new material may be assimilated. Advance organizers may also serve to encourage an encoding strategy in which the subject attempts to integrate incoming information with meaningful context. In the study there were two experiments. In the first experiment subjects were given a 24 frame text on computer programming. One half received random order and the other half received logical order. Random organization students who received advance organizers performed better on a posttest than the control group. The opposite was true for those
who received the logical organization. In the second experiment, subjects read a four paragraph text about imaginary countries that were organized either by name or attribute. Low ability subjects who were given an advance organizer prior to reading performed better on questions that required integrating subject matter across different paragraphs. Subjects given advance organizers after reading performed better on questions that related to one paragraph. Mayer (1978) concluded that advance organizers serve as an assimilative context for unfamiliar organization. A second study by Mayer (1977) also attempted to study the effectiveness of a preorganizer on encoding and subsequent performance. With several trials he taught subjects letter or number chains. Those that learned the pattern or rule performed better on tests of transfer.

Mayer (1976) also investigated conditions of meaningful learning for computer programming. The two conditions investigated were advance organizers and subject control of frame order. Subjects who were given pretraining performed better on novel problem solving and worse on routine problem solving as compared to those receiving post-training or no training.

Advance organizers have also been used to facilitate the retention of oral instruction and television instruction. Alexander, Frankiewicz, and Williams (1979) worked with fifth, sixth, and seventh graders who received
oral instruction in social studies. The subjects were divided into four treatment groups; advance organizers before and after the presentation, and presentation of the material visually or orally, and a control group receiving no advance organizer. Students were tested after the presentation and two weeks later. Alexander et al. (1979) concluded that nonwritten cognitive organizers facilitated both the learning and the retention of oral instruction.

A second study dealt with the effective use of advance organizers with instructional television. Nugent, Tipton, and Brooks (1980) obtained data from 943 students and 54 teachers at the college level. Introductory organizers were tested. Results showed that advance organizers significantly increased student comprehension.

In summary, several preinstructional strategies other than instructional objectives have been researched in the literature (Barnes & Clawson, 1975; Faw & Waller, 1976; Hartley & Davies, 1976). Research with pretest questions and overviews to enhance learning has had mixed results (Faw & Waller, 1976; Hartley & Davies, 1976). Another preinstruction strategy that has been investigated and continues to be investigated is the advance organizer. Several studies have shown the advance organizer to enhance learning from a text (Alexander, Frankiewicz, & Williams, 1979; Ausubel, 1968; Luiten, Ames, & Ackerson, 1980; Mayer, 1975, 1977, 1978, 1980). Others have questioned the
effectiveness of the advance organizer (Anderson, Spiro & Anderson, 1978; Barnes & Clawson, 1975)

As one can see from the above, there has been a great amount of research concerning the effectiveness of preinstructional strategies. By far, most research in preinstructional strategies has been completed in the area of instructional objectives and advance organizers. Both of these areas continue to produce research. The present research project examines the effect of preinstructional strategy of instructional objectives when used with prose material. The reason for selecting instructional objectives is that neither the research on objectives nor advance organizers has been conclusive, yet both continue to be widely used. The present investigation examines objectives with the additional variable of specification of level of performance (easy and hard). It is hoped that from the results of the present study, additional information will be provided that will indicate whether objectives are effective, and if so, what form they should take (quantitative, qualitative, or a combination of quantitative and qualitative).

Facilitating Objectives Related to Prose Learning

The research concerned with the use of instructional objectives related to prose learning has been much more extensive and consistent than the research previously cited. Those concerned with the use of objectives and prose
material have been concerned with both relevant and incidental information. Relevant material is defined as that material directly related to the objective and incidental material being all other material contained in a particular passage. Furthermore, prose learning research has also looked at several other variables that influence the effectiveness of material with objectives over material without objectives. Studies have looked at such things as (a) specificity of phrasing objectives (Dalis, 1970; Kaplan, 1976a; Rothkopf & Kaplan, 1972), (b) number of objectives (Kaplan, 1974; LaPorte & Nath, 1976; Rothkopf & Billington, 1975; Rothkopf & Kaplan, 1972), (c) text length (Gagné & Rothkopf, 1975; Rothkopf & Kaplan, 1974), (d) location of objectives (Frase, 1968a; Gagné & Rothkopf, 1975; Kaplan, 1974, 1976a; Kaplan & Simmons, 1974; Rothkopf & Bisbicos, 1967), and (e) the amount of information contained in the objective (Dalis, 1970; Kaplan, 1974; Kaplan & Simmons, 1974; LaPorte & Nath, 1976; Rothkopf & Kaplan, 1972). In this section several studies will be reviewed that primarily will look at the effectiveness of instructional objectives and also the above listed variables that could improve the effectiveness of using objectives.

Duchastel and Brown (1974) conducted a study to investigate whether objectives were effective with prose material as related to performance and whether this was caused by the fact that objectives provided a direction for
learning. One half of a group of 58 college students received objectives for the text and the other half received none at all. Those that received objectives performed better than their counterparts on those questions that were relevant to the stated objectives and less well on those items not covered by their objectives. These findings are in conflict with research by Morse and Tillman (1972) and Rothkopf and Kaplan (1972) who found that objectives enhance both relevant and incidental learning. Duchastel and Brown attribute this discrepancy to the fact that the subjects had experience with an objective-referenced instructional model.

Research conducted by Kaplan and Simmons (1974) was concerned with the construction of the objective, its placement and the results it would elicit as to relevant and incidental learning. The findings were that objectives aided in the acquisition of relevant material, both when the objectives were presented before or after the text. However, performance on incidental information was greater when the objectives appeared at the end of the text. The outcomes were attributed to different methods used by the students to process the text information. When objectives or questions are presented prior to the material, they serve as orienting stimuli that results in selective attention to relevant or objective related material. When objectives appear at the end of the material, the text is read non-selectively. The objectives are inadequate as a summary or
Kaplan (1974) has also looked at the placement of objectives within the text. Kaplan used three passage lengths with either specific or general objectives. The results showed that both relevant and incidental learning improved with the use of objectives. By dispersing the objectives throughout the material, relevant learning could be improved. Gagné and Rothkopf (1975) obtained similar results with high school students. One half of a group of 157 students received a reading preceded by a list of objectives. The other half received a reading with objectives dispersed throughout. The objectives that were not dispersed resulted in a substantial elevation of performance on all objectives relevant to the text material. With objectives dispersed throughout the passage improvement was seen on only the first relevant element for each objective. Incidental learning was lower in both groups as compared to the central group which received only generalized instructions.

Closely related to the above study is one by Kaplan and Rothkopf (1974) in which text length and density or amount of objective relevant sentences within each passage were considered. Again, those receiving objectives out performed those in the reference group. It was also found that the amount of objective relevant learning decreased with more objective relevant sentences but was not related to passage
length. Incidental learning decreased with passage length and specifically stated objectives resulted in the learning of more intentional material. Kaplan (1976a), in a later study, also looked at the effects of grouping and response characteristics of instructional objectives when learning from prose. Subjects were given objectives which were either specific or general in nature. For one half of those receiving specific objectives, the objectives were interspersed throughout the text and for the other half the objectives were grouped. Additionally, one half of each group was instructed to overtly respond to each objective. The results showed greater intentional learning with objectives than without objectives. There was no difference between overt and covert responding, but overt responding resulted in less incidental learning than covert responding, particularly when objectives were interspersed. He also found a strong relationship between correct identification of object-relevant text sentences and subsequent text performances. Kaplan (1976b) also examined the relationship between student experience with objectives and the effectiveness of objectives in learning from text material. Four different treatments were used: no objectives, objectives before text, objectives after text, and a combination of before and after text. The findings were that experience with objectives produced greater overall learning and greater intentional rather than incidental learning.
The number of goals as related to the amount of achievement has been studied by Rothkopf and Billington (1975). They tested 192 college students and randomly assigned them to eight groups. Treatment groups were differentiated by: (a) number of assigned goals, (b) number of goals achievable for passage, and (c) resemblance between unachievable goals and certain text segments. It was found that goal-relevant learning was reduced by increasing numbers of assigned goals whether or not they could be achieved. More incidental learning was found for text segments resembling goals than for dissimilar texts.

Recent research on the use of objectives has addressed the question of how an objective changes a learner's behavior when learning from prose. Geiselman (1977) studied memory from prose as a function of learning strategy and inspection time. He found that, when subjects were given specific instructions (generalized goals or objectives) about what material to study, they studied the material at a slower pace. Those that were given specific instructions also spent more time on the material that was not emphasized as well as the emphasized, but there was no similar increase in learning. In the second part of the experiment, Geiselman found that inspection time was necessary for increased learning to occur. Gagnè, Bing & Bing, (1977) hypothesized that goals affect the organization of free recall thus facilitating the solving of problems. Working
with 24 high school students, they found that this was the case; objectives do have an effect on organization.

Rothkopf and Koether (1978) investigated the organization of objective lists and the prose material to which they related in terms of discrepancies between the sequence of the two. Gagnè and Rothkopf (1975) observed that study goals are less effective when the sequence of the list of objectives does not match the sequence of objective relevant material in the passage. In their experiment some of the objectives could not be found from the information in experimental passage. They hypothesized that students stop looking for out-of-order objective relevant material once they find the material is not in the text. The Rothkopf and Koether (1978) study replicated the Gagnè and Rothkopf (1975) study except all objective related material was in the text. The finding was that objective relevant learning was lower when the objectives and the text sequence did not match. Duchastel (1979) studied the role of objectives in relation to the organization of text. The texts were organized in terms of ideational prominence. In a high ideational prominence passage, the target topic is placed high in the content structure of the text. In this experiment, ideational prominence was manipulated and influenced learning on its own, but it was found to lose its affect when relevant objectives were also provided. Objectives and structure were interpreted as providing redundant
orientation in the learning situation.

A quantitative goal may be defined as a goal that specifies numerically what the student is to attain from an instructional experience. For example, "You will be able to spell at least 80% of the spelling words assigned". The 80% is considered a quantitative goal. Quantitative goals can be used in prose learning. The use of quantitative goals had at least part of its beginning in the early work with behavioral instructional design. Gagné (1965), in his article analyzing the use of instructional objectives, gives two reasons for utilizing a quantitative component to an instructional objective. First, it specifies the postlearning behavior for measurement. There is an observable measurement which will tell the instructor that the student has met the objective. The second reason is that specification of level of attainment can be communicated to the student. The student then carries out the necessary matching procedures to insure that the objective is met. In this sense the quantitative objective is seen as a motivator; something that the student will strive for and thus complete the task. Locke (1968) proposed such a theory of motivation. The basic premise of the theory is that an individual's conscious intentions regulate their actions. Locke (1968) defines a goal as what the individual is consciously trying to do. He further states that hard goals result in a higher level of performance than easy
goals and specific hard goals result in a higher level of performance than do no goals or the general goal of "do your best". In addition, the theory states that a person's goals mediate how performance is affected by monetary incentives, time limits, knowledge of results, participation in decision making, and competition. Locke, Bryan, and Kendall (1968) found, in a series of experiments, that the relationship between goals and incentives is two-fold: Incentives do not affect behavior unless they also affect goals and intentions. Goals and intentions are related to the obtained level of behavior regardless of incentives.

Locke's (1968) propositions have been tried experimentally both in the business and school settings. Latham and Yukl (1975a) reviewed the application of goal setting in the business environment. They examined the following aspects of Locke's theory: (a) the effects of specific goals versus generalized goals or no goals, (b) the effects of goal difficulty on performance, and (c) goals as mediators of performance feedback, monetary incentives and time limits. The first two categories will be reviewed in that they are of an interest in this research. Latham and Yukl (1975a) reviewed ten studies that supported Locke's position on specific goals (Blumenfeld & Leidy, 1969; Burke & Wilcox, 1969; Kolb & Bayatzis, 1971; Latham & Baldes, 1975; Latham & Kinne, 1974; Latham & Yukl, 1975b; Lawrence & Smith, 1955; Ronan, Latham & Kinne, 1973; Sorcher, 1967;
Wexley & Nemeroff, 1975). In terms of goal difficulty, six studies (Blumenfeld & Leidy, 1969; Carroll & Tosi, 1970; Dachler & Mobley, 1973; Steers, 1975; Zander, Forward & Albert, 1969; Zander & Newcomb, 1967) have found that difficult goals lead to greater performance.

Several recent studies have also tested Locke's (1968) hypothesis. Strang, Lawrence and Fowler (1978) examined the effects of assigned goal level and knowledge of results on arithmetic. Female university students either received or did not receive explicit knowledge of results while under easy or challenging goal assignments. A control group received neither a goal assignment or knowledge of results. Subjects receiving knowledge of results under a challenging goal assignment significantly increased their computation speed without losing accuracy. Without knowledge of results, goal assignments had no noticeable effect on computational speed and lead to a significant increase in errors. Dossett, Latham and Mitchell (1979) found the opposite in terms of knowledge of results. Female clerical personnel were randomly assigned to participative, assigned, and do your best goal conditions. With goal difficulty held constant, there was no significant difference between the assigned and participative conditions on performance or goal acceptance. No main or interaction effects were found for knowledge of results. A final study by Becker (1978) showed that knowledge of results and difficult goals
improved performance. Eighty families were asked to set a goal to reduce their residential electrical consumption for several weeks during the summer. One half received a difficult goal of reducing their consumption 20% while the other half received an easy goal of reducing consumption 2%. One half of each of these groups received feedback three times a week about their consumption. The group given the hard goal and which received regular feedback conserved the most energy and were the only group to significantly conserve more energy than the control group.

Three studies (Gardner & Gardner, 1978; LaPorte & Nath, 1976; Rosswork, 1977) have applied Locke's (1968) motivational approach in the academic setting. LaPorte and Nath (1976) investigated the effect of learning goal instructions on prose learning. Subjects read and were tested on two passages. Different goal instructions were introduced for the second passage. One group received a hard specific goal (answer 18 out of 20 test questions correctly) a second group received an easy goal (answer 5 out of 20 test questions correctly) and the third group received a general goal (do your best). The hard goal group scored higher on a test of comprehension than the other two groups. Rosswork (1977) measured the effects of goal setting and varying magnitudes of incentive. The experimental group consisted of 86 grade school students who were assigned either a specific difficult goal or nonspecific
general goal. There were four levels of monetary incentive with two levels of ability blocked within each group. Each subject received three trials at a task of learning spelling words. The results were that specific difficult goals lead to higher levels of performance than nonspecific goals across various incentive conditions. Gardner and Gardner (1978) found similar results with retarded children. Goal setting was found preferable over no goal setting in the learning of spelling words.

It should be noted that much of the preinstructional strategy research contained in the Hartley and Davies (1976) and Faw and Waller (1976) reviews presented earlier in this literature review can be applied to prose learning. Many of the studies dealing with prequestions cited in their reviews utilized prose material (Campbell & Stanley, 1963; Hartley, 1969; Peeck, 1970; Rothkopf, 1966; Welch & Walberg, 1970). The same is true for advance organizers. The majority of the research with advance organizers has been completed using prose material. Hartley and Davies cite many of these studies (Ausubel, 1960; Ausubel & Fitzgerald, 1961; Newton & Hickey, 1965; Wagner, 1973). The three Mayer (1975, 1976, 1978) studies also utilized prose material.

There is much research that has examined variables other than objectives and preinstructional strategies to facilitate prose learning. Readability of the prose material and factors that affect readability have been
researched (Fass & Schumacher, 1978; Klare, 1976). Several studies (Royer & Cable, 1975, 1976; Royer & Perkins, 1977; Royer, Perkins & Konold, 1978) have presented evidence that learning of meaningful material can be facilitated by relating the to be learned information to previous known information. Other research (Frase & Schwartz, 1975; Rickards and August, 1975) has shown that if subjects took part in some activity which they generated themselves (such as writing their own questions or underlining phrases) they performed better on future tests of comprehension. Although the above examples are not preinstructional strategies, they are but just a few of the many variables being examined that are attempting to meet the same goal as preinstructional strategies; that is, to improve comprehension of prose material.

After reviewing many of the studies cited above, Melton (1978) concluded that a variety of complex conditions determine whether or not behavioral objectives enhance relevant learning and depress or enhance incidental learning. Those studies that have tried to determine whether or not objectives aid in learning material have over-simplified the problems. Melton feels that we should not direct our efforts at proving whether or not objectives aid learning but rather we should regard objectives as just another tool available to educators. That is to say that research should be directed toward identifying the
conditions under which objectives can be used most effectively.

All in all, the above investigations conclusively show that instructional objectives enhance learning from prose material. These studies also show that there are a great many variables such as specificity of phrasing objectives, number of objectives, text length, location of objectives and the amount of information contained in the objective which can either enhance or detract from this interaction. Further research is needed to determine the best combination of variables (type of preinstructional strategy, text length, location of intentional cues) that will facilitate learning from prose material.

**Intentional (Relevant) and Incidental Learning**

For many years experimental psychologists have been concerned with the question, "Do we learn things incidentally as we go about performing tasks?" They have been concerned with whether the intent to learn (i.e. being instructed to learn something) is the critical factor in learning or if it is the interaction with some other variable (e.g. what the subject attends to) that causes an individual to learn.

Postman (1964) has identified two types of situations where incidental learning may take place. They are identified as Type I or Type II situations. A Type I situation is when a subject is exposed to the learning
materials under some pretext. For example, he may be shown a list of words and be asked to rate them on some feature. Then he would be asked to recall as many words as possible. Type II is very similar to the type of experiments that have been conducted using instructional objectives. The subject is asked to learn some material, usually through a set of directions, and is then asked questions about material the directions have not told him specifically to learn. For example, the subject may be asked to learn pairs of nonsense syllables which are printed in different colors. Then, later on, he is asked which colors were associated with each syllable. The color was not a part of the instructions, but an intrinsic part of the material. Several experiments have been done to study this interaction.

Most of the research has been conducted with the Type I model. Postman and Adams (1956) varied the orienting task that assured exposure to the materials. There were three groups: (1) an intentional group that was instructed to learn the material; (2) a group that performed the orienting task and also were instructed to learn the material; and (3) the incidental group. Each was given two tasks; a list of 20 nonsense syllables and a list of 30 adjectives. The findings were that on the nonsense syllables the intentional learners scored better on posttests of learning. The second group, which was
instructed to learn the material and perform an orienting task, did no better than the incidental group who performed the orienting task only. With the adjectives the intentional learners always performed better than the incidental learners. Postman, Adams and Phillips (1955) also conducted experiments with nonsense syllables and found that there was very little difference in learning between groups on those nonsense syllables that had low association. Eagle and Leiter (1964), Breitman (1969), Gleitman and Gillett (1957), and Mechanic (1964) all found similar results: that the intention to learn has no direct effect on learning but it influences it indirectly through the kinds of learning responses it generates. What becomes important is the quality of the learning responses rather than the intent.

There have been fewer experiments conducted that were concerned with Type II learning. Mechanic (1962a), using nonsense syllables, found that the meaningfulness of the incidental items was important in terms of learning. He found that low meaningful items were easily remembered. The same finding was also noted by Feldman and Underwood (1957) and Jantz and Underwood (1958). It should be noted that the results in Type II situations have not always been in agreement when verbal and nonverbal situations have been investigated (Postman, 1964; McLaughlin, 1965; Mechanic, 1962b). Mechanic (1962a) was able to show that this
difference can be attributed to the relative interference between the incidental and intentional components of the task.

Research continues in this area of intentional and incidental learning in the 1970's but generally with fewer studies being published today than in the 1950's and the 1960's. The focus of the reported research is still to identify the variable or variables that causes learning to take place. Eagle and Milliken (1974), using affective ratings of stimulus words, found that intent to learn was not the critical factor; but the effectiveness of the operations to learn and the facilitation of affective ratings is what is critical. Till and Jenkins (1973) also found that recall was dependent on the nature of the orienting tasks. A variety of orienting tasks were used. Wolk and Svoboda (1975) studied the role of orienting tasks of field dependence/independence. Two groups were used. One was told to read for content while the other was instructed to detect typographical errors. In terms of incidental learning, the group that read for content experienced more incidental learning and field-dependents exceeded independents in incidental learning. They also found that retention of incidental material was substantial after 21 days. These three studies typify the type of research being published on intentional and incidental learning today.

The research reviewed here tends to support the
hypothesis that intent to learn is not sufficient to cause learning. An important factor is the type of response that is generated. Thus, if responses are elicited in some other manner such as orienting tasks, they will also cause learning to take place. Most of the studies related to intentional and incidental learning have been conducted with a Type I model. This model exposes subjects to stimuli but does not tell them precisely what to learn, rather it instructs them to perform some operation such as matching geometric objects. Unfortunately, few experiments have been conducted with the Type II model where subjects are exposed to material and are told to learn parts of it and then tested over all the material. This type of study is very similar to the type of experiment being conducted here. All of this research does have implications for instructional psychologists and generally supports the statements of Rothkopf (1970) and Anderson (1970): "You not only have to tell a subject to learn something, but the material must be presented in such a way that the student can respond to it. The response is the important aspect". More research must be done in the applied area to see how the findings really work in the classroom setting and if they can be applied in generalized learning situations.

The Delay-Retention Effect

The delay-retention effect is a part of the larger
topic, feedback effects. Feedback, in the learning setting, is usually defined as a means to provide the learner with an awareness of the appropriateness of his or her responses. The issue of whether feedback should be provided immediately has been extensively studied, yet no firm answer exists. This research has examined the effect of feedback on psycho-motor and perceptive tasks, standardized test scores, behavior modification, verbal learning, programmed instruction, role of errors and false feedback.

Annett (1969), in an exhaustive review of the literature concerning feedback and human behavior, identified three factors that possibly explained the effect of feedback on learning and retention. These three factors are: (1) reinforcement, (2) incentive, and (3) information. Annett concluded that feedback may be regarded as information about the outcome of a test carried out on the environment. He further stated that knowledge of results as an incentive function adds nothing to its properties as feedback; in a general sense, motivation can be regarded as feedback in action. The so called incentive function of knowledge of results seems to involve both providing the subject with a performance standard to aim for and information necessary for corrective action. These conclusions were confirmed in a study by Carels (1975). He found that feedback provided to the learner enhanced learning and retention of programmed text materials. He
further found that the beneficial effects of feedback could more appropriately be explained in terms of the information it conveys.

In another rather extensive review Geis and Chapman (1971) cited several studies that examined the effect of knowledge of results and other possible reinforcers in self-instructional systems. There is ample evidence that, under some circumstances, feedback affects performance. However, with self-instructional material, the results have been mixed. Several studies have shown that feedback does enhance learning (Alter & Silverman, 1962; Anderson et al., 1971; Campeau, 1968; Krumbaltz & Keisler, 1965; Wittrock & Twelker, 1964). Even more numerous are the studies questioning the effectiveness of feedback (Becker, 1964; Feldhusen & Birt, 1962; Hough & Revsin, 1963; Jacobs & Kulkarni, 1966; Moore & Smith, 1961, 1964; Ripple, 1963; Swets, Millman, Fletcher & Green, 1962). Geis and Chapman also reviewed the literature that dealt with delay of confirmation. Though not entirely consistent, the research strongly suggests that delaying the presentation of the reinforcing consequence reduces its effect on the behavior upon which it has been made contingent. One study by Evans, Glaser and Homme (1962) using programmed instruction to teach symbolic logic investigated delay of feedback. Delays in confirmation seem to have only a little effect on criterion performance. The authors suggested that, when
the correct response is highly probable, the effect of
confirmation may be minimal. A study by Meyer (1960)
involved teaching Latin prefixes to eighth graders with a
19 lesson programmed text. One group received immediate
feedback while the other group received feedback on their
answers 24 hours later. Students in the delayed feedback
group produced more errors. Meyer concluded that immediate
feedback is preferable over delayed feedback for the
acquisition of material. Boersma (1966) using a modifica­
tion of a symbolic logic program found a significant
interaction effect of delay of feedback (i.e. time from
response to feedback exposure), and post-feedback delay
(i.e. time between end of feedback exposure and presentation
of next frame) on program errors, but not on criterion tests.
Geis and Chapman (1971) conclude that the evidence is weak
that confirmation is a reinforcer. They state further; if
there is a trend, it is toward showing no real reinforcing
effect of feedback.

The effect of delayed feedback in facilitating the
retention of instructional material from prose has been
studied for several years. There have been several studies
that have indicated that delaying feedback to students of
results from examinations is superior to immediate feedback.
Kulhavy (1977) in an extensive review cites several of these
studies. Sassenrath and Yonge (1968) gave 160 undergraduate
college students a 60 question multiple choice test. One
half received feedback immediately, the other half received feedback 24 hours later. The type of feedback was also varied: half received both the stem of the question and the correct responses; others received just the responses. Also, one half of the group was provided with positive incentives. The results indicated that on a test of delayed retention, the groups receiving delayed feedback, both the stem of the correct response to the question and positive motivation, scored higher. Several other studies with similar results have also been reported. Sassenrath and Yonge (1969) working with college students found no differences in immediate retention between those receiving immediate and delayed feedback. On delayed retention those receiving delayed feedback performed slightly but reliably higher than those receiving immediate feedback. More (1969) worked with eighth grade students and investigated the effects on learner performance of feedback delays ranging from immediate to four days. Retesting took place either immediately or three days after feedback. In terms of acquisition, the immediate feedback group scored significantly lower than those who received delayed feedback. Within retention groups the two and a half hour and one day groups scored significantly higher than those that received immediate feedback and four days of delay. Sturges (1969) used multiple choice questions. Subjects received information about their test performance either immediately or
24 hours later. Students were tested for retention immediately after receiving information feedback and seven days later. Delay had no effect on tests of immediate retention, but, after seven days, retention was superior for those that received delayed feedback. Finally, Kulhavy and Anderson (1972) tested high school juniors and seniors who completed multiple choice tests on topics in introductory psychology under various conditions of immediate and delayed feedback. On the same test a week later, delayed feedback groups performed significantly better than immediate feedback groups. Those groups that studied the feedback booklet prior to the initial testing performed best of all. It should be noted though that there have been studies which have had contrary findings (Renner, 1964; Taber, Glaser & Schafer, 1956). There are contradicting positions on this issue in the field of psychology.

In an effort to answer the criticisms of the above studies that they were not truly representative of school learning and thus lacked external validity, Surber and Anderson (1975) conducted an additional experiment. To do this they used an environment that approximated the normal classroom. They also used methods and materials that were very similar to those used in the classroom. They used a 550 word passage about army ants. There were four treatment groups; two received instruction prior to the initial test and two received no instruction. One pre-instruction
and one no instruction group received feedback on day two. All groups took tests on retention on day one and day seven. There were also two control groups. The results indicated again that feedback was preferable over no feedback and that delayed feedback was preferable over immediate feedback.

Newman, Williams and Hiller (1974) again offered criticism that the preceding Surber and Anderson (1975) study was still not truly representative of the normal instructional setting. Specific errors cited in the Surber and Anderson study and corrected in the Newman et al. study were: (a) students were required to answer test questions without relevant prior instruction, (b) subjects were carefully deprived of any indication that they were to be retested, (c) achievement level was not established as instrumental for any reinforcement such as course grades, and (d) instructional materials relevant to the test were not made available to the subjects during the interval between initial and retention testing. With all these criticisms taken into account, no overall differences were noted between those that received immediate feedback and those that received delayed feedback. The general conclusion was that the previous experiments conducted lacked external validity.

Two theories attempt to explain the beneficial effect of delayed feedback on delayed retention. The verbal
facilitation theory (Sassenrath, 1975) states that delayed feedback subjects have more time than immediate feedback subjects to make use of response produced verbal cues originating from the stimulus material. When meaningful verbal material is presented to older children and adults the verbal cues can help the subject mediate or covertly rehearse the material during the delayed feedback period. The second theory developed by James R. Surber and Richard C. Anderson (1975) is the interference-preservation hypothesis and states that over the delayed feedback the initial wrong responses are forgotten more readily and less proactive interference occurs when learning the correct response from feedback. Sassenrath (1975) reanalyzed several of the studies cited in this review using two ratios: wrong responses on the first test that were changed to a right response on test two and the change of right responses on the first test to wrong responses on test two. Feedback was either immediate or delayed between test one and test two. Sassenrath found that delayed feedback produced a higher number of wrong responses that were corrected on the second test thus supporting the interference-preservation theory. Immediate feedback did not produce a higher number of items that were right on both the first and second tests than did delayed feedback. This indicated that immediate feedback does not act as a reinforcer of right answers but rather as information to
change wrong responses to right responses.

Three recent studies had mixed results with delayed feedback enhancing learning. Phye, Gugliemella and Sola (1976) conducted an experiment with 320 undergraduates. There were four experimental groups. One group took a 40 question multiple choice test and one group took a 40 question completion test. One half of each group received feedback immediately after the test; the rest received delayed feedback 48 hours later. The delayed feedback was not superior as predicted by the delayed retention effect. Also, feedback in the form of correct answer only was superior to correct answer plus distractors. Sturges (1978) administered a multiple choice or completion computer assisted test to a group of college undergraduates. Subjects either received immediate feedback or delayed feedback 24 hours later. Delayed feedback was found to be more effective with the multiple choice test. There was no significant difference between immediate and delayed feedback with the completion test. Peeck and Tillma (1978) had 67 fifth graders study a text and take a test of comprehension. One third received feedback after 30 minutes, one third after 24 hours, and one third received no feedback. The students were tested a week later. Those students receiving feedback 24 hours later scored the highest.

The above information indicates that delayed feedback appears to have effect on the retention of material
presented, but further research needs to be completed to determine its actual effects in the classroom. Also, the interference-preservation theory appears to offer one explanation of these findings.

During the last five years, the effect of feedback on subjects in the school setting has been investigated in terms of several variables other than delay of feedback. Some of the areas researched are the effects of types of feedback on learning various tasks (Barringer & Gholson, 1979; Donohue & Ratliff, 1976; Dwyer & Arnold, 1976; Henderson, 1977), effect of feedback on present and future performance of the student (Clair & Snyder, 1979; Latta, 1978; Saudargas, Madsen, Jr. & Scott, 1977; VanHouten, Hill & Parson, 1975; Van Houten & McKillop, 1977; Woolfold, 1978) and the effect of evaluative feedback in use of feedback to control classroom behavior (Marholin & Steinman, 1977; Walker & Hops, 1976). Let's first look at the effect of feedback on conceptual learning.

The effects of type and combination of feedback upon conceptual learning by children with implications for research in academic learning was extensively reviewed in an article by Barringer and Gholson (1979). Barringer and Gholson define concept formulation as the process of learning to differentiate phenomena of one class from phenomena not found in that class. In learning these discriminations, feedback can be given in several forms:
verbal, the experimenter says correct or wrong following the response; symbolic, which involves a tone or flash when the correct response is provided; and tangible reinforcement such as tokens, candy or money for correct responses. Feedback may be given in several ways: (a) feedback for both correct and wrong answers, (b) feedback for correct answers only, and (c) feedback for incorrect answers only. Barringer and Gholson (1979) after reviewing the literature, concluded that verbal feedback and symbolic feedback produce more rapid acquisition than does tangible feedback (Spence, 1970, 1971; Spence & Dunton, 1967; Spence & Segner, 1967). They also concluded that providing feedback for correct answers only was the least efficient method for teaching children conceptual material (Curry, 1960; Mims & Gholson, 1977; Spence, 1966; Williams, 1972). Feedback which followed wrong answers but not right answers usually resulted in the most efficient learning during acquisition (Curry, 1960; Meyer & Seidman, 1961; Spence, 1966). This detrimental effect of tangible feedback has been attributed to the fact that it distracts the child's attention from the stimulus materials (Miller & Estes, 1961; Penny, 1967; Spence & Dunton, 1967). Barringer and Gholson (1979) closed their review by stating that educators should look closely at the research before instituting feedback systems that use tangible feedback, such as token economy, because the research tends to show them least effective.
These conclusions were supported in a study by Donohue and Ratliff (1976). They investigated the differential effects of a contingent reward (candy), punishment (loss of candy) and knowledge of results with ten year old boys during an acquisition exercise on a laboratory instrument. The level of performance was significantly higher for those who received knowledge of results only with no other reinforcement. Donohue and Ratliff (1976) concluded that knowledge of results serves to focus attention on the relevant aspects of the task. The candy reward served as a distraction.

Recent studies have investigated the role of visual feedback on the acquisition of the task. Dwyer and Arnold (1976) studied the effects of verbal and visual feedback. Subjects were provided with a programmed instruction in one of two forms: (1) providing printed (verbal) reinforcement (2) visual reinforcement. A third group received text like material. Differences were found between the groups for several criterion. Henderson (1977) examined the role of various sources of feedback in developing and maintaining the complex skill of dart throwing. Both visual and auditory feedback were manipulated. Immediate and delayed feedback effectiveness was also measured. When there was a brief delay of visual feedback, accuracy was affected, but with practice the accuracy recovered. When the subjects received no visual feedback, they used subtle
cues. The subject identified the relative location of the dart from the sound of it hitting the target. When even the sound was removed, the subject's consistency remained the same, but accuracy fell. As soon as all feedback cues were restored, accuracy improved. Henderson's conclusions were that delayed feedback was detrimental to performance. She also noted that subjects can improve their competence when no external feedback is available.

A great amount of the research completed during the last five years investigated the effect of feedback on present and future performance of the student (Clair & Snyder, 1979; Latta, 1978; Saudargas et al., 1977; VanHouten, Hill & Parson, 1975; VanHouten & McKillop, 1977; Woolfolk, 1978). All have attempted to identify how feedback can facilitate acquisition of skills and the student's future performance. Clair and Snyder (1979) conducted an experiment with college students to examine the effect of instructor delivered evaluative feedback on a subsequent classroom task. It was hypothesized that the evaluative feedback to students on their past performance would result in changed performance on a subsequent task. This has been referred to as the self-fulfilling prophecy or 'Pygmalion effect' in previous research (Rosenthal, 1971; Rosenthal & Jacobson, 1968). In the Clair and Snyder study, subjects received one of four evaluative feedback conditions on six learning task trials (uniformly positive,
uniformly negative, negative-to-positive, positive-to-negative). The subjects then listened to an audio tape and took a performance test. The subjects' performance was higher for those who received positive reinforcement, followed by negative-to-positive, positive-to-negative, and uniformly negative. Woolfolk (1978) studied student learning and varying conditions of teacher verbal and nonverbal evaluative communication. Two male and two female teachers presented four combinations of feedback to sixth graders. They were (a) verbally and nonverbally positive (b) verbally positive and nonverbally negative (c) verbally negative and nonverbally positive, or (d) verbally and nonverbally negative. Their findings were that negative nonverbal behavior lead to significantly greater performance during the lesson.

Latta (1978) investigated the effects of initial achievement orientation and prior success feedback on the mastery of subsequent difficult and easy tasks. His experimental group consisted of 80 male introductory psychology students; 40 had been identified as high in initial achievement orientation and 40 had been identified as low in initial achievement orientation. Latta administered six trials of a digit-symbol substitution task on which they received either feedback or no feedback. The participants then learned an easy or difficult list of paired-associates with no feedback about performance.
Results indicated success facilitates digit-symbol performance in general, but slightly more for participants initially low in achievement orientation. The findings also showed that success feedback has: (1) no effect on rate of mastery on a subsequent easy task, (2) a positive transfer effect on rate of mastery of a subsequent difficult task for participants initially high in achievement orientation, and (3) a negative transfer effect on the rate of mastery of a subsequent difficult task for participants initially low in achievement orientation.

Three studies (Saudargas et al., 1977; VanHouten et al., 1975; VanHouten & McKillop, 1975) examined the effect of a performance feedback system on academic performance. VanHouten, Hill and Parsons (1975) used timing, feedback, and public posting of student scores to improve story writing performance. The use of all these variables improved the story writing, reading comprehension, and word meaning exercises of elementary school children. VanHouten and McKillop (1977) replicated the previous study with tenth and eleventh grade honor students. The treatment consisted of the same elements: explicit timing of the composition period, self scoring and public posting of the highest scores. The writing rates of all students improved. Saudargas, Madsen and Scott (1977) investigated the effects of fixed and variable time feedback, in the form of home reports on the production rates of elementary
school children. The reports consisted of the amount of work completed, an evaluation of the quality of work and a place for the parent's signature. The reports were either distributed every Friday or on a variable time basis. When the reports were distributed on a variable time basis more assignments were completed.

Feedback has also been used to reduce behaviors that do not contribute to classroom learning. Marholin and Steinman (1977) worked with fifth and sixth grade students who had behavior problems. They found that these problems were reduced when reinforcement was contingent on academic accuracy and rate, rather than for the child working on the task. Walker and Hops (1976) had opposite results. They used three intervention groups. One was reinforced for facilitative or academic performance; one for correct academic performance; and group three for both. No significant differences were found. However, there was significant difference between the experimental and control groups favoring the experimental groups in reading and math achievement and level of appropriate behavior.

In summary, many studies have utilized feedback and other variables to enhance student performance in the classroom. In most of the studies, knowledge of results was only one aspect of the feedback. In almost every study, the feedback was immediate. The present study examines the differential effect of knowledge of results
upon learning and retention of prose material when feedback is presented immediately and when delayed. Hopefully, the results of the present investigation taken in combination with the reported outcomes of the delayed feedback experiments prior to 1975 (Anderson, 1975; Kulhavy & Anderson, 1972; More, 1969; Sassenrath & Yonge, 1968, 1969; Sturges, 1969), and the research completed in the last five years (Clair & Snyder, 1979; Latta, 1978; Saudargas et al., 1977; VanHouten, Hill & Parson, 1975; VanHouten & McKillop, 1977; Wolfolk, 1978) will help identify the specific role of feedback and the conditions under which it should be provided.

Recapitulation

The concept of attending or drawing attention to particular instructional material is a well established principle in education. As one can see from the literature reviewed above, there has been a great deal of research concerning the use of instructional objectives. When objectives are applied to broad and general learning situations, the results appear mixed (i.e. objectives appear to work only in some situations). However, the effectiveness of objectives becomes much more apparent when one deals with prose material. In every study reviewed, it was shown that acquisition of objective relevant material is improved when students are given objectives. It was also shown in many studies that incidental material, that not
related to the objectives, is also retained through the use of objectives. Taken together, these studies have also shown that performance on achievement tests can be enhanced by the specific way in which the objectives are used. That is to say that objectives are useful when they are: placed in front of the material to be read, made specific to what the instructor intends the student to learn, and provided in a sufficient number to adequately identify the material to be learned.

The results of experiments with intentional and incidental learning are also mixed. The Type I experiments (i.e. exposing the subject to learning materials under some pretext and then measuring their recall) have fairly well established that intent to learn is not in and of itself enough to insure learning. Of more critical importance, is the type of response elicited through the use of orienting activity. Unfortunately, little work has been done with the Type II experiment which is comparable to those experiments dealing with objectives; (i.e. giving the subjects a reason to complete the material then directing them to learn parts of it and testing them over all the material contained in the exercise). The few Type II experiments reported have agreed with the findings that intent is not crucial as reported in the Type I experiments, but too few Type II experiments have been done to draw a valid conclusion. It should also be noted
that most of the research on incidental learning is more on the basic end of the research continuum while studies with objectives are more applied. It would appear from the above discussion that further research must be conducted to see if the basic research findings are also true in applied situations.

Generally, the purpose of the present study is to further investigate the use of objectives in prose learning. This study focuses specifically on the little researched area of the use of both quantitative and qualitative objectives. The majority of the experiments have used qualitative objectives, but LaPorte and Nath (1976) had excellent results with quantitative objectives. The present experiment investigates both intentional, or objective relevant, and incidental learning. The primary interest in the present study is whether or not objectives direct the subject to relevant material.
METHOD

Statement of Hypotheses

The following null hypotheses were tested:

1. There will be no difference in the learning and/or retention scores in those situations in which quantitative objectives alone, qualitative objectives alone, and a combination of quantitative and qualitative objectives are presented to learners.

2. There will be no difference in learning and/or retention scores in situations using a combination of quantitative and qualitative objectives as opposed to using only one type of objective.

3. There will be no difference in the amount of incidental learning between those subjects receiving both quantitative and qualitative objectives versus those receiving quantitative objectives only or qualitative objectives only.

4. There will be no difference in the amount of direction provided for learning between qualitative and quantitative objectives as assessed by the amount of relevant material learned.

5. There will be no difference between the results on tests of comprehension of written material in those situations in which feedback is delayed versus those situations in which feedback is not delayed.
Subjects

All 64 members of two consecutive annual classes (n = 31, n = 33) of practical nursing students attending a small private school of practical nursing located within the city of Chicago formed the experimental group. All subjects had either a high school diploma or two years of high school and had passed the General Education Development Tests. In addition, all subjects had been required to take a battery of entrance screening examinations on which they had to have a minimum intelligence quotient of 90 on the California Capacity Inventory, a vocabulary grade level of 10.5 and a reading comprehension grade level of 10.5 on the Nelson Denny Reading Inventory. The experimental subjects were randomly assigned to four treatment groups (1-quantitative objectives only, n = 14; 2-qualitative objectives only, n = 15; 3-qualitative and quantitative objectives, n = 16; or 4-no objectives, n = 14). The data was analyzed from only 59 of the experimental subjects because five subjects were not present for both sessions of the experiment. This resulted in experimental groups with unequal numbers.

Procedure

The specific treatment each group (qualitative objectives only; quantitative and qualitative objectives; quantitative objectives only; and no objectives) received is described below:
1. The Qualitative Objectives Only Treatment Group. This
group received ten qualitative objectives with prose reading material. They were directed to read and study the material. At the conclusion of the study period they were given a 20 question completion test. Ten questions covered the objectives given with the prose material. The other ten questions covered incidental (not objective related) material in the passage. After taking the test one half of this group, randomly selected, received immediate feedback of their performance. They were shown the answers and were allowed to correct their test. Twenty-four hours later the other half of the group were shown the answers and were allowed to correct their test. Seven days after the initial test the entire group was retested.

2. The Quantitative and Qualitative Objectives Treatment Group. This group received the same ten qualitative objectives as the first group. They were also given a quantitative objective of 18 out of 20 correct on a posttest of comprehension. They were directed to read and study the material. At the conclusion of the study period they were given a 20 question completion test. Ten questions covered the objectives given with the prose material. The other ten questions covered incidental (not objective related) material in the passage. After taking the test, one half of this group was randomly selected and received immediate feedback of
their performance. They were shown the answers and were allowed to correct their test. Twenty-four hours later the other half of the group were shown the answers and were allowed to correct their test. Seven days after the initial test the entire group was retested.

3. The Quantitative Objectives Treatment Group. The third group received the difficult goal of 18 out of 20 correct on a posttest of comprehension. They were directed to read and study the material. At the conclusion of the study period they were given a 20 question completion test. Ten questions covered the objectives given with the prose material. The other ten questions covered incidental (not objective related) material in the passage. After taking the test, one half of this group was randomly selected and received immediate feedback of their performance. They were shown the answers and were allowed to correct their test. Twenty-four hours later the other half of the group was shown the answers and were allowed to correct their test. Seven days after the initial test the entire group was retested.

4. The No Objectives Group. This group received neither quantitative nor qualitative objectives. They were given the written material and instructed to read and study it. At the conclusion of the study period they
were given the same 20 question completion test all other groups had received. After taking the test, one half of this group was randomly selected and received immediate feedback of their performance. They were shown the answers and were allowed to correct their test. Twenty-four hours later the other half of the group was shown the answers and were allowed to correct their test. Seven days after the initial test the entire group was retested.

All subjects had 30 minutes in which to read and study the material during the initial study period. Since the average person reportedly reads 250 words per minute, as measured by the Nelson-Denny Reading Test (Brown, 1976), the experimental passage was constructed to include 2,400 words so that each subject had approximately ten minutes for reading and 20 minutes for studying. It should be noted that the subjects were free to control their time. When they felt confident that they had studied enough, they indicated the time required for completion on the cover sheet and exchanged the reading materials for a posttest.

**Materials**

The instructional materials consisted of a passage entitled "Conditions Under Which Mushrooms Grow and Thrive" from a text entitled *The Mushroom Handbook* by Kruger (1967) pages 32-51 (see Appendix B). The passage was ten pages long and contained approximately 2,400 words. It dealt with
such aspects of development as food, temperature requirements, parasitism, etc. This selection was chosen because the subjects would probably be unfamiliar with the material. This material also approximated undergraduate college-level material which all the subjects should have been able to comprehend. Twenty objectives (see Appendix D) were prepared from the passage. These objectives were very specific requiring the subjects to recall information from one or two sentences of the text. They basically fell into Bloom's (1956) classification of knowledge objectives. An example of an objective is as follows: After completing this unit you will be able to (a) give two examples of plants which form cooperative symbiosis with fungi (b) state the name for a plant's response to gravity.

The posttest (see Appendix C) was developed so as to directly reflect the objectives. One item was written for each of the objectives. Since each subject received only half of the objectives, those questions relating to the objectives the subjects received were defined as objective relevant and the remaining ten questions served as the incidental material. An example of questions that were related to the sample objectives above is as follows: (a) Give two examples of plants which form a cooperative symbiosis with fungi (b) What is the name for a plant's response to gravity? All questions were written in the recall rather than the recognition format.
The objectives, test, and posttest were reviewed by at least two other educational specialists who were familiar with objectives and construction of instructional materials. Also, three members of the faculty of Loyola University of Chicago double checked the material for face validity and accuracy. Both the educational specialists and the faculty groups reviewed each objective to see that it was clearly stated and each posttest item was directly referenced to its appropriate objective.
RESULTS

Treatment Group Comparisons

Overall, a 2 X 4 factorial analysis of variance design with unequal n's was used to evaluate amount of material learned with each of the treatments (quantitative objectives only, qualitative objectives only, quantitative and qualitative objectives, and no objectives). Two factors were employed in the analysis. One was the type of objective or combination of objectives received by the subject. These were quantitative objectives, qualitative objectives, combination of both quantitative and qualitative objectives and no objectives (control).

The second factor employed in the analysis was the type of learning: relevant, incidental, and total (the sum of the two). The dependent variable was number of correct responses on a test of 20 questions (see Appendix C). Ten questions were related to objective relevant material and ten questions were not (i.e. incidental material). Type of learning (quantitative objective only, qualitative objective only, quantitative and qualitative objectives, and no objective) was considered a replication factor (both the relevant score and incidental score are considered a part of the total score). As pointed out on page 71, the unequal n was
the result of subjects not being present for the entire experiment. The Bio-Med statistical computer package was utilized to compute the univariate tests. In addition, a one-way analysis of variance was calculated for relevant and incidental learning independently across type of objective. The SAS statistical package was used to calculate the one-way analysis of variance results.

Table I depicts the mean scores for objective relevant, incidental, and total learning for each treatment group on the posttest. The two-way analysis of variance using repeated measures revealed a significant difference for type of learning, $F(1, 55) = 16.76, p = .0001$. A Newman-Keuls Test (Kirk, 1968, p. 91) at the .01 alpha level revealed a significant difference between relevant and incidental learning for the qualitative objectives only and a combination of quantitative and qualitative objectives groups. There was significant interaction, $F(3, 55) = 7.35, p = .0003$ between type of objective X type of learning (see Table II). A graphic representation of the significant interaction depicted in Figure I shows that those groups receiving qualitative objectives only or a combination of qualitative and quantitative objectives recalled more objective relevant material than incidental material. While those receiving quantitative objectives only or no objectives recalled approximately the same amount of both objective relevant and incidental material. A one-way analysis
Table I
Mean Number Correct for Type of Learning
in Each of the Four Treatment Groups

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>n</th>
<th>Relevant</th>
<th>Incidental</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative Objective</td>
<td>14</td>
<td>3.64</td>
<td>3.64</td>
<td>7.28</td>
</tr>
<tr>
<td>Qualitative Objective</td>
<td>15</td>
<td>5.67</td>
<td>3.47</td>
<td>9.14</td>
</tr>
<tr>
<td>Quantitative &amp; Qualitative Objective</td>
<td>16</td>
<td>6.25</td>
<td>3.44</td>
<td>9.69</td>
</tr>
<tr>
<td>No Objective</td>
<td>14</td>
<td>4.00</td>
<td>4.07</td>
<td>8.07</td>
</tr>
</tbody>
</table>

Note. Total Incidental Score = 10
Total Relevant Score = 10
Total = 20
Table II

Summary Table Analysis of Variance with Repeated Measures for an Objective X Type of Learning Factorial Design on Posttest Recall

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Objective</td>
<td>23.41</td>
<td>3</td>
<td>7.80</td>
<td>.99</td>
</tr>
<tr>
<td>Type of Feedback</td>
<td>36.64</td>
<td>1</td>
<td>36.64</td>
<td>16.76 *</td>
</tr>
<tr>
<td>Objectives X Feedback</td>
<td>48.21</td>
<td>3</td>
<td>16.07</td>
<td>7.35 **</td>
</tr>
<tr>
<td>Within Cell</td>
<td>120.26</td>
<td>55</td>
<td>2.18</td>
<td></td>
</tr>
</tbody>
</table>

* p = .0001
** p = .0003
Figure I The Interaction of Mean Number Correct for Relevant and Incidental Learning on the Posttest
of variance was calculated independently for both objective and incidental relevant learning. A significant difference was found for relevant learning $F (3, 55) = 5.20, p = .003$ (see Tables III and IV). A Newman-Keuls Test revealed a significant difference at the .01 alpha level between those subjects receiving a combination of qualitative and quantitative objectives and those subjects receiving no objectives. In addition, a Newman-Keuls Test at the .05 alpha level of significance revealed a difference between the performance of subjects in the combination of objectives treatment group versus the quantitative objectives only treatment group. There also was a .05 alpha level of significant difference found between the performance of subjects in the qualitative objective only treatment group, the quantitative objective only treatment group, and no objectives treatment group. However, no significant difference was found for incidental material between the quantitative objectives only treatment group, qualitative objectives only treatment group, quantitative and qualitative objectives treatment group, and no objectives treatment group. These results must be interpreted in light of the interaction found in the initial two-way analysis of variance previously reported and depicted in Tables I and II and Figure I.

The results partially reject null hypothesis one (there will be no difference in the learning and/or retention
Table III
Summary Table of Analysis of Variance for Relevant Learning by Type of Objective

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Objective</td>
<td>71.30</td>
<td>3</td>
<td>23.8</td>
<td>5.20 *</td>
</tr>
<tr>
<td>Within Cell</td>
<td>251.55</td>
<td>55</td>
<td>4.57</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>322.85</td>
<td>58</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* \( p < .003 \)
Table IV
Summary Table of Analysis of Variance for Incidental Learning by Type of Objective

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Objective</td>
<td>3.71</td>
<td>3</td>
<td>1.237</td>
<td>.22</td>
</tr>
<tr>
<td>Error</td>
<td>307.81</td>
<td>55</td>
<td>5.596</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>311.52</td>
<td>58</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
scores in those situations in which quantitative objectives alone, qualitative objectives alone, and a combination of quantitative and qualitative objectives are presented to learners). In terms of relevant learning, the quantitative and qualitative objectives group scored the highest followed by the qualitative objective only group. The no objectives group with the quantitative objectives only group scored the lowest. The difference was significant between the posttest scores of subjects in the quantitative and qualitative objective group and the quantitative only and no objectives groups. There was also a significant difference in posttest scores between the qualitative only group, the quantitative only group, and the no objectives group.

Therefore, subjects who received qualitative objectives or both quantitative and qualitative objectives were apparently affected in their learning of prose material. However, it appears that quantitative objectives alone do not have an affect on prose learning. The second hypothesis (there will be no difference in learning and/or retention scores in situations using a combination of quantitative and qualitative objectives as opposed to using only one type of objective) was also partially rejected with the above data. For relevant learning, both a combination of quantitative and qualitative objectives was significantly better than quantitative objectives or no objectives. However, there was no significant difference between the posttest scores in the
combination of quantitative and qualitative objective group versus the qualitative only group. Again, these results may be interpreted by the fact that significant differences were found in the one-way analysis of variance but not in the two-way analysis and there was a significant interaction between type of objectives and the type of learning.

The fact that there was a significant difference between objective relevant and incidental learning scores for both the combination of quantitative and qualitative objective group and the qualitative objective group rejects both null hypothesis three (there will be no difference in the amount of incidental learning between those subjects receiving both quantitative and qualitative objectives versus those receiving quantitative objectives only or qualitative objectives only) and null hypothesis four (there will be no difference in the amount of direction provided for learning between qualitative and quantitative objectives as assessed by the amount of relevant material learned). When given a combination of quantitative and qualitative objectives or qualitative objectives only, relevant learning becomes significantly higher. Thus, it appears that qualitative objectives do direct subjects to the objective relevant material in the text. This is also supported by the interaction between type of learning and type of objective as noted previously. When qualitative objectives are
provided, either alone or in combination with quantitative objectives, relevant learning is greater than incidental learning; without qualitative objectives, relevant and incidental learning is basically the same.

An Exploratory Investigation of the Delay-Retention Effect

A total of six 2 X 4 factorial analyses of variance with unequal ns were used to analyze the data gathered in the second phase of the experiment (examining the effect of informational feedback with objectives).

Table V depicts the mean total scores on the seven day test for those receiving immediate or delayed feedback by type of objective. No significant difference was found between type of feedback or type of objective. In addition, there was no significant interaction (see Table VI).

Tables VII and VIII depict the means for relevant and incidental learning for immediate and delayed feedback by type of objective on the seven day posttest. No significant difference was found between either type of feedback or type of objective for both relevant and incidental learning. Once again, there was no significant interaction (see Tables IX and X).

A 2 X 4 factorial analysis of variance was also used to analyze the gain scores between the posttest and the seven day test. Table XI depicts the results for the total scores. No significant difference was found between type of feedback or type of objective, nor was there any
Table V

Mean Total Scores on Seven Day Test

by Type of Objective

<table>
<thead>
<tr>
<th>Feedback</th>
<th>Group</th>
<th>Immediate</th>
<th>Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quantitative Only</td>
<td>9.14</td>
<td>7.14</td>
</tr>
<tr>
<td></td>
<td>Qualitative Only</td>
<td>8.12</td>
<td>9.28</td>
</tr>
<tr>
<td></td>
<td>Quantitative and Qualitative</td>
<td>9.00</td>
<td>9.50</td>
</tr>
<tr>
<td></td>
<td>No Objectives</td>
<td>9.57</td>
<td>7.57</td>
</tr>
</tbody>
</table>

Note. Maximum Score = 10
Table VI
Summary Table of Factorial Analysis of Variance
for Type of Objective X Feedback Group
on a Total Seven Day Recall Test (Number Correct)

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Objective</td>
<td>9.40</td>
<td>3</td>
<td>3.13</td>
<td>.33</td>
</tr>
<tr>
<td>Type of Feedback</td>
<td>3.98</td>
<td>1</td>
<td>3.98</td>
<td>.42</td>
</tr>
<tr>
<td>Objective X Feedback</td>
<td>30.04</td>
<td>3</td>
<td>10.01</td>
<td>1.05</td>
</tr>
<tr>
<td>Within Cell</td>
<td>485.4</td>
<td>51</td>
<td>9.5</td>
<td></td>
</tr>
</tbody>
</table>
Table VII
Mean Relevant Learning Scores on Seven Day Test
by Type of Objective

<table>
<thead>
<tr>
<th>Group</th>
<th>Immediate</th>
<th>Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative Only</td>
<td>4.57</td>
<td>3.71</td>
</tr>
<tr>
<td>Qualitative Only</td>
<td>4.37</td>
<td>5.14</td>
</tr>
<tr>
<td>Quantitative and Qualitative</td>
<td>5.25</td>
<td>5.87</td>
</tr>
<tr>
<td>No Objectives</td>
<td>4.86</td>
<td>3.57</td>
</tr>
</tbody>
</table>

Note. Maximum Score = 10
Table VIII
Mean Incidental Learning Scores on Seven Day Test by Type of Objective

<table>
<thead>
<tr>
<th>Group</th>
<th>Immediate</th>
<th>Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative Only</td>
<td>4.57</td>
<td>3.43</td>
</tr>
<tr>
<td>Qualitative Only</td>
<td>3.75</td>
<td>4.14</td>
</tr>
<tr>
<td>Quantitative and Qualitative</td>
<td>3.87</td>
<td>3.62</td>
</tr>
<tr>
<td>No Objectives</td>
<td>4.71</td>
<td>4.00</td>
</tr>
</tbody>
</table>

*Note. Maximum Score = 10*
Table IX

Summary Table of Factorial Analysis of Variance
for Type of Objective X Feedback Group
on a Seven Day Recall Relevant Learning Test (Number Correct)

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Objective</td>
<td>19.57</td>
<td>3</td>
<td>6.52</td>
<td>1.95</td>
</tr>
<tr>
<td>Type of Feedback</td>
<td>.314</td>
<td>1</td>
<td>.314</td>
<td>.09</td>
</tr>
<tr>
<td>Objectives X Feedback</td>
<td>11.8</td>
<td>3</td>
<td>3.93</td>
<td>1.17</td>
</tr>
<tr>
<td>Within Cell</td>
<td>170.82</td>
<td>51</td>
<td>3.34</td>
<td></td>
</tr>
</tbody>
</table>
### Table X

Summary Table of Factorial Analysis of Variance for Type of Objective X Feedback Group on a Seven Day Recall Incidental Learning Test (Number Correct)

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Objective</td>
<td>2.85</td>
<td>3</td>
<td>.95</td>
<td>.28</td>
</tr>
<tr>
<td>Type of Feedback</td>
<td>2.44</td>
<td>1</td>
<td>2.44</td>
<td>.72</td>
</tr>
<tr>
<td>Objective X Feedback</td>
<td>4.74</td>
<td>3</td>
<td>1.58</td>
<td>.47</td>
</tr>
<tr>
<td>Within Cell</td>
<td>171.96</td>
<td>51</td>
<td>3.37</td>
<td></td>
</tr>
</tbody>
</table>
Table XI
Mean Difference Between Day Seven and Day One
Total Scores by Objective

<table>
<thead>
<tr>
<th>Group</th>
<th>Immediate</th>
<th>Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative Only</td>
<td>0.72</td>
<td>1.00</td>
</tr>
<tr>
<td>Qualitative Only</td>
<td>(1.24)</td>
<td>0.42</td>
</tr>
<tr>
<td>Quantitative and Qualitative</td>
<td>(0.62)</td>
<td>(0.25)</td>
</tr>
<tr>
<td>No Objectives</td>
<td>1.29</td>
<td>(0.28)</td>
</tr>
</tbody>
</table>

*Numbers in parenthesis indicate a decline in test scores between Day 7 and Day 1.
significant interaction (see Table XII). Tables XIII and XIV show the results for relevant and incidental data. For both variables, no significant difference was found between type of feedback or type of objective, nor was there any significant interaction (see Tables XV and XVI).

The above results failed to reject null hypothesis five (there will be no difference between the results on tests of comprehension of written material in those situations in which feedback is delayed versus those situations in which feedback is not delayed). Therefore, when the information on the correctness of answers on the posttest of recall was delayed, prose learning was not enhanced.
Table XII

Summary Table of Factorial Analysis of Variance for Type of Objective X Feedback Group of Changes Between Day Seven and Day One for Both a Relevant and Incidental Learning Test (Number Correct)

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Objective</td>
<td>22.08</td>
<td>3</td>
<td>7.36</td>
<td>.74</td>
</tr>
<tr>
<td>Type of Feedback</td>
<td>1.35</td>
<td>1</td>
<td>1.35</td>
<td>.14</td>
</tr>
<tr>
<td>Objectives X Feedback</td>
<td>19.00</td>
<td>3</td>
<td>6.33</td>
<td>.64</td>
</tr>
<tr>
<td>Within Cell</td>
<td>517.75</td>
<td>51</td>
<td>9.96</td>
<td></td>
</tr>
</tbody>
</table>
Table XIII
Mean Difference Between Day Seven and Day One Relevant Learning Scores by Objective

<table>
<thead>
<tr>
<th>Feedback&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Group</th>
<th>Immediate</th>
<th>Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quantitative Only</td>
<td>.14</td>
<td>.85</td>
</tr>
<tr>
<td></td>
<td>Qualitative Only</td>
<td>(1.38)</td>
<td>(.43)</td>
</tr>
<tr>
<td></td>
<td>Quantitative and</td>
<td>(.87)</td>
<td>(.5)</td>
</tr>
<tr>
<td></td>
<td>Qualitative</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No Objectives</td>
<td>.43</td>
<td>.00</td>
</tr>
</tbody>
</table>

<sup>a</sup>Numbers in parenthesis indicate a decline in test scores between Day 7 and Day 1.
Table XIV
Mean Difference Between Day Seven and Day One
Incidental Learning Scores by Objective

<table>
<thead>
<tr>
<th>Group</th>
<th>Immediate</th>
<th>Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative Only</td>
<td>-.57</td>
<td>.14</td>
</tr>
<tr>
<td>Qualitative Only</td>
<td>.13</td>
<td>.86</td>
</tr>
<tr>
<td>Quantitative and Qualitative</td>
<td>.37</td>
<td>.25</td>
</tr>
<tr>
<td>No Objectives</td>
<td>.85</td>
<td>(.28)</td>
</tr>
</tbody>
</table>

*Number in parentheses indicate a decline in test scores between Day 7 and Day 1.*
<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Objective</td>
<td>23.85</td>
<td>3</td>
<td>7.95</td>
<td>2.36</td>
</tr>
<tr>
<td>Type of Feedback</td>
<td>3.75</td>
<td>1</td>
<td>3.75</td>
<td>1.11</td>
</tr>
<tr>
<td>Objectives X Feedback</td>
<td>3.54</td>
<td>3</td>
<td>1.18</td>
<td>.35</td>
</tr>
<tr>
<td>Within Cell</td>
<td>175.03</td>
<td>51</td>
<td>3.36</td>
<td></td>
</tr>
</tbody>
</table>
Table XVI
Summary Table of Factorial Analysis of Variance for
Type of Objective X Feedback Group on Changes Between
Day Seven and Day One Incidental Learning Test (Number Correct)

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Objective</td>
<td>.289</td>
<td>3</td>
<td>.096</td>
<td>.02</td>
</tr>
<tr>
<td>Type of Feedback</td>
<td>.817</td>
<td>1</td>
<td>.817</td>
<td>.14</td>
</tr>
<tr>
<td>Objective X Feedback</td>
<td>6.56</td>
<td>3</td>
<td>2.19</td>
<td>.64</td>
</tr>
<tr>
<td>Within Cell</td>
<td>209.88</td>
<td>51</td>
<td>4.03</td>
<td></td>
</tr>
</tbody>
</table>
DISCUSSION

Discussion of the Effects of Objectives on Prose Learning

Table I (see page 79) summarizes the effect of different types of objectives on relevant and incidental learning. For relevant learning, a combination of qualitative and quantitative objectives and qualitative objectives only were significantly more effective than the quantitative objectives only and no objectives treatments (hypothesis one). The finding that qualitative objectives alone or in combination with other information facilitate the retention of objective relevant material is consistent with several other studies (Blaney & McKie, 1969; Dalis, 1970; Duchastel & Brown, 1974; Frase, 1968b; Frase, Patrick & Schumer, 1970; McNeil, 1967; Patrick, 1968; Rothkopf & Kaplan, 1972, 1974).

The basic explanation for these results can be described within the general framework of the use of orienting stimuli (Rothkopf, 1970). Essentially, orienting stimuli are thought to elicit inspection behaviors which in-turn determine what is going to be learned by the subject. The qualitative objectives presented in the present study supposedly focused the subjects' attention on the important aspects of the reading material. This focused attention
apparently led to increased performance on the posttest of comprehension.

One alternative explanation as to why objectives are generally effective is presented by Gagné (1978) using the ACT model of human memory developed by Anderson (1976). The ACT model proposes that human cognition is made up of two systems; a propositional network and a set of productions. The propositional network is a set of nodes connected by links. The nodes generally represent ideas and the links represent some sort of relationship between those ideas. A production represents procedural knowledge. The formal structure of a production is that of a condition followed by an action. Using the ACT model the effectiveness of qualitative objectives can be interpreted in two ways. First, as material is entered into the memory it is encoded to form the links and nodes discussed above. With objectives, subjects apparently altered their attending and encoding productions. That is to say, that when reading objectives the subject established a set of productions that say, "If x matches an objective, incorporate x into the propositioned network; if x does not match, don't incorporate x". Alternatively, or simultaneously, the learner could set up from the objectives a set of rehearsal productions by encoding all of the objectives and then, after reading, posing questions based on the encoded objectives. Answering these questions would strengthen the pathway used to the
extent that self-questions matched retention test questions, thus long-term recall should be improved. A third facilitative role for objectives may be that of providing an alternate pathway for to be remembered material. This is especially true when the objective is general rather than specific.

The present study indicates that a combination of quantitative and qualitative objectives is superior to quantitative objectives only and no objectives in facilitating the learning of objective relevant material from prose (hypothesis two). Frase (1975a) has proposed that the information learned from prose is a function of the reader's internal learning goals and the constraints of the prose material upon the reader's intentions. Changes in learning behaviors were conceptualized by Frase as resulting from changes in the reader's goals of learning. One method by which a reader's goals may be influenced is by externally presenting learning goals. The simplest explanation as to why subjects perform differently depending on the goal is that goals affect the amount of time spent reading the passage. However, the effectiveness of quantitative objectives to increase prose learning must be evaluated in light of the fact that there was no significant difference between those groups receiving both quantitative and qualitative objectives and those receiving qualitative objectives only. Also, those subjects receiving quantita-
tive objectives only scored the lowest on relevant learning. These findings are not consistent with other research (Frase, 1975a; Kaplan & Rothkopf, 1974; LaPorte & Nath, 1976; Locke, 1966; Rothkopf & Billington, 1975; Rothkopf & Kaplan, 1972) which show that goal instructions do produce changes in learning behaviors. These discrepant results may be explained in many ways.

First, the studies listed above compared groups that received goal statements that were actually qualitative in nature with groups that received no goal statements and found superior performance for those receiving goal statements. In addition, the studies cited above did not use quantitative objectives. The present study would also support the effectiveness of qualitative objectives. Another consideration is the actual construction of the experiment. Results of previous experiments involving quantitative objectives only have been somewhat different. Locke (1966) did not use prose material. He had subjects study and recall lists of words after they had been given a hard or easy goal of the number of words to recall. One study (LaPorte & Nath, 1976) was located in the literature search which dealt with quantitative objectives only. In this study three separate groups were provided with a quantitative learning objective: hard, medium, and easy. Generally, LaPorte and Nath found that students performed at the objective set for them. In contrast, in the present
study only two levels of quantitative learning objectives were provided; hard, 80% correct and easy, no specified level of performance. There also was a combination of a hard quantitative and qualitative objective. The last, a combination of both was found to be superior. Additionally, LaPorte and Nath also repeated the exercise while subjects in the present study were given instructions and had only one trial. Overall, these differences in procedure between the LaPorte and Nath study and the present study may have affected the outcome. The results with hard and easy quantitative objectives in the present study were reversed, with those receiving no quantitative objective scoring higher than those receiving the hard quantitative objective.

Another possible factor to consider when using objectives is the subject's lack of knowledge of the material and the use of quantitative objectives. Duchastel and Brown (1974) found when they studied college students learning from instructional objectives that knowledge of the use and function of instructional objectives helped students acquire more information and thus perform better on posttests of recall. The lack of knowledge about the process may have caused those who received the quantifiable objective not to recognize their purpose and importance, thus not internalizing them. Gagné (1978) in her review of long-term retention from prose learning gives a similar
explanation using Anderson's (1976) ACT memory model and elaboration hypothesis. Anderson's elaboration hypothesis states that the greater the knowledge of a prior topic, the more elaboration will take place and therefore, the greater the long-term retention. Anderson defines elaboration as the internal construction of links between ideas that had not been explicitly linked within the prose material. This is substantiated by two studies by Johnson (1973, 1974). He found college students recalled more information on immediate and seven day tests after reading prose which they had rated high as to meaningfulness and comprehensibility than on that information they had rated low on these dimensions. It seems reasonable to assume that meaningfulness and comprehensibility are correlated with prior knowledge and therefore this data provides evidence for the hypothesis that prior familiarity with material has a positive effect on long-term retention.

In the present study, the subjects in the quantitative only and those in the control group which received no objectives had little prior knowledge and no specific stimulus; such as an objective to guide them, in the processing of the material. Thus, the necessary internal constructions could not be made. This is further illustrated by the fact that after the subjects had taken the test and been given feedback, their scores increased. Apparently, the test material and feedback provided the necessary stimulus
to retain the material.

Further possible explanations of the lack of effectiveness of quantitative objectives from Gagnè's (1978) review are self-confidence and ability. Gagnè points out that the ACT model assumes that sometimes people give up the attempt to recall information. This may be related to how much in the past they have been reinforced for being persistent in completing a task. This assumption has been supported by Hiller (1974) who found that self-confidence correlated with both immediate and two-week recall information from a difficult passage. Although no specific information is available about the self-confidence of subjects in this study, it is possible that the self-confidence factor could have played a part in the scores obtained by those in the quantitative objective only group and this may have depressed the scores of many of the subjects. Practical nurse training is primarily a skill acquisition program rather than a highly intellectual program. This type of experimental exercise may actually have threatened some subjects. Ability is another factor which Gagnè discusses. After summarizing several studies (Allen, 1970; Martinez, 1973; Sanders, 1973), Gagnè concludes that verbal ability has been found to be related to long-term retention and to interact with other variables in determining the amount of long-term retention. For this to be an explanation in this study, one must then
look at the power of qualitative objectives to compensate for ability. As pointed out previously, all subjects in the present experiment passed an initial screening examination for aptitude and academic achievement that required them to have average academic ability. They were assigned to treatment groups randomly, yet those receiving qualitative objectives supposedly performed better on the test because objectives provided direction to the learner as to what material was to be learned. However, it should be noted that there are other possible explanations available in the literature.

There was a significant difference between the amount of relevant learning and incidental learning for both groups that received qualitative objectives only and a combination of qualitative and quantitative objectives (hypothesis three and hypothesis four). Generally, the results obtained in this study are in agreement with previous research (Duchastel & Brown, 1974; Frase, 1968b; Frase, Patrick & Schumer, 1970; Morse & Tillman, 1972; Patrick, 1968; Rothkopf & Kaplan 1972) in that objectives facilitate student learning by providing direction for learning. However, the effect of objectives on incidental learning has not been clearly identified. Although research has shown that prequestions depressed incidental learning, in the present study there was no significant difference between groups on the incidental learning
questions. Rothkopf and Kaplan (1972) contrasted the effects of objectives on relevant and incidental learning and found that experimental groups that were provided with objectives performed better in relevant learning situations than in incidental learning situations. However, they also performed better in incidental learning situations than a control group who were told to learn everything. Duchastel and Brown (1974) found significant differences between the amount of incidental material learned between a group receiving objectives and a group not receiving objectives. The group not receiving objectives learned more incidental material.

The present study also supports the findings which show that there is no significant difference in incidental learning between groups receiving and not receiving objectives (Duchastel & Brown, 1974; Morse & Tillman, 1972). One reason for this result is that the subjects did not have experience with objectives and criterion-referenced testing in their academic courses. Tiemann (1968) points out that the possible effects of objectives may not be detected in research in which the subjects have not fully accepted the idea that the posttest which they will be taking is directly referenced to the objectives presented to them. If the student thinks the instructor is going to test him or her on all the material, he or she may not pay attention to objectives as much as he or she should.
Duchastel and Brown's (1974) research supports this hypothesis. Using subjects who were familiar with objectives, the one group of subjects that received objectives learned less incidental material than the group that received no objectives.

Passage length and density of objectives could also be examined as a possible contributing cause of the lack of incidental learning. The passage used in the present experiment was 2,400 words. In studies using passages up to 1,500 words, Kaplan and Rothkopf (1972, 1974) found that the amount of relevant and incidental learning decreased with the length of passage. The number of sentences relating to the stated objectives was small; less than 1%. Duchastel (1972) found that the learning of incidental information was interfered with when the number of sentences in the passage relating to the objectives was small. Studies by Kaplan and Rothkopf (1972, 1974) reported no difference between relevant and incidental learning when subjects received objectives and 13 to 85% of the sentences in the prose material related to the objectives. Apparently, increased numbers of objectives forced the subject to inspect the material more thoroughly. The present study had approximately 5% of the sentences relating to the stated objectives. Because of this, the subjects in the present study may have searched the passage without closely inspecting the incidental material.
The significant interaction found between type of learning and type of objective is consistent with other research (Frase, 1968b; Frase, Patrick & Schumer, 1970; Kaplan, 1974; Kaplan & Rothkopf, 1974; Kaplan & Simmons, 1974; Morse & Tillman, 1972; Patrick, 1968; Rothkopf & Kaplan, 1972). That is to say that when subjects are provided with qualitative objectives they will be directed to the specific material they are to learn and they will score higher on a test of relevant learning and lower on incidental learning items. When not provided with qualitative objectives, learning will be evenly distributed between relevant and incidental learning since the student does not have the stimulus that will focus him or her toward specific material.

Discussion of the Delay Retention Effect

This experiment failed to reject the null hypothesis that there is no significant difference in retention of prose material when delayed feedback is provided as opposed to immediate feedback. This failure to reject the hypothesis must be evaluated in light of the limitations of the present study.

At least seven studies have reported superior retention with a delay of 24 to 48 hours prior to presenting feedback (English & Kinzer, 1966; Kulhavy & Anderson, 1972; More, 1969; Phye & Baller, 1968; Sassenrath & Yonge, 1968; Sturges, 1969, 1972). The experimental conditions under
which this delay-retention effect was found were basically the same in the following ways: (a) the learning task was academic material, (b) the initial test and informative feedback were presented in multiple-choice format, (c) there was only one presentation of informative feedback, and (d) the retention test consisted of the same items as the initial test.

It is important to point out that the present experiment met some, but not all of the criteria listed above. The criteria that were not met are discussed below to determine the differences that may have produced the differing outcome. First, let us dispose of two criteria that were the same in the present experiment and those previously mentioned. There was only one presentation of information feedback for each group. Second, the seven-day test consisted of the same items as the initial test. One variation that distinguishes the present experiment from others is the type of study material. The present study used a prose passage which was academic material while several other experiments have merely used a series of multiple choice questions (Kulhavy & Anderson, 1972; Sassenrath & Yonge, 1968; Sturges, 1969). Generally, the results of those studies using multiple choice questions have shown a positive relation between delay of feedback and retention of material. Some other studies have used prose material (Sturges, 1978; Surber & Anderson, 1975).
and have also had positive outcomes, while others (Newman, Williams & Hiller, 1974) found no significant difference between immediate and delayed feedback. Also, the material used in the present experiment was probably unfamiliar to the subjects and this was not the case in the experiments mentioned above. Therefore, the type of stimulus material could be a possible factor influencing the outcome. It can be assumed that all subjects had to search through unfamiliar material and half of the subjects had to locate responses to specific objectives. This searching for material would have proceeded at a much slower pace than the 240 words per minute average reading rate of the group. The 240 words per minute average reading rate is the rate predicated on reading material not searching for answers (Brown, 1976). It should also be noted that subjects were free to control their own time so there was no way of actually knowing if students used the entire time for study. In other studies (Sturges, 1978), the subjects' time was more closely controlled to insure that the subject was attending to the material. In either case the subject may not have conducted the deeper processing and made full use of the information supplied at feedback.

Another difference between previous studies and the present study is the type of question used for testing retention of material learned. The present study used completion type questions. The previously mentioned seven
studies that found significant results for delayed feedback and retention used multiple choice questions for testing. A few studies have found that the type of test item does make a difference. Sassenrath, Yonge and Schnable (1968) found that immediate feedback facilitated retention of multiple choice questions but not completion questions. Sturges (1969) varied the form of informative feedback. Feedback was received in either the form of a multiple choice question with a stem and the four alternate responses with the correct one underlined or the stem with only the correct response. Seven-day retention was superior with 24 hour delay information feedback when the feedback was presented with the stem and four alternative answers. Sturges (1978) used completion questions in a delay feedback experiment utilizing the computer and found no significant difference between immediate and delayed feedback. In the present experiment, completion questions were used and feedback was presented as a question with the correct answer. Using this format may have prevented the subjects from fully processing the material at the point of information feedback. Sturges points out that it is not what happens during the delay period that is important, but what happens immediately following the information feedback and this reaction depends, at least in part, on the information provided at the time of feedback. Also important according to Sturges, is that for
delayed information feedback to be effective, the subject must have knowledge of alternative responses, more specifically, of incorrect alternatives. This conclusion is based on the concepts developed by Craik and Tulving (1975). The basic propositions of Craik and Tulving's research is that information stored in the long-term or episodic memory is the result of operations carried out on the information by the cognitive system. How long information remains in the episodic memory depends on the depth of processing it received in the cognitive system. Depth of processing is best defined as stimulus elaboration. In the present study stimulus elaboration would have been greater when subjects were given the alternate or incorrect responses such as in a multiple choice question. Less stimulus elaboration would take place with a completion question when the subject was given only the answer and no incorrect responses. With the use of completion test items as in the present study, there were no alternative answers available to the subjects. This was especially true for those receiving no qualitative objectives. These results were reversed for those receiving immediate feedback who scored higher on the seven day test. Those groups receiving qualitative objectives had results similar to those that Sturges (1978) had reported. Delayed feedback was superior over immediate feedback in terms of retention on the seven day test but it was not significantly higher.
The findings of this study do not agree with a large group of studies which strongly suggests that delaying the presentation of the reinforcing consequence reduces its effect on the behavior upon which it has been made contingent. Most of this literature has involved infrahumans, although there is a fairly large collection of studies dealing with retarded children (Renner, 1964). Both Geis and Chapman (1971) and Annett (1969) note that the evidence that delaying feedback affects the performance of humans is less solid than the evidence of such effects with lower organisms. In an effort to explain these varying findings concerning delay of results research, Geis and Chapman (1971) suggested that the organismic variables such as anxiety, sex, IQ, age, and achievement may have an affect on the usefulness of feedback. The present study did not take into account any of the above variables and this may be a possible thrust for future research. There is research which has demonstrated a relationship between achievement, anxiety, and poor performance in females (Campeau, 1968; Carels, 1975; Devi, 1969; Suchett-Kaye, 1972; Walsh, 1971). O'Neil (1972) also found a relationship between high anxiety and poor performance on computer assisted materials. Higher levels of anxiety were associated with more difficult learning materials and high anxiety students were found to make more errors in the more difficult portions of the learning tasks. In the present study, the experimental
group consisted of 57 females and 2 males. No measure of anxiety was taken prior to the experimental sessions. The variables of intelligence, age, and achievement motivation, cited by Geis and Chapman (1971) were not controlled in the present study. Geis and Chapman could find little research that attempted to control or manipulate the variables mentioned above. There is also some research suggesting that various instructional methods are best utilized by those subjects with certain personality traits (Blitz & Smith, 1973; Conroy, 1971; Hashell, 1971; Truog, 1977). However, there does not appear to be any correlation between personality traits and affective feedback. Group differences may also be considered. Most previous studies utilized either college undergraduates (Sassenrath & Yonge, 1968, 1969; Sturges, 1968, 1969) or high school students (Surber & Anderson, 1975). College graduates and high school students may possess many of the variables discussed above that possibly enhance feedback effects. The thrust of future research could be to identify feedback procedures that can be generalized for a large population.

In addition, the type of feedback may have been inappropriate for the type of learning. Geis and Chapman (1971) stated that there may be a relationship between the type of task and the effectiveness of feedback. They concluded that feedback may be more reinforcing when one
is executing a complex motor coordination than when one is merely recognizing a correct item in a choice situation. Kulhavy (1976) also states that feedback will not be very effective when the material is very difficult and the learners spend most of their time guessing at the answers and then trying to associate the feedback with the question. The feedback process for the present experiment was very simple. The students compared their test with an answer sheet and were asked to write the correct answer. Whether the subjects found the feedback inappropriate for the task, as Geis and Chapman suggest, or that the material was too difficult, as Kulhavy suggests, are important considerations worthy of attention. Controls for both of these variables should be built into future experiments.

Suggestions for Future Research

Research concerned with the relationship between the use of objectives and prose learning still has many challenging areas that require further research. One of these areas is the relationship between quantitative and qualitative objectives. The present study is one of the first studies to use a combination of a specific quantitative objective and a specific qualitative objective. Previous studies (Kaplan & Rothkopf, 1974; Rothkopf & Billington, 1975; Rothkopf & Kaplan, 1972) have used varying degrees of specificity or varying levels of quantitative performance (LaPorte & Nath, 1976). The next phase of this research
could investigate this relationship by using the same qualitative objectives and varying the level of the quantitative objective. This research would allow one to identify the specific effect the quantitative objective has on prose learning when used in conjunction with qualitative objectives.

A second area which needs further investigation is the relationship of relevant and incidental learning in the use of objectives. To date, the results have been mixed as to whether objectives reduce or increase incidental learning (Duchastel & Brown, 1974; Frase, 1968b; Rothkopf & Kaplan, 1972). The key variable in these studies appears to be the number of objectives for length of passage or density of objectives. Further studies need to be completed that vary the density of objectives. Emphasis should be placed on using a few objectives with a long passage and then increasing the density while holding the passage length constant. This type of experiment will better define the role of number of objectives in enhancing incidental learning. Another issue that should be addressed in terms of relevant and incidental learning is the subject's knowledge about the use of objectives. Some have contended (Duchastel & Brown, 1974) that if the subject is familiar with objectives, relevant learning will be enhanced and incidental learning depressed. Research needs to be completed that will relate students' knowledge of the use
of objectives with the amount of prose learning the subject exhibits when objectives are used. If it is determined that knowledge of how to use objectives does make a difference in the amount of learning, then instructional materials could be developed that instruct students in the use of instructional objectives prior to utilizing them.

Another area for future research is that of verifying the information processing models that have attempted to explain why objectives are effective in enhancing prose learning. Models and their explanation of how objectives work are very interesting. Yet, to date very little, if any, research has been completed to specifically verify these models. Experiments should be developed that would systematically test these models and their propositions. Once these models have been identified and verified, instructional objectives and instructional material could be organized to compliment the model and thus facilitate learning.

Future research dealing with the effect of feedback when used in conjunction with different types of objectives needs to focus on the specific form the feedback should take. There are several studies (Sturges, 1969, 1972, 1978) that indicate that for delayed feedback to be effective, it must provide for sufficient depth of processing by the subject. Further experiments need to be designed that will match one type of objective with different levels of
processing. The desired outcome of such research is to identify the best combination of objectives and the level of processing to maximize the effectiveness of prose learning through the use of delayed feedback, objectives and the appropriate form of feedback.

The effect of gender on this type of task requires further study. Carels (1975) found significant sex differences in a study dealing with false feedback. His results were consistent with those obtained by Marx, Witter and Muller (1972) who found that males were superior in multiple choice learning and that females were slower learners. A study by Palmer (1972) has also shown that females react differently to frustration; specifically, that males are generally more accepting of overt reactions to frustration. Several students in the experimental group indicated that the experiment was "hard". Interpretation of this discussion about group factors becomes more difficult to explain because of the significant difference found in the first part of the experiment as opposed to the second. One must ask the important question as to why these were influences in the second part of the study but not in the first.

Future research should also place emphasis on conducting experiments in a more natural situation such as the classroom. The present study was conducted with students who were enrolled in a technical nursing training
program. Students enrolled in such a technical program may have possessed certain characteristics (IQ, aptitude, academic achievement) that affected the outcome of the experiment. Future experiments should select subjects randomly from a larger population. This would reduce the chance of subjects with high or low motivation from being concentrated in the experimental group. It should be noted though, that randomization will not totally solve the problem of motivation. It still is not known whether the subjects selected are motivated to perform the task presented to them. As one can see by the several potential research areas discussed above, the use of preinstructional strategies, such as instructional objectives, remains a viable area of research. The results of future research will hopefully provide data related to at least two areas of instructional psychology. First, additional information on how to construct and utilize instructional objectives to make them most effective in enhancing prose learning will be provided. Second, future research will help identify the type of individual who benefits most from the use of instructional objectives. Together these results will enhance the quality of time spent in classroom learning activities.
SUMMARY

The overall premise of the present investigation was that qualitative objectives presented to subjects prior to reading prose material would enhance learning and that the addition of quantitative objectives would further enhance learning. The subjects consisted of all students enrolled in two classes of a small school of practical nursing located in Chicago who were randomly assigned to four treatment groups (quantitative objectives only, qualitative objectives only, quantitative and qualitative objectives, and no objectives). Each treatment group was given one type of a combination of the objectives previously mentioned along with a prose passage. After reading the prose material all subjects took a posttest of comprehension. One half of each group then received feedback immediately on their test performance and the other half received feedback 24 hours later. It was hypothesized that there was a significant relationship between type of feedback, (immediate and delayed) and type of objectives (quantitative only, qualitative only, quantitative and qualitative, and no objectives) and the degree of relevant and incidental prose learning assessed by the posttest of retention. Specifically, it was hypothesized that delaying feedback would
enhance learning prose material when used in conjunction with quantitative and qualitative objectives. Overall, the results indicated that the provision of quantitative and qualitative objectives improved learning of prose material. That is to say, that those subjects receiving both quantitative and qualitative objectives scored higher on a posttest of retention for relevant learning than those receiving qualitative, quantitative or no objectives. It is interesting to note that the second highest scorers on relevant learning were the qualitative objectives only group. However, there was no significant difference in incidental learning. On the other hand, there were significant differences between types of learning (relevant and incidental) with the combination of quantitative and qualitative objectives and qualitative objectives groups demonstrating significant differences between relative and incidental learning. There was also a significant interaction effect between type of learning and type of objective. These results are generally consistent with other studies which continue to show that instructional objectives are an effective aid to prose learning.

Unfortunately, the exploratory component of the experiment which investigated the effects of feedback on the retention of prose material revealed no significant difference between the posttest of retention scores for those subjects in the delayed versus the immediate feedback sub-
groups. Perhaps this lack of significant findings was due to the fact that academic material unfamiliar to the subjects was used. Also, completion type questions were used in the posttest and the subjects could perhaps not fully process the information. Individual difference variables such as anxiety, sex, IQ, and achievement may have had an effect on the outcome of the feedback. Finally, the type of feedback provided may have been inappropriate for the type of learning task.
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# APPENDIX A

## Student Study Exercises

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Study Exercise - A

Qualitative Objectives Only

Directions: This is an exercise to see how well you learn from written material. You will have a maximum of twenty minutes to read and study the material and at the end of the session you will be tested over what you have read. Below are the objectives for the material. When you have completed studying, mark the time on the top of the page, turn in your material and obtain the test. After completing this unit of study you will be able to:

1. State which substance mushrooms lack which other plants have to produce food.
2. State the name for a mushroom that lives off of dead plants.
3. Define parasitism.
4. State the species of fungus that feeds on wheat.
5. Name one kind of mushroom that is found under or near green plants.
6. State the scientific term for mushroom roots-hairs.
7. State the seasons of the year when mushrooms grow best.
8. State what is the effect of extreme heat on a mushroom.
9. State how much water a mushroom must have to grow.
10. State the name for a fungus living outside a root of a plant.
Study Exercise - B

Quantitative Objectives Only

Directions: This is an exercise to see how well you learn from written material. You will have a maximum of twenty minutes to read and study the material. When you complete your studying, mark the time at the top of the page and turn in your material and obtain the test. On this test you will be expected to get 18 out of 20 correct on it.
Qualitative and Quantitative Objectives

Directions: This is an exercise to see how well you learn from written material. You will have a maximum of twenty minutes to read and study the material and at the end of the session you will be tested over what you have read. Below are the objectives for the material. You are expected to get 18 out of 20 correct on a test over the material. When you have completed studying, mark the time on the top of the page, turn in your material and obtain the test. After completing this unit of study you will be able to:

1. State which substance mushrooms lack which other plants have to produce food.
2. State the name for a mushroom that lives off of dead plants.
3. Define parasitism.
4. State the species of fungus that feeds on wheat.
5. Name one kind of mushroom that is found under or near green plants.
6. State the scientific term for mushroom roots-hairs.

7. State the seasons of the year when mushrooms grow best.

8. State what is the effect of extreme heat on a mushroom.

9. State how much water a mushroom must have to grow.

10. State the name for a fungus living outside a root of a plant.
Study Exercise - D
No Objectives

Directions: This is an exercise to see how well you learn from written material. You will have a maximum of twenty minutes to read and study the material. After you have completed studying, mark the time on the top of the page, turn in your material and obtain the test.
APPENDIX B
CONDITIONS UNDER WHICH MUSHROOMS GROW AND THRIVE

FOOD REQUIRED

Unable, because of the lack of chlorophyll, to manufacture for themselves out of the carbon dioxide of the air, out of water, and out of certain mineral salts the food they require, fungi, in order to grow and thrive, attack the higher, green plants that alone possess this power. In this respect they resemble animals. Like these, they must have starch, sugar, and other substances. Such fungi as are parasitic invade living tissues (see Parasitism, p. 33); others, the saprophytic kinds, are content with dead remains (see Saprophytism, p. 32).

SAPROPHYTISM

With few exceptions all fleshy mushrooms are saprophytes, that is, they settle upon and disintegrate plants already dead. A walk in the woods in the autumn will show them at work. Great tree trunks, lying prostrate, will be found covered with species belonging to a variety of genera (plate 1). Species of Collybia, Mycena, Omphalia, Pluteus, Pholiota, Armillaria, Tricholoma, Flammula, Hypholoma, Boletus, Clavaria, Hydnum and Thelephora find nutriment here. Scattered over the débris of the forest floor—on and amongst thoroughly rotted wood, branches, twigs and leaves—are troops of fungi, ranging from gorgeously colored and stately Amanitas to ever-so-tiny species of Marasmius. One of the latter genus, M. rotula, is always a pleasure to behold (figure 106). Upon a black stem, as fine as horsehair, is poised a delicately fluted cap, on the underside of which are gills so

PARASITISM

Whereas the saprophytic, scavenger activities of mushrooms are necessary and welcome in nature’s colossal laboratory, the parasitic, life-destroying activities, though equally necessary, are not so welcome, at least to man, in so far as plants of economic value are concerned. But destruction alternating with reproduction (construction) are the two great and eternal principles of the organic world as well as of the rest of the universe. The little,
"hopeful" acorn of the White Oak, as it germinates, is not aware of the existence of a host of fungus species already lying in wait to kill and destroy the mighty tree of which it is the humble beginning (Farlow and Seymour, 1888; Saccardo, 1882-'26, vol. 13; Seymour, '29). By far the worst of the oak's enemies is the Root-rot, caused by the Honey Mushroom, Armillaria mellea (figure 69), a species equipped with an insatiable hunger for woody tissues, including those of our prized fruit trees.

Where are our chestnut trees that represented two hundred million dollars worth of lumber? With few isolated exceptions one and all fell prey to a fungus of insignificant size, introduced into our country from Asia. All that remains now of those magnificent trees are gray skeletons, naked and desolate.

The ravages of the Wheat Rust are so enormous that our annual output of this precious cereal is considerably reduced (p. 105). For the entire world the toll levied on our economic plants by parasitic fungi is almost beyond computation. Plant breeders and students of plant diseases, by their incessant activities, attempt to hold these ravages in check.

MYCORRHIZAS OR MUSHROOM ROOTS

Collectors and students have long known that certain kinds of mushrooms are constantly found under or near trees and other green plants. Boletus larinus and B. elegans, for example, are always found under larches; Boletus granulatus (plate 9) and B. luteus (figure 70), under pines. Others do not limit themselves to specific trees, but occur either in coniferous or deciduous woods, or in both, while ubiquitous and omnivorous kinds, like the detested Armillaria mellea (figure 69), grow wherever there is wood to be devoured.

Some forty years ago, a German mycologist (Frank, 1885), after examining into the nature of this association between mushrooms and higher plants, found that the mycelia of the species studied form mantles of fine hairs or "mushroom roots" (hyphae) on the roots of their "hosts." He also stated that the relationship between the two plants is not one of parasitism, but rather one of mutual interdependence. These mushroom root-hairs he called mycorrhizas (p. 34); the relationship between the plants concerned, symbiosis (p. 36).

The question as to whether there is a perfect equilibrium in the life processes, working for the preservation of both fungus and flowering plant, is still a matter of controversy.

Mycologists distinguish between two kinds of mycorrhizas, one kind living on the outside of the roots (ectotrophic), the other within (endotrophic). It is conceded that the latter are beneficial to the invaded plants; indeed, certain orchids are absolutely dependent upon their assistance, as will be learned further on. The former are held to be mildly parasitic, at least by one school of workers.

The following mushrooms have been found to form ectotrophic mycorrhizas on the roots of trees:

- Amanita muscaria, on Birch, Larch, Pine and Spruce.
- Boletus badius, on Pine.
- Boletus edulis, on Birch.
- Boletus cibenis, on Tamarack.
- Boletus granulatus, on Pine.
- Boletus scaber, on Birch and Poplar; var. fuscus, on Birch.
Boletus versipellis, on Birch and Poplar.
Cantharellus floccosus, on Fir.
Cortinarius camphoratus, on Larch.
Hygrophorus russula, on Beech.
Lactarius deliciosus, on Pine and Spruce.
Lactarius piperatus, on Beech and Oak.
Russula emetica, on Oak.
Russula fragilis, on Pine.
Scleroderma vulgaris, on White Oak.
Tricholoma flavobrunneum, on Birch.
Tricholoma terreum, on Pine and Beech.
Tricholoma transmutans, on Oak.

Consultation of the list of mushroom species under Habitats (p. 50) will offer further suggestions to the student interested in possible mycorrhiza associations (Hatch and Doak, '33; Hatch & Hatch, '33; Henry, '32; Kauffman, '06; Kelly, '32; Mason, '30; Masui, '27; McDougall, '14; Melin, '30; Mimura, '33; Rayner, '22).

SYMBIOSIS

Cooperation is the present-day watchword among enlightened individuals, corporations and societies, and, apparently, among nations. Competition, sooner or later, means the end of one or more, or perhaps of all competitors. Some plants learned to cooperate many eons ago. In considering the mycorrhizas, or mushroom roots, it was learned that orchids and certain fungus mycelia are dependent one upon the other. This is particularly true of a Japanese orchid, Gastrodia elata, which produces no flowers on the offsets of its tuberous rhizomes unless these have been infected by mycorrhizas produced by the rhizomorphs (cord-like strands of mycelium) of that

arch tree-enemy, Armillaria mellea (Ramsbottom, '23). Frank's term, symbiosis, aptly describes this cooperative effort in plants, being derived from two Greek words meaning, "living together." Another well-known instance of symbiosis—the cooperation of fungi and algae in the lichens—was mentioned in the introduction.

TEMPERATURE REQUIREMENTS; SEASONAL OCCURRENCE

Every mushroom grower knows that temperature is one of the chief factors in the successful production of a crop. In fact the limits are very narrow, between 50 and 60 degrees Fahrenheit (see Growing Mushrooms, p. 121).

In the case of wild mushrooms there is a greater tolerance for both high and low temperatures. In the coolness of early spring—rarely in late autumn—we get morels, Pezizas and other Ascomycetes. Some, such as Boletus, occur in the hot summer months. (Is it possible that their capacity to endure the direct rays of the sun in midsummer is due to the unusually thick flesh of the caps?) The great majority of mushrooms grow in late summer and autumn. A sure sign of the approach of the latter season is the appearance of troops of Cortinarii. At the end of autumn and until well into the frosty days of November certain species of Hygrophorus of the Limacium group still hold their own. But these Hygrophori, especially H. fuligineus (for descriptions of species, consult the index), are well protected against cold by the thick slime which completely envelops the plants. One fleshy species, Collybia velutipes, grows in winter, the velvety coat of its stem and the glutinous exterior of the cap keeping out the nipping cold of December and January days (Graham, '26).
So much for mushrooms of temperate regions. In regions of a torrid or semi-torrid climate, like the hot inner valleys of California, fungi keep well under ground until their structural parts are fully formed and the spores are ready for dissemination. In *Podaxon* (figure 60b), for example, the cap, after having been perfected deep under the surface of the hot soil, is pushed up by a tough, almost wood-like, stem. In the tropics fungi of a tender, fleshy nature are rare, or they appear at high altitudes in the mountains. Extreme cold has an inhibitive effect upon fungous growth, though Buller ('24) finds that *Schizopyllum commune* is not killed by the lowest temperatures. Extreme heat, on the other hand, long enough applied, will kill the life-plasm.

![Image](https://via.placeholder.com/150)

*Figure 7* *Mitrula phalloides* as one finds it in its natural surroundings, in cold, boggy places in the Adirondacks.
WATER; MOISTURE CONDITIONS

As with all organisms, mushrooms must have water. The very low, almost alga-like, Phycomycetes actually live in water and in the juices of potatoes, fruits, etc. But ordinarily, mushrooms grow when the water supply is just sufficient for growth. Too much or too little effectually prevents or stops it (see Growing Mushrooms, p. 128). Every hunter of the common Meadow Mushroom knows that it is useless to look for this delicacy during a time of drought. He also knows that, given a favorable season of moderate rain and heat, it is equally useless to seek specimens in low, wet places, as, almost invariably, they are to be found on more or less elevated ground in meadows.

An old Italian investigator, and a modern one (Farrow), found that small Coprinus species sometimes grow in water, and certain Ascomycetes (species of Vibrissea [figure 49a] and Mitrula [figures 7, 47d]) grow on water-soaked sticks and leaves that have long lain in the cold water of mountain brooks and swamps.

LIGHT; PHOTOTROPISM

Though mushrooms as a class, unlike green plants, are relatively independent of light, there are some species that are unable to form caps and hymenial surfaces in its absence. A certain species of Lentinus (figure 57e), when growing in the dark, produces no caps but only oddly-formed stems; other species fruit freely in cellars, mines and caves (figure 29). As will be seen by consulting the list of species cited under Habitats (p. 50), some grow in the open, others in the more or less dense shade of woods and forests. One small dung-inhabiting fungus, Pilobolus crystallinus, is provided with a tiny, transparent bladder that functions as an eye. At the terminal end of the bladder is a black spore-case that is shot off with considerable force, but the shooting does not begin until the longitudinal axis of the bladder is in perfect alignment with the source of light (figure 8). Since this interesting little species grows on horse-dung, anyone can verify this phenomenon (Allen and Jolivette, '14; Buller, '21).

GRAVITY

If a large gill-mushroom in perfect condition—say, an Amanita—be left lying on a table in the horizontal position over night, it will be found by the next morning to have changed its shape. The straight stem will be curved, the upper end having assumed an approximately vertical position. The cap, which was left with its margin touching the table, will have resumed the horizontal position (figure 9). The cause of this spectacular phenomenon is gravity. Every plant must adapt its structures to the steady pull of this force. Just as the engineer, in constructing a bridge, must design its parts in such a manner that it will not be pulled down by the earth's attractive force, so a mushroom that similarly essays to construct parts above the earth's surface must arrange those parts so that the entire structure will not topple over. The problem with a gill-mushroom of the type of Amanita, in which a perfectly circular disk, the cap, is to be elevated above the soil in the horizontal position, is to have the straight, columnar stem attached to the exact center of the cap. Now, when such a specimen is laid on its side, the straight stem no longer serves this purpose. In order to bring the cap back again to the horizontal position, the
stimulus of gravity reasserts itself by curving the stem sufficiently to accomplish this.

The gills exhibit a like response to this force. In order that the spores may fall without coming in contact with the gill-sides on which they were produced, the gills hang down from the underside of the cap in the absolutely perpendicular position (figure 20a; Buller, '09, '22, '24). They do this so long as the specimen remains erect. When it is laid on its side, the gills, to regain the closest approximation to the vertical, fall over sidewise, those to the right falling to the right, those to the left falling to the left. In viewing the gills of a cap that has lain undisturbed on its margin for a few hours, it will be seen that the uppermost gills have parted from each other, whereas those lowermost are closely pressed together to form what appears like the crest of a wave. Artists, who wish to give their mushroom pictures a natural appearance, will do well to heed these truths.
The phenomenon of a plant’s response to the earth’s pull is called **geotropism**, that is, turning towards the earth. Botanists distinguish between two kinds of geotropism, viz., **positive geotropism**, which draws tissues or organs such as roots and gills toward the earth, and its negation, **negative geotropism**, which causes plant-parts, such as the plumules of seeds and the stems of mushrooms, to grow upwards and away from the earth.

### FAIRY-RINGS


 Quite a formidable list, but best known are the rings formed by *Marasmius oreades* (figures 10, 11).

To be seen almost anywhere where there are extensive areas of grass, these rings have attracted the attention of man from earliest times. In the absence of a scientific explanation of the phenomenon, the imagination was
drawn upon. Fairies were supposed to step "the light fantastic" on misty, moonlit nights, whirling around in circles as they danced, thus wearing down the grass. Gnomes and hobgoblins buried their treasure within the confines of such rings. Dragons, resting momentarily from the labor of scaring simple folk out of their wits, breathed living fire; thus scorching the greensward about them. Even "old Nick," when not at his usual devilish work, sometimes churned butter in such places, and so forth, endlessly. Later, seeking more natural causes, the then "scientists" thought that the rings marked the spots where thunderbolts had struck in the open, where a whirlwind had passed, where ants or moles had been active, or where haystacks had stood. It was not until the latter part of the eighteenth century that an English botanist (Withering, 1796) hit upon the real cause, the above-mentioned mushroom, _Marasmius oreades_ (Ramsbottom, '27; Rolfe, '25).

A fairy-ring is in reality a grass disease. Beginning from a point of infection, where spores of this fungus have started the growth of a mycelium, it spreads steadily outward (unless interrupted by lack of food), sometimes attaining a diameter of great dimensions (300 to 800 feet; this in the case of another species). In Colorado, rings, or segments of rings, have been found that must have taken anywhere from 250 to 600 years to form. The rate of advance of a ring varies according to conditions, the minimum being three inches in a year, the maximum about thirteen. The effect of fairy-ring mycelia on grass has been recently studied (Shantz and Piemeisel, '17). The initial stimulation experienced by the grass through the liberation of nitro-

![Figure 11](https://example.com/image.png)

Figure 11 Cross-section of a fairy ring produced by _Marasmius oreades_. a, center of ring; d, grass in central portion; b, inner stimulated zone; c, bare zone showing fruit-bodies of the _Marasmius_; d, outer stimulated zone; e, normal grass outside of ring; f, the mycelium. Adapted from Shantz and Piemeisel ('17) who reproduce Moliard's figure.

Three types of fairy-rings are known, the one just described, another in which the verdure is stimulated without the production of a bare zone, and a third in which no effect is visible.

The mycelia of fairy-rings are excellent illustrations of the perennial type of mycelium as opposed to that formed anew each year (see p. 80).
ANIMAL EATERS OF MUSHROOMS

Man is inclined to rate himself rather highly, especially in the realm of gastronomy, but, "there are others", creatures quite as selective, when it comes to "tickling the palate".

To begin near the bottom of the scale of animal life, the common slug does not pass by a mushroom that happens to stand in its slimy path; it halts and gormandizes until there is nothing left of the plant but a complete wreck, sometimes much to the disgust of the student who may have wanted the specimen for his scientific collections. Buller ('22) tells of the wonderful "smeller" these lowly animals have for a certain fungus.

Insects, too, are no despisers of a mushroom diet. Indeed, the larvae of some kinds may be regarded as among the happiest creatures on earth, for the mother, in depositing her eggs, seeks out especially tasty mushrooms that will serve as a food-bed for her progeny (Johannsen, '09-'12; Weiss, '22).

Certain large tropical ants, the termites, even go so far as to cultivate little, mycelial bodies as food for themselves. The "compost" is made of green leaves which are brought in by hosts of these intrepid mushroom growers. During a recent visit to Cuba, the writer saw a long procession of "bibijaguas"—Atta insularis, a termite peculiar to the island—advancing, Indian fashion, toward their nest, each individual holding a leaf-fragment aloft, like an umbrella, from which habit they get their popular name, "umbrella-ants".

The original observations on these mushroom-cultivating ants were made on Brazilian species of Acromyrmex and Atta (Forel, '28; Möller, 1893).

Advancing up the line of animal life, the tortoise occasionally stops in its leisurely peregrinations to take more than a look at the mushroom it meets. A friend of the writer once surprised this animal "red-handed" at the business of devouring an Amanita! He did not actually see it eating, but there was the Amanita with fresh evidences of having been picked at, and there was the tortoise, its beak still retaining tell-tale fragments of the meal! A jury would hang a man on evidence so conclusive.

But the prime mushroom eaters, short of discriminating humans, are the red squirrels (Buller, '20; Cram, '24; Hatt, '29). Specimens of Boleti are frequently found, their caps showing distinct signs of having been nibbled at by these rodents. When satiated, they store specimens in the forked branches of trees for future use (figure 12).

Figure 12 Red squirrel storing mushrooms in the forks of a tree branch. After W. E. Cram ('24)

They seem to prefer the substantial Boleti, but other kinds are also eaten. According to one observer (Metcalf, '25),

even the poisonous Fly Agaric, *Amanita muscaria* (plate 3) is not despised. To the forester it is not news that
deer and cattle are also fond of mushrooms.

Animals, in eating mushrooms, unconsciously aid in the
distribution of the various kinds eaten, for in devouring
the fungi they also take within themselves the spores which
are later scattered far and wide in the excreta (see Spore
Dissemination, pp. 23, 85).

**HABITATS; WHERE MUSHROOMS GROW**

General remarks. To say where mushrooms—and
fungi generally—do not grow would be easier than to
give even a few of their numberless habitats. That they
grow everywhere except in fire and in boiling water would
be a statement approximating the truth. The lower forms,
bacteria and the ferment-producers, being omnipresent,
fill the air with their tiny cells and spores that are ever
ready to pounce upon both living and dead plants and
animals. Sticky culture-plates, carried into the upper
atmosphere by airplanes and there exposed, have caught
up spores of the rust of wheat. The larger fungi, or
mushrooms, occur on all substances that offer nourishment.

In a general way it may, therefore, be said that the
places where their food plants grow, are also the places of
their occurrence. Some grow only in the open, while
others require sheltered, shady ground. Some grow
under or on certain kinds of trees, while others are to be
found in mixed woods. Many may be sought only on
dung, while others prefer association with mosses, lichens
and ferns. In a few cases they even parasitize each other
(Graham, '27, '28).

The appended tabulation, in which a large number of
the species of fleshy mushrooms are classified according
to their habitats and hosts, should prove useful to the
beginner who, finding himself in any one of the situations
where the plants or plant associations indicated grow,
would like to know what mushrooms he is apt to encounter.
The principal omissions in the list consist of species that
occur either generally in woods the character of which is
not specifically indicated in the literature, or of species that
are too rare to be taken note of in this general account.

**KINDS OF MUSHROOMS GROWING MORE OR LESS
IN THE OPEN**

- **On Mossy Rocks and in Rocky Soil**
  - *Hebeloma pascuense*
  - *Lycoperdon calyptroideum*

- **In Gravelly Soil**
  - *Amanita spreia*
  - *Entoloma scabrinellum*
  - *Hebeloma velatum*

- **In Sandy Soil**
  - *Inocybe marinimoide*
  - *Inocybe seratina*
  - *Inocybe subfulva*
  - *Laccaria laccata*
  - *Laccaria trullisata*
  - *Lactarius chelidonium*
  - *Leptota arenicola*
  - *Nauroa arenaria*
  - *Nauroa leucites*
  - *Polysaccium piscaepium*
  - *Psalliota halophila*
  - *Psilocybe arenulina*
  - *Tricholoma equestre*

- **In Clayey Soil**
  - *Clavaria argillacea*
  - *Eccilia housei*
  - *Helvella infula*

- *Inocybe rigidipes*
- *Inocybe unicolor*
APPENDIX C
Directions: Below is a quiz over the material you just studied.

1. Name the substance mushrooms lack which other plants have to produce food.

2. What is the name for a mushroom that lives off of dead plants?

3. What fungi specializes in the destruction of railroad ties?

4. What is parasitism?

5. What species of fungus eats woody tissue?

6. What species of fungus feeds on wheat?

7. Name one kind of mushroom that is found under or near trees and green plants.
8. What is the scientific term for mushroom roots-hairs?

9. What is symbiosis?

10. Give two examples of plants that form cooperative symbiosis with fungus.

11. At what temperature do mushrooms grow best?

12. What seasons of the year do mushrooms grow best?

13. How do mushrooms respond to excessively hot climates?

14. What species of mushrooms will grow in extreme cold?

15. What is the effect of extreme heat on a mushroom?

16. How much water must a mushroom have to grow?

17. How much light is needed to grow mushrooms?

18. Name a plant's response to gravity.
19. What is the name for a fungus living outside a root of a plant?

20. What is the name of the species of mushroom that grows in water?
APPENDIX D
Appendix D

Objectives - Mushroom

1. State which substance mushrooms lack which other plants have to produce food.
2. State the name for a mushroom that lives off of dead plants.
3. Name the fungi that specializes in the destruction of railroad ties.
4. Define parasitism.
5. State the species of fungus which eats woody tissue.
6. State the species of fungus that feeds on wheat.
7. Name one kind of mushroom that is found under or near green plants.
8. State the scientific term for mushroom roots-hairs.
10. State two examples of plants that form cooperative symbiosis with fungus.
11. State the temperature at which mushrooms grow best.
12. State the seasons of the year when mushrooms grow best.
13. State how some mushrooms respond to excessively hot climates.
14. State the species of mushroom that will grow in extreme cold.
15. State what is the effect of extreme heat on a mushroom.
16. State how much water a mushroom must have to grow.
17. State how much light is needed to grow mushrooms.
18. State the name for a plant's response to gravity.
19. State the name for a fungus living outside a root of a plant.
20. Name the species that grows in water.
The dissertation submitted by Lawrence A. Biro has been read and approved by the following Committee:

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The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the Committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Education.