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Evaluation of videotapes as a supplement in a college zoology course

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EVALUATION OF VIDEOTAPES AS A SUPPLEMENT IN A COLLEGE ZOOLOGY COURSE

Iowa State University PH.D. 1980

Evaluation of videotapes as a supplement in a college zoology course

by

Nadia Abdel Azeme Mohamed

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CHAPTER I. INTRODUCTION

An important development in education that has emerged as a result of research in educational psychology and theories of learning is individualized instruction.

Gagné (1970) states that an important part of the learning process is contributed by the student and his past experience. The particular way the student codes a presentation is peculiar to him, and not shared by anybody else. Allen (1975) states that if an individual is found to be deficient in abstract reasoning, perceptual coding, or analytical skills, for example, it might be possible to predict how this individual will respond to subject material that demands such processes or compensates for these deficiencies. Cronbach and Snow (1977) suggest that an adequate way of coping with individual differences might be to provide instructional methods that fit the aptitude patterns of the learner.

North (1974) suggests five ways to individualize learning programs:

1. individualizing educational objectives;
2. individualizing the evaluation process;
3. individualizing learning paths;
4. individualizing scheduling;
5. individualizing the educational facilities which students use.

From a study on learning styles, Smith (1976) concludes that students differ in their preference for teaching modalities, and if the instructional program is individualized to meet the needs of the learner, differences in student learning style preference is a variable that requires consideration.

These statements about individualized instruction are samples of the literature which indicate that individualized instruction has been accepted by most educators as an efficient method of instruction and support the idea that learning is a unique process (Burns, 1971). The old concept that all students in a given classroom should be able to learn at the same pace has been seriously questioned (Harrisberger, 1971). Educational practitioners have lagged behind in identifying and administering successful teaching strategies which facilitate learning based on these beliefs about individual differences.

Individualized instruction has often been referred to as "prescribed instruction," "self-paced instruction," and "a personalized system of instruction." All of these approaches involve the following:

1. learner diagnosis and clear goal setting;
2. continuous evaluation of learner progress;
3. self-paced learning and testing;
4. a variety of teaching materials and aids;
5. a variety of curricular units (Burns, 1971).

In universities where many courses have high student enrollment, lecture sections have been the method of instruction. In these situations, educators have found that applying the concept of individualized instruction is not easy. Recent attempts to individualize instruction in universities have provided instructional materials for each student to use when and where he wants at his own pace and convenience. Three different methods usually have been used to provide these options: the audio-tutorial system (A-T), the multi-media system, and the Personalized System

of Instruction (PSI). Samuel Postlethwait introduced the audio-tutorial method (A-T) of teaching biology at Purdue University in 1961. The A-T system of instruction was followed by the personalized system (PSI) which was introduced in 1968 by Keller. These two methods have been adopted in many colleges and universities with variations.

Recent reviews of research evaluating the audio-tutorial approach (A-T) indicate that A-T instruction has been at least as effective as conventional teaching in stimulating achievement (Mintzes, 1975; Kulik and Jaksa, 1977; Fisher and McWhinney, 1976). There also is evidence that A-T instruction reduces the amount of time students spend to complete the course work.

Research about the effectiveness of the personalized system of instruction (PSI) also has been reviewed. Different measures have been used to evaluate this system. Some of these measures are achievement at the end of the course, achievement on quizzes, number of times students repeat the quizzes, time needed to complete the course requirements, long range effect, i.e., retention and transfer of knowledge and skills achieved, and students' attitudes. All the reviews conducted indicate that students who used PSI achieved at statistically higher levels than students who were taught by the conventional methods (Robin, 1976; Fisher et al., 1976; Kulik and Kulik, 1979). PSI students achieved higher scores on retention tests and also were more able to transfer the knowledge and skills to other learning situations when compared to students taught by traditional methods. Kulik and Jaksa (1977) indicate that early studies suggested that students needed more effort and time to complete PSI

courses, while recent studies report different results. They attribute these differences to the methods used earlier in determining effort and time needed to complete the courses. They state that "Whenever students have reported study times frequently during a course rather than once at the end of a semester, they report overall time requirements for PSI courses that are consistent with time requirements for conventional courses." These authors also report a study carried out at the University of Utah in which all the materials for a psychology course were deposited in a study center. The time each student spent in this center was monitored, and the results of the study showed that the average study time for students in PSI course was 45.5 hours, while the average study time for students enrolled in the conventional course was 49.2 hours.

Cronbach and Snow (1977) state that most research about individualized instruction involves comparisons of average outcomes between two groups using two different methods of instruction. They believe, however, that interactions between learner characteristics and instructional methods in these designs should be expected and that group designs are not appropriate. The problem is to identify and locate these interactions. When aptitude-treatment interaction studies are carried out, findings suggest that the academic performance of learners who possess similar characteristics are affected by the instructional methods used. For example, students high in a given ability or aptitude achieve better under one method of instruction than they do under another method. Parkhurst (1975) suggested that knowledge of kinds of interactions would help designers of instructional materials to compensate for individual differ-

ences by identifying the materials and methods which facilitate the learning of a task. This knowledge would help also in building a basis for informed selection of alternative methods of self-paced instruction.

Background

In 1973 at Iowa State University, a strategy was developed and used in the course Biology 101 to meet the needs of students and to overcome some of the disadvantages of the large enrollment lectures. This plan, called the Phase Achievement System (PAS) (Dolphin et al., 1973), made use of three types of instructional sources:

1. large enrollment lecture sections;
2. assigned readings in a text;
3. an audio tape library.

The audio tapes were not intended to replace live lectures but were to provide an instructional alternative for students. This plan was supported by a computer-based data processing system used to score examinations and to provide master copies of the examinations from a 2,500 entry, multiple choice question pool. This instructional strategy was based mainly on mastery learning, and students could take examinations more than one time to reach the predetermined goals of the course. Students had the opportunity to take examinations up to six times throughout the quarter. The purpose of these examinations was for students to learn through the evaluation process. Examinations were criterion-referenced, and mastery of a predetermined number of phases was required for the student to pass the course.

Flynn and Simco (1974) have emphasized the need for the individualizing of evaluation when an individualized learning approach is used. He recommended that feedback for individuals rather than groups be provided, and that decisions based on the feedback be relevant to each individual. Hodgkinson (1975) reports that evaluation, when individualized, should become a way of improving learning, not just measuring learning. Further, Hodgkinson notes that the more learning is individualized, the more students need diagnostic information to perform midcourse corrections. Students who used the PAS system at ISU had an individualized system of testing. They had an opportunity to take the phase examinations up to six times. Achievement in this study was measured by the highest score a student achieved on these examinations.

Results of a study by Latta, Dolphin, and Grabe (1978) evaluated the Phase Achievement System versus the traditional system showing the following:

1. The significant predictors of the grade a student obtained were high school graduation rank (HSR); Minnesota Scholastic Aptitude Test score (MSAT); and American College Test score (ACT).
2. More able and better prepared students in both instructional systems earned higher grades (number of high school science semesters and Minnesota Scholastic Aptitude Test score were used as indicators of background and ability).
3. The low-ability students in the Phase Achievement System performed a full grade higher than compared female students in the traditional system.

4. The underachievement of certain female students in the traditional system was attributed to high test anxiety, while the noncompetitive nature of PAS appeared to allow highly test-anxious students to perform at a higher level through perseverance.
5. Perseverance was found to be positively related to performance in PAS, which was not the case for the females in the traditional system. The researchers concluded that the Phase Achievement System was apparently compensatory for female test anxiety.

As a result of this study, instructors felt that PAS should be used to a greater extent in teaching freshman courses such as Biology 101 and 103, and Zoology 155. Therefore, in 1976, a project was developed and funded by a grant from the National Science Foundation to apply the PAS mastery learning model to the three lecture courses in freshman biology and to create video cassette instructional materials at varying concept levels in an attempt to provide for individual differences, not only in testing, but in instruction.

Zoology 155, which represents the concern in this study, was one of the freshman courses that was included in the project. Students usually sign up for this course in their third or fourth quarter in the University. The title of Zoology 155 is "Basic Human Anatomy and Physiology." For the project, this course was first divided into 10 phases or modules, which were later reduced to six phases, with each phase covering one or two human body subsystems. The course includes the following phases:

Phase 1 - body organization and the integumentary system;

Phase 2 - the nervous system;

Phase 3 - the skeletal system and the muscular system;

Phase 4 - the circulatory system;

Phase 5 - the digestive system and the respiratory system;

Phase 6 - the urinary system and the reproductive system.

Thirty videotape lectures were made on these topics for the following purposes:

1. to create an alternative means of acquiring the basic concepts of anatomy and physiology;
2. to make lectures available on demand through video cassettes in the university library for students preparing for self-paced examinations;
3. To permit the use of outstanding materials and demonstrations which could not be successfully shown in a large lecture hall;
4. to provide lectures for those who have been unable to attend classroom lectures.

Therefore, the learning resources comprising Zoology 155 are large lectures, assigned readings in a text, a study guide, and thirty videotapes.

A research study was carried out during the grant period to determine the effect of videotape use on achievement of students. Results obtained indicate a positive relationship between achievement and the frequency of use of the video cassettes. In a multiple regression analysis, student grades in Biology 101, Biology 103, and Zoology 155 were used as dependent variables, and the MSAT scores, HSSC, Test of Anxiety scores, and TV viewing as the independent variables. All regression equations were found to be highly significant. When students were divided into high and low groups of ability and background and analysis of variance was used, all groups were seen to profit from viewing the videotapes (Dolphin, 1980).

Fulton, in 1969, obtained similar results in a ten-year experiment of teaching psychology using video cassette lectures. His results indicate that students who replayed tapes achieved higher course grades. Fisher and her colleagues carried out a study in which they compared three groups of students, one group enrolled in a video-auto-tutorial course, and two groups enrolled in two similar introductory genetics courses taught by the lecture-discussion method. The criterion of effectiveness used in the comparison was the gain in knowledge of the subject as measured through objective tests of achievement preceding and following instruction. The results indicated that the video-auto-tutorial group, while beginning the instructional quarter with less knowledge of the subject matter, completed the quarter with greater knowledge of the subject than students in the lecture groups (Fisher et al., 1977). Much of the previous research reports the effects of the videotape viewing on achievement of students. The quality of the videotapes as perceived by the students was ignored in most of these studies. Therefore, one of the objectives in the proposal for the project was to evaluate the quality of the video cassettes. Because of this objective, and because of the preliminary results which were obtained indicating the role of tape viewing as a moderator variable in an individual differences model, it was decided that more information about each tape and group of tapes in the teletutor system was needed.

Purposes of the Study

1. This study evaluates the videotapes as a learning device supporting the Phase Achievement System (PAS), with the following subpurposes:

a. To determine and analyze the frequency of use of the videotapes as a whole, and of each tape separately, in Fall Quarter, 1978.

b. To obtain opinions from students about the quality of each tape and how each tape satisfied their needs.

c. To determine the reasons students spend time viewing the videotapes.

d. To study the relationship between videotape viewing on each phase and students' scores on that phase.

e. To determine factors influencing use of videotapes including cognitive and affective data.

2. In addition to evaluating the videotapes, the effect of the backgrounds and abilities of the students on their scores in each phase was investigated. The background variables used in this study were measured by the number of biological science credits each student had during or before enrollment in Zoology 155 (CBIO), and by the number of semesters of high school science students had taken (HSSC). The abilities of the students were represented by their grade point average in college (GPA), their high school rank (HSR), and their Minnesota Scholastic Aptitude Test scores (MSAT).

3. The third part of the study investigated differences in study styles, represented in the amount of time spent viewing the videotapes, by students who had different science backgrounds and abilities.

4. Because television viewing is just one of the styles of study that could affect the scores of students on each phase, the effects of lecture notes, textbook readings, and the study guide were also investigated. The time students spent using these resources was obtained from a questionnaire administered to the students (Appendix A).

Analysis of variance was used to test hypotheses concerning the effects of TV, ability and background on achievement, and effects of ability and background variables on TV use. This was done to treat data in a simple Aptitude-Treatment Interaction framework. Main effects as well as interactions were sought. Because learning was meant to be self-paced and designed to meet individual needs, the evaluation process also aimed at searching for individual needs.

Assumptions of the Study

This study assumes the following:

1. The frequency of use of videotapes indicates the usefulness of these videotapes as a learning device.
2. The students who answered questionnaires were able to evaluate the usefulness of videotapes in fulfilling their needs in the course.

3. The students who answered the questionnaire aimed at evaluating each tape are a representative sample of all the students who watched the videotapes.
4. The students who attended Zoology 155 Fall Quarter, 1978, are representative of the students who attend this course other quarters, and the results are thus generalizable to other universities.

Limitations of the Study

Because this is a local experiment and the conditions or the environment of learning might differ at other places, educators who intend to use these results should carefully examine the learning conditions which prevailed in this study before generalizing to other learning environments.

Definition of Terms

Phase Achievement System (PAS)

The Phase Achievement System as identified and used in the project developed by Dolphin and colleagues at Iowa State University is

> A system designed around large enrollment lecture sections and audiotape library (now changed to videotape library), assigned readings in a textbook, and multiple choice examinations, compiled in a modular format. Grades are based on a criterion referenced policy requiring students to achieve a minimum score on each phase, and to pass a minimum number of phases before receiving a course grade. (Dolphin et al., 1973).

The module

A module, as identified by Burns (1971), is a short, organized learning sequence covering one or a few expected behaviors. Rahmlow (1971)

defined the components of the module as including a set of behavioral objectives, learning activities, and criterion references test items. In the Phase Achievement System, a module (phase) is an organized sequence of learning material covering one or two systems of the human body, and accompanied by a modular (phase) examination.

The Iowa State University Committee on the Use of Human Subjects in Research reviewed this project and concluded that the rights and welfare of the human subjects were adequately protected, that risks were outweighed by the potential benefits and expected value of the knowledge sought, that confidentiality of data was assured and that informed consent was obtained by appropriate procedures.

CHAPTER II. LITERATURE REVIEW

The concern of this study is to evaluate the effect of videotapes as a learning supplement to individualize learning, in relation to other sources of information available to students in the Phase Achievement System. Therefore, the review of literature concentrates mainly on two areas:

1. Individualized instruction as an instructional strategy, specifically in colleges and universities, and the development of research in individualized instruction.
2. Instructional television in general, and in colleges and universities in particular. The role of instructional television in education, the areas of study in instructional television (ITV), the advantages and disadvantages of ITV, the conditions for good programs, the research results in this field and the hypothetical interpretations of these results are discussed.

Individualized Instruction

The movement toward individualizing instruction began from two directions. One was to provide individual educational objectives, individual pacing of study, and individual sequencing of instructional material for each student. The other was to provide varying instructional methods which would allow different types of students to reach the same educational goals (Koran, 1972).

In universities, individualized instruction has been used widely following the plans developed by Keller (1968), and Postlethwait at Purdue

(Postlethwait et al., 1972). The audio-tutorial system (A-T) developed by Postlethwait utilizes different media to pace students in independent study sessions, a general assembly for group activities, and integrated quiz sessions. The features that characterize the A-T system are behavorial objectives, learning for mastery, self-paced learning, multimedia activities, repetition and reinforcement.

In Keller's plan, five components are incorporated and distinguish it from conventional systems of instruction. Those components are mastery-oriented learning, individually paced instruction, printed study guides that contain detailed behavioral objectives, and (or) study questions for communication of information, student proctors for quiz evaluation, and few lectures for stimulation and motivation (Kulik et al., 1978). Both A-T and PSI systems share some of their features and differ in other features. The Phase Achievement System used at Iowa State University also shares some of these features. (For a detailed description of the similarities and differences between PSI and PAS, see Najmaie, 1979.)

The results of research on PSI indicate that the system is effective as a whole, compared to the conventional system of instruction. The research comparing the PSI system to the traditional system represents the first stage of research in PSI. Findings of the superiority of the PSI system led to the second step, investigation of the effectiveness of the different components of the systems, trying to recognize the features that are behind the superiority of PSI. Hundreds of studies have been carried out in which researchers used different variations of the original system according to the purpose and design of their research to evaluate the

effectiveness of the components. (For a detailed discussion of the components of PSI, see Najmaie, 1979.) Kulik and his colleagues (1978), in their review of research on component features of the Keller system of instruction, found that the level of student performance in unit quizzes is a function of the level of mastery required. They also found that self-paced groups of students score higher than instructor-paced groups. Research results do not indicate that short units prevent students from developing an overall view. In an article in 1979, Kulik et al. report that the superiority of PSI has been demonstrated in a variety of course settings with a number of different research designs.

Cronbach and Snow (1977) note that "adaptation to the individual" has been a slogan widely held among educators, although such adaptation has never been systematic because no one is sure of the principles that govern matching the learner with the instructional environment. Through the use of research designs that provide for the measurement of the interaction between the instructional system and the characteristics of students, it has been found that certain groups of students can achieve better when they are instructed by a certain strategy, while other groups achieve better when they have another strategy of instruction. Therefore, the recent trend in individualized instruction research has been to investigate the instructional strategies that optimally benefit each individual. This kind of research is known as "Aptitude Treatment Interaction Research."

Koran has described the goal of aptitude treatment interaction research to be "the development of theory that reflects the manner in which

aptitude variables might be differentially related to learner performance under varying methods of instruction." The immediate objective is to seek a match between the aptitudes of learners and the instructional methods used (Koran, 1972). DiVesta (1975) describes early research that investigated the interaction between instructional treatment and individual traits as ineffective. This can be attributed to the failure of investigators to provide for trait interaction with treatments and strategies of learners in processing the information. Merrill (1975) notes that students have multi-dimensional dynamic-state aptitudes, and these dynamic aptitudes change from moment to moment. It becomes very difficult, therefore, to determine the instructional treatment that must be appropriate for a given individual at a given moment.

Allen (1975) points to some tentative generalizations reached after reviewing the aptitude treatment interaction research. These generalizations were not given as proven conclusions but stated "as indicators of the direction of the evidence." Following are some of these generalizations:

1. Individuals who have a high mental ability may benefit more from presentations by complex, fixed pace, multi-channel motion pictorial forms like television and motion pictures than do low ability individuals.
2. Advance organizers and the motivating preparatory procedures used with them facilitate the low mental ability individuals in learning, while they make no difference for high and middle mental ability individuals.

3. The use of relevant cues to emphasize the material to be learned increases the learning of that material by all ability groups.
4. Lower mental ability individuals benefit more from active participation in the learning process when they get direct feedback for their responses. They also benefit more than high ability individuals when questions related to the instructional material are provided for them.

These kinds of generalizations, although requiring more research for confirmation, can be used effectively in designing instructional strategies for individuals who have different abilities and aptitudes.

Unfortunately, most of the studies carried out in universities using individualized strategies were devised for first-year college students only, or as Dowdeswell (1973), a visitor to some of the American universities which used individualized instruction, stated, "Hardly any of these advances seem to have penetrated into subsequent years, where the teaching is still almost exclusively along traditional lines." The reasons behind this limitation are the constraints of time, money, and qualified personnel who can carry out and apply these individualized strategies.

When the attitudes of students toward individualized instruction were investigated, students preferred it to more traditional courses (Chapman et al., 1977). The proctor-tutor component stood as the preferred factor with self-pacing as the second factor. Kulik, Kulik, and Cohen (1979) reported that in 10 out of eleven studies they reviewed, students rated PSI higher than conventional courses. They also cited eight studies which investigated students' ratings of the kind of learning they achieved from

the two systems. Students also rated PSI higher in all of these studies.

In summary, individual instruction research is changing from simple comparisons between a traditional system used with one group and an individualized system used with another group, to more relevant designs in which the main concern is not to ask what kind of instruction is better but to ask what kinds of instruction are effective with what kinds of students to achieve what kinds of objectives. This kind of research is not expected to suffer from the nonsignificant results obtained in most of the previous research. In fact, it is quite logical to look for and find system-student interactions since one would not expect all students to do well under one system of instruction unless a pancea were created.

Instructional Television

Several criteria that are important for good instructional television programs have been reported. This section discusses some of the major conditions.

Ohliger (1970) indicates that a good instructional television program should be a part of an integrated system (the system approach). This approach has been defined by the National University Extension Association as "An integrated programmed complex of instructional media, machinery, and personnel whose components are structured as a single unit with a schedule of time and sequential phasing." Ohlinger also notes that the integration of educational materials, each with a carefully designed role, is the core of the system approach, indicating that instructional tele-

vision is seldom effective alone. Its optimum value is achieved only when used with other learning resources and experiences.

The system approach has been used in the most successful and innovative work, such as that of Postlethwait and Keller where more than one learning resource was used to communicate the learning information to the students. In these systems, each resource has its own objectives which are related to the objectives from other resources. This approach is not only applicable to instructional television but also to any learning system used to provide a variety of teaching materials to individualize instruction. The Phase Achievement System (PAS) also uses more than one resource of learning experiences, each with its own flexible objectives.

Anderson (1972) reports some other criteria to be considered when producing a televised instructional program. He indicated that the presentation of irrelevant cues in oral or visual channels causes a loss of learning from the other channel, although visual cues are considered better than oral cues when the goal of the program is recognition learning. Adding more cues in oral or visual channels produces more learning if these cues are not redundant, since redundancy of information does not increase learning over either channel. Katzman and Nyenhuis (1972) also find that additional visual cues such as those provided by color or live presentation tend to increase recall of pictorial material and material that is not relevant to the basic information. When they investigated the hypothesis that color presentations increase the time of attention to the program, however, this was not supported. Chu and Schramm (1967) declared that there is insufficient evidence to suggest that color television

improves learning significantly, although color may play an essential part in certain particular learning tasks.

Television in Education

Although television has been used as an educational medium in all levels of education from preschool to adult education, it has been used more frequently in elementary and secondary schools than in colleges and universities. Science and social studies appear to be the most popular areas in educational television (Lawson, 1970). One of the major purposes for which university level educational television has been used is to compensate for weaknesses in the high school background of students. Myers (1975), at the University of Florida, describes a weekly television program in solving quantitative chemical problems for students who had a poor background in mathematics. In this program, an instructor worked out the assigned homework. Examinations and quizzes taken in this course guaranteed that students worked these problems on their own and then used the television solutions to correct their mistakes and learn alternative approaches. The results of this study noted that students whose performance was better than expected on the basis of the pretest were generally those students who regularly attended the television sessions. Pantaloe (1975) used videotapes for laboratories in freshman chemistry, finding that the use of videotapes increased the percentage of students who met the predetermined criterion by 15 percent. In addition, he found that videotapes as instructional aids were comparable in cost and required less production time than standard slide-tape programs.

Videotapes were used with other media to teach general zoology to large numbers of students at the University of Maryland (Linder and Golmon, 1976). The learning materials in this study included a complete video and audio cassette collection of the zoology course. The cassette collection was designed for independent study and could be used for remedial work, for review, and for enrichment according to the desires of the individual learner. The authors report that a careful record of the use of the video and audio cassettes was maintained, with the daily frequency of use recorded as a percent of the enrollment. This record indicated that the use of cassettes never exceeded 20 percent of the class for a single day during the semester. The achievement of students on tests administered at the end of the semester seemed to be improved when compared to the achievement of the students over past semesters, and a favorable attitude was generated among students.

An experimental program at Stanford (Tutored Videotape Instruction--TVI) in 1973 contained videotapes of live presentations, small interest groups, and tutors to interact before, during, and after the presentation for group discussions. Different measures were used to evaluate this system of instruction: comparing the grade point average achieved by the experimental and control groups; comparing the grade performance; comparing the quarter-by-quarter GPAs the experimental and control groups achieved; and finally using a statistical method based on admission qualifications to estimate how well a student would be expected to perform on the Stanford campus. The estimated performance was then compared to the actual performance. Results obtained indicate that television in-

struction is as good as live instruction in large lecture classes. Furthermore, it has an advantage for students of low abilities or marginal preparation (Gibbons et al., 1975).

At three University of California campuses, an experiment was carried out in which video-autotorial instruction was provided for large enrollment courses in introductory genetics. The experimental approach used 25-minute videotape modules, a detailed syllabus, and a learning center staffed by faculty and teaching assistants. In this study, identical forms of student background questionnaires, pretests, and final tests were administered to 623 students on the three campuses. Two different analyses were used to evaluate this system of instruction. Comparisons on both pretest and final test were carried out using a one-way analysis of variance. Students were then divided into three subgroups on each campus according to their performance on the pretest to examine the extent to which instructional methods might be differentially effective for students who began the course with differing degrees of knowledge of genetics. The second analysis was a multiple-regression analysis in which background, pretest, and instructional treatment were the predictors, and achievement on the final was the criterion variable. The results indicated that differences in achievement between the experimental group taught by the video-autotorial system and the other two control groups that were taught by conventional method of instruction were significant. The researchers did not report any interactions between instructional method and background. The most potent predictor of student achievement was found to be the

instructional treatment, followed by GPA and then pretest performance (Fisher et al., 1976).

Educational television also has been used to solve different problems faced by educators and administrators in schools and universities. For example, Biedenback (1971) described the use of videotapes in in-service training programs to be used at the convenience of employees without enrolling in fixed scheduled classes. The programs he described were twelve two-hour packages, with a televised prerecorded lecture performing the teaching functions. Thomas (1976) developed a model of using television to overcome the problem of administering the standardized tests that needed to be taken by large numbers of students. He described the administration of a test called the TV Test of Science Processes to evaluate the Science for the Seventies project in Pennsylvania. This project, an experimental science curriculum for elementary schools, makes extensive use of instructional television. Thomas (1976) described television as having great potential for educational evaluation and as effective as normal classroom testing when it is constructed with care. The model he developed included nine steps: publicizing the test by giving the dates and times of the broadcast; soliciting interested schools and school districts; identifying participating institutions; distributing the test booklets, answer sheets, and teachers' manuals; verifying proctoring procedures; presenting the test; collecting test materials; distributing the results; and evaluating test and administration.

Another use of educational television has been to overcome the problem of providing technical material for students in remote areas. Anthony

(1975) reports a study in which a remote question and answer unit (Q-A) using slow scan television (SSTV) was used to provide an audiographic feedback system in remote engineering programs. The remote Q-A unit consisted of a slow scan TV camera, a TV monitor, a slow-to-fast scan converter and an audiotape recorder. Through this system, students were able to present their technical problems orally and graphically.

Research in Instructional Television

Hundreds of studies have been conducted with instructional television. The areas of research that have been extensively examined are summarized below:

1. Comparisons of television with direct instruction.
2. Studies of the attitudes of students and instructors related to instructional television.
3. Studies investigating the effects of production variables such as color versus black and white television on recall, time of attention to the program, and retention the information learned.
4. Studies comparing instructional television with no instruction at all.

Among the several efforts made to summarize the research on instructional television are these:

1. Christopher Reid and Donald W. MacLennan's (1967) summary of research carried out between 1950 and 1964, which defines the decade from 1954 to 1964 as the era of most intensive research on instructional television. The "no significant differences" con-

clusion was present in the vast majority of the studies they reviewed. A few studies showed differences in favor of instructional television, and others found differences in the opposite direction. In some of these studies, differences that were found on immediate tests of learning disappeared when students were tested after a few days or weeks.

2. Schramm's (1962) review of a total of 425 studies, concluding that "the average student is likely to learn about as much from television instruction as from ordinary classroom methods, in some cases he will learn more, and in some less."
3. Lawson's (1970) report of research in 57 studies concerned with the impact of television on learning between 1963 and 1967. Thirty of these studies came from higher education and post-graduate schools. Thirty-seven of these studies had a comparison of television to other methods as their goal. Only two of them rated television inferior to other methods. The other 20 studies were concerned with other variables: comparison of screen size, effect of programming, results of feedback, and development of attitudes.
4. Chu and Schramm's (1967) review of most of the studies conducted prior to 1967. One of the conclusions they drew was that most of the experiments were not rigidly designed. When these poorly designed experiments were compared with the few well-designed experiments, they were found to have the same results which were "no significant difference between learning from televised

teaching and learning from conventional teaching." In 15 percent of the studies, however, televised instruction was superior to conventional teaching; in 12 percent of the cases, it was inferior.

5. Kulik and Jaksa's (1977) review of ten studies carried out in the last ten years on the effectiveness of instructional video as an alternative to traditional college teaching. In seven of those ten studies, there were no significant differences in the achievement of students taught by television and lectures. Cited are two studies in which students achieved higher scores when taught by television, while one study reported significantly higher scores achieved by students taught by the conventional method.

If students can learn from televised instruction at least as much as they learn from the conventional lectures, how do the administrators, instructors, and students in schools and colleges perceive instructional television?

A study involving superintendents, principals, and classroom teachers in districts throughout the United States was conducted on the use of instructional television. In this study, questionnaires were developed and sent to subjects. The results indicate the presence of positive attitudes toward instructional television by more than fifty percent of all educators. Less than ten percent of those responding viewed instructional television negatively. Approximately thirty percent were estimated to have had training in the use of instructional television, being used

regularly by fifteen million students in public schools (Dirr and Pedone, 1978).

A study by Reid and MacLennan (1967) that included instructors in universities and colleges reported that faculty attitudes often have been more negative toward instructional television than those of teachers in elementary and secondary schools or their students. The negative attitude held by educators toward instructional television has been attributed to the fact that instructional television is perceived as a technological device which dehumanizes the teaching process and perhaps results in less effective learning. These attitudes are expected to continue until research proves that instructional television can enhance learning.

Surprisingly, attitudes of students toward instructional television are reportedly not related to their learning or achieving from it (Anderson, 1972). In his study, Janoscrat (1976) also indicates that preference of instructional medium had no effect on learning time or task performance time. Also, no relationship was found between preference and error rate at the .05 level of significance. Stefanides (1976) found in his study that positive change in student attitude can be related to achievement gain and that attitudes of students and teachers are related. Schramm and his colleagues (1970) noticed that attitudes of students became more favorable towards educational television after they have had experience with television.

The report of Chu and Schramm on educational television research concludes that at the college level, students tend to prefer small discussion classes to television classes and television classes to large

lecture classes. It also was found that students sitting in the back one-third of large lecture halls were more likely to prefer television than those in the middle one-third of the lecture hall, who in turn, preferred television more than those in front one-third of the lecture halls. The clear conclusion to be derived from this report is that "students learn effectively from instructional television when favorable conditions are provided, or when the other instructional materials and learning environment are poor." When instructional television is not efficient, the reason is usually in the way it is used.

The nonsignificant results most researchers have obtained from their experiments have been attributed to one or more of the following reasons:

1. Deficiencies in the experimental design of the experiments; the most common of these deficiencies was the use of nonrandom groups.
2. The use of measuring instruments that were not sharp enough to detect differences. Using predominantly verbal tests with visual media may be one reason for the weakness of these tests.
3. Confounding of variables so that one variable cancels the effects of another variable or is not strong enough to produce significant differences in learning.
4. The use of unidimensional tests, excluding relevant dimensions of variation. Also, content tests of unknown structure have given ambiguous scores that confound relevant dimensions of variation (Ives, 1971).

Why Instructional Television?

In addition to the research conducted about instructional television and the results obtained from them, there are many studies which discuss the advantages and the reasons behind using instructional television.

1. Television instruction can reach large audiences.
2. It is economical when a program is used for several times.
3. It provides immediacy and versatility (Lawson, 1970).
4. Learning is enhanced when students both see and listen to the material (Biedenback, 1971).
5. Some kinds of demonstrations and media are better suited to a televised program than to a live lecture.
6. Students can assimilate the material at a time they choose and at the rate they prefer in video-cassette based systems.
7. Instructional television provides a method of extending the instruction of good, experienced teachers.

The Washington County Schools used instructional television with students for nine years. The major conclusions reported by Brish (1965) indicate:

1. Pupil achievement improved significantly when television was consistently used.
2. Television accelerated the professional growth of teachers.
3. Television made it possible to upgrade the curriculum and enrich the educational program more easily and economically.
4. The operational costs of television could be met without increasing the normal school budget.

5. Television changed the role of the classroom teacher and made him a part of a teaching team.
6. Television brought greater equality of opportunity for all pupils.

The advantages of educational television mentioned above do not mean that all educators have accepted it as a good learning medium. Many educators have explained their negative opinions about instructional television as listed below:

1. There is no or little human contact, which is considered indispensible in university learning for the exchange of ideas.
2. Independent learning through instructional television tends to satisfy requirements for learning simple facts and concepts, but does not work exceedingly well when learning more complicated concepts.
3. Dividing topics into minitopics or modules to be presented on instructional television often results in the loss of linkage between the ideas being presented. The student might not be able to understand the relationship between ideas or grasp the ultimate concept at which it is aimed.
4. The lack of immediate feedback may reduce the effectiveness of learning. This deficiency seems more important when the students are advanced and the material they study is more complicated (Carlson, 1973).

Most of these disadvantages, when examined carefully, could be overcome if a systems approach were used. The instructional television pro-

gram would need to be carefully planned to represent a part of a whole learning system with its own objectives and its own shortcomings considered. Although Carlson (1973) stated that "He regrets, under any conditions, the use of television as a total substitute for the lecturer," advocates of instructional television have suggested that human contact and discussions could be carried out in lectures or small group discussions. In recent years, immediate feedback has become possible when using instructional videotapes, even at remote places (Anthony, 1975). This does not mean that the systems approach can solve all the problems of instructional television. The instructor still must carefully plan his system of teaching to overcome expected problems. Choosing instructional television as a learning medium is usually left to the judgment of the instructor, his goals, his facilities, and the learning environment he wants to provide for his students.

To conclude, in individualized instructional environments, unlike group environments, each learner deals directly with media resources. Duane (1978) states that "individualized instruction considers individual differences in both learning styles and learning rates, and a wide diversity of media must be available to compensate for these differences." Educational television can be used successfully in teaching many subject-matters in all levels of education when effectively planned and carried out. The use of video-cassettes, with the advantages they provide, stands as an important medium in individualized instruction. Fisher (1974) indicates that using the video-cassettes in individualized instruction systems can expand teachers' capabilities so they can use minicourses,

provide enrichment tapes, self-pace students, use mastery teaching, and finally allow them to make more creative use of their time and interact with students.

Kulik and Kulik (1979) indicate that "individualized instruction is teaching adapted to the background and aptitude of individual learners and materials and procedures in individualized teaching are designed to influence how, when, how much, and what students study on their own time." They also mention that some educators have predicted that television would radically change the nature of science teaching.

This current study attempts to evaluate the potential of educational television, and the other materials provided for students enrolled in Zoology 155 at Iowa State University, and used in the PAS system of instruction on their own time, considering their abilities and backgrounds. These materials include, besides the videotapes collection, a study guide, a textbook, and students' lecture notes.

CHAPTER III. METHODOLOGY

The Phase Achievement System (PAS) used in teaching zoology in this study was an individualized system of instruction designed to provide for individual differences in learning and testing. The materials included a textbook (Human Anatomy and Physiology by John W. Hole, Jr., 1978), a study guide, and thirty self-contained videotapes. Eleven copies of each tape were provided in the Media Center in the Iowa State University Library to be used on demand. Most of the tapes were about 30 minutes long and each tape covered one topic. The Media Center was equipped with 36 playback machines and 12-inch color TV monitors and a set of headphones for each machine. This center was open seven days a week for about 105 hours. Students who wanted to use the tapes made a conscious effort to go to the library and seek the tapes. A reserve system in which a student could reserve in advance a machine to use for as many hours as he wanted reduced the waiting time to less than fifteen minutes.

The study guide used was composed of ten sections, each containing many questions, diagrams, and tables as well as sample tests of either true-false or five-option multiple choice questions on one body system. It contained the concepts upon which all live lectures, videotape lectures, and examinations were based.

The Subjects

Two different groups of subjects were used for the study. The first group of 315 was enrolled in Zoology 155 at Iowa State University in Winter Quarter, 1979. This group answered two questionnaires which evalu-

ated the videotapes and investigated the reasons for spending time viewing the videotapes.

The second group of 160 students was enrolled in Zoology 155 in Fall Quarter, 1978, at Iowa State University. The reasons for using a different group of subjects were that data on their scores on the different phases, their backgrounds, their abilities and the number of tapes they viewed were available from data files collected under a National Science Foundation Comprehensive Assistance to Undergraduate Science Education Project (NSF CAUSE Project #76-16100). The differences between the students as a group in the Fall Quarter, 1978, and the students in the Winter Quarter, 1979, were assumed not to be significant. In both quarters, students were taught through the Phase Achievement System (PAS) although the instructors were different.

The Procedures

Two questionnaires were developed. One was designed to collect opinions of students about the usefulness of each tape in fulfilling their needs. The second questionnaire investigated the reasons that motivated students to view the videotapes. The two questionnaires were answered only by students who viewed the videotapes and were therefore able to evaluate them. The first questionnaire was administered by inserting a copy of it into each video-cassette in the library. When a student checked out the videotape he was asked by a member of the library staff to complete the questionnaire. This process was repeated until approximately twenty responses for each videotape were completed. This process took the entire Winter Quarter, 1979.

The second questionnaire was administered near the end of Winter Quarter, 1979. It was at this time that students had enough experience with the different types of learning sources to accurately state their reasons for viewing the videotapes. This questionnaire was attached to the last examination the students took before the end of the quarter and were collected at the end of the examination period. This examination was attended by 226 students (about 72 percent of all the students). Sixty-three of these 226 students did not use the videotapes. Four students did not answer the questionnaire leaving 159 completed responses.

The frequency of use of videotapes in Fall, 1977, and Winter, 1978, was also used as an indicator of the opinions students had toward them as a learning device. The use of tapes in each phase was obtained from the request slips students completed before checking out each tape in the library. The twenty-nine videotapes evaluated were distributed as follows:

System	Number of tapes
Body organization	1
Integumentary	2
Skeletal	2
Nervous	5
Muscular	3
Circulatory	4
Digestive	3
Respiratory	3
Urinary	3

System	Number of tapes
Reproductive	3
Total	29

Records available for each student included scores on each phase, grade point average (GPA) for current quarter, high school rank (HSR), the number of biological science credits studied concurrently or before studying Zoology 155 (CBIO), Minnesota Scholastic Aptitude Test Score (MSAT), and the number of high school semesters a student studied biology, chemistry, and physics. The college biology credits (CBIO) each student earned were obtained from responses students made to a questionnaire administered during the tenth week of the quarter. Among the students attending Fall Quarter, 1978, sixteen students did not report their college biology credits and are considered as missing values, yielding a response rate of eighty-four percent. The grade point average (GPA) was based on the credit hours a student earned at Iowa State University at the end of Fall Quarter, 1978. Students who had no credit hours at Iowa State University and had a zero or blank score in the computer files were treated as missing values. Ninety-five percent of the students had usable GPAs, while eight students were treated as having missing values. All blanks and zero values in the computer files for HSR were considered as missing values. From the one hundred and sixty students who took Zoology 155 in Fall, 1978, twenty-five students had missing HSR values. Furthermore, students who had zero or blank values in the computer files for their MSAT scores were treated as having missing values. Twenty-five percent of the MSAT scores were missing. A variable representing a student's

high school science (HSSC) background was created by adding the number of semesters each student studied biology, chemistry, and physics. When blanks on computer files for biology, chemistry, and physics were considered missing values, HSSC was 97.5 percent complete. When HSSC, CBIO, GPA, HSR, and MSAT scores were tested for homogeneity, HSR and GPA were found to be not normally distributed, but none of the known transformations corrected the dissimilar variances.

The constraints of time and costs usually mandate that all educational studies be carried out using homogeneous subgroups rather than individuals, and this study was not an exception. Students were divided according to their backgrounds and their abilities. HSSC and CBIO were used as indicators of student background. Those two variables were chosen to represent backgrounds of students because previous studies had shown that achievement of students in college biology depends on the backgrounds of students in high school biology, chemistry, and physics (Johnsten, 1968; Bennette, 1975).

The HSR, MSAT, and GPA in Fall Quarter, 1978 were used as indicators of students' abilities in this study. Butzow et al. (1977), in their study of predictors of success in college chemistry, found that GPA is the best predictor of achievement. Fisher et al. (1976) report a study about the relative contributions of student background variables on the performance of students, concluding that GPA is the second most potent predictor, after instructional treatment, in predicting achievement. Latta et al. (1978), in their evaluation of the Phase Achievement System (PAS)

used in this project, found that MSAT, HSR, and the American College Test (ACT) were all significant predictors of student grades.

The Instruments

Two questionnaires were developed and used by the investigator in this study. The first questionnaire was developed after analyzing the responses of students to an older questionnaire which was used in previous quarters by researchers working on this project. The second questionnaire was also developed in two steps. The first step used a preliminary questionnaire containing chiefly free response questions given to the students who attended Fall Quarter, 1978. The second step analyzed these reactions and opinions and then developed a more detailed and precoded questionnaire which was administered to the students in the Winter Quarter, 1979. In developing the questionnaires, two texts were used heavily: Oppenheim (1966) and Berdie and Anderson (1974). Copies of both questionnaires are in Appendix B.

The first questionnaire had 17 questions, 16 of which were precoded, and one of the free response type. Questions two and seven were developed so that if the student's response to the first part of the question was less than a particular value, he was asked to freely respond to the other part. This procedure was adopted to encourage students to list concepts and illustrations in the videotapes which they did not understand and to make suggestions about improving the television lecture.

The second questionnaire, although aimed at evaluating videotapes, provided some insight into the opinions of students about the other learning resources, i.e., the textbook, the lectures, and the study guide.

The tests used in determining student achievement were generated by a computer from a 3,000 entry multiple choice question pool. Forbes gathered the questions from instructors teaching the course and from colleagues at other universities, using the objectives of the course as a guide. A different test covering each phase was administered five times throughout the quarter. Tests were held in the evenings and not at the time scheduled for regular classes. Class time was used only for lectures. Each test had 30 multiple-choice questions for each phase, totaling 180 questions for the six phases contained in the course. The final examination, equaling seventy points, was administered at the end of the quarter and covered all phases.

Student grades in Zoology 155 were determined according to two elements or dimensions:

1. The score earned on each phase determined the depth of understanding of the material.
2. The completion of all phases successfully at the 55 percent level controlled the breadth of achievement (Dolphin et al., 1973).

Because of the nature of this study, only the depth of understanding was dealt with in the statistical analysis. This means that the data used in this study were the highest score each student obtained on each phase.

The Statistical Methods

For the first part of the study means and standard deviations were computed for each question on each tape to evaluate the videotapes as learning devices.

The following statistical procedures were used to test the hypotheses of this study:

1. A Pearson correlation matrix was computed to investigate the relationships between all the background variables, the ability variables, the number of videotapes viewed in each phase, and the student scores on the six phases.
2. To test the first hypothesis, students were divided into two groups, high and low, according to their backgrounds as measured by HSSC and CBIO variables. A two-by-two analysis of variance was used, in which the score on each phase was the dependent variable; TV viewing and HSSC were independent variables at one time; and TV viewing and CBIO were independent variables at the other time.
3. To test the second hypothesis, students were divided into two groups, high and low, according to their abilities as measured by MSAT, GPA, and HSR variables. A two-by-two analysis of variance was used, in which the score on each phase was the dependent variable, and TV viewing and one of the three ability variables were used as independent variables.
4. To test the third hypothesis, students were divided into two groups, low and high, according to the background and ability

variables. A two-by-two analysis of variance was used, in which the number of tapes viewed in each phase was the dependent variable, and two of the background and ability variables were used as independent variables.

5. Hypotheses four and five were tested using three different statistical analyses:
   a. A Pearson correlation matrix was computed for groups of students who had different abilities and backgrounds, showing the relationships between lecture notes, textbook, study guide, videotape viewing and achievement as measured by the total points achieved in all six phases.
   b. Two-way analyses of variance were used to test the main effect of these four resources of information, and the possible interactions between those resources and students' abilities and backgrounds.
   c. Step-wise regression analysis was carried out to investigate the importance of resources in predicting score and to identify the learning styles that help students with different abilities and backgrounds the most.

CHAPTER IV. EVALUATION OF THE VIDEOTAPES

The findings of the first part of the investigation are shown in this chapter. These include the frequencies of use of each video-cassette lecture and the results obtained from investigating students' opinions about the tapes. The students' reasons for using the videotapes as reflected in the answers to questionnaires are also explored.

The Frequency of Use of the Videotapes

The frequency of use of tapes was obtained for two different quarters: Fall, 1977, when the course instructor in Zoology 155 was the same person who made the videotapes (Dr. Forbes); and Winter, 1978, when a different instructor (Ms. Fassel) taught the course. The records showed that 216 students attended Zoology 155 in Fall, 1977, using the tapes 3139 times. In Winter Quarter, 1978, 261 students attended Zoology 155, using the videotapes 2050 times.

Table 1 shows the absolute frequency of use of each tape, the percentage of students viewing the tape compared to all the students attending Zoology 155, and the percentage of use for each tape compared to total use of the video-cassette collection.

Table 2 shows the frequencies calculated by each phase and the percentage of this frequency to the number of all tapes viewed during the entire quarter in Zoology 155.

The number of tapes cited in Tables 1 and 2 was twenty-nine tapes. The tape indexed 307.4 (see Appendix C) was not included because it was

Table 1. The frequency of use of each tape in Winter, 1978, and Fall, 1977, and the percentage of these frequencies to the total use of tapes and total number of students

Tape number	Winter, 1978			Fall, 1977		
	Absolute frequency of use	% to total tapes viewed	% to total course enrollment	Absolute frequency of use	% to total tapes viewed	% to total course enrollment
300	93	4.5	35.6	132	4.2	61.1
301.1	103	5.0	39.5	133	4.2	61.6
301.2	86	4.2	32.9	129	4.1	59.7
302.1	97	4.7	37.2	156	4.9	72.2
302.2	98	4.8	37.5	154	4.9	71.3
303.1	109	5.3	41.8	166	5.3	76.8
303.2	112	5.4	42.9	131	4.2	60.6
303.3	104	5.1	39.8	123	3.9	56.9
303.4	77	3.7	29.5	123	3.9	56.9
303.5	63	3.1	24.1	47	1.5	21.8
304.1	104	5.1	39.8	167	5.3	77.3
304.2	97	4.7	37.2	152	4.8	70.4
304.3	81	3.9	36.0	157	5.0	72.7
305.1	77	3.7	29.5	10	.32	4.6
305.2	73	3.6	27.9	8	.25	3.7
305.3	54	2.6	20.7	6	.19	2.8
305.4	38	1.8	10.4	1	.03	.46
306.1	57	2.8	21.8	135	4.3	62.5
306.2	57	2.8	21.8	124	3.9	57.4

Table 1. (Continued)

Tape number	Winter, 1978			Fall, 1977		
	Absolute frequency of use	% to total tapes viewed	% to total course enrollment	Absolute frequency of use	% to total tapes viewed	% to total course enrollment
306.3	41	2.0	15.7	126	4.0	58.3
307.1	45	2.2	17.2	121	3.9	56.0
307.2	40	1.9	15.3	104	3.3	48.1
307.3	36	1.8	13.8	100	3.2	46.3
308.1	69	3.4	26.4	109	3.5	50.5
308.2	62	3.0	23.7	109	3.5	50.5
308.3	38	1.8	14.6	105	3.4	48.6
309.1	55	2.7	21.1	113	3.6	52.3
309.2	41	2.0	15.7	101	3.2	46.8
309.3	43	2.1	16.5	97	3.1	44.9

Table 2. Number of tapes viewed in each phase in Winter, 1978, and Fall, 1977, quarters and the percentage to the total number of tapes viewed in each quarter

Phase number	Tapes cover the phase	Winter, 1978		Fall, 1977	
		Absolute frequency of use	% to all tapes viewed	Absolute frequency of use	% to all tapes viewed
1	300, 301.1, 301.2	282	13.8	394	12.6
2	303.1, 303.2, 303.3, 303.4, 303.5	465	22.7	590	18.8
3	302.1, 302.2, 304.1, 304.2, 304.3	477	23.3	786	25
4	305.1, 305.2, 305.3, 305.4	242	11.8	25	.8
5	306.1, 306.2, 306.3, 307.1, 307.2, 307.3	276	13.4	710	22.6
6	308.1, 308.2, 308.3, 309.1, 309.2, 309.3	308	15.0	634	20.2
Total	29	2050		3139	

not mentioned in the study guide; therefore, there was little if any use of this title.

The number of students viewing the videotapes each week through Winter Quarter, 1978, was computed from the library slips turned in by the students. These slips were tabulated daily by the project personnel and the data were stored for later use on computer tapes.

Week	Number of students viewing the tapes	
1	29	
2	114	
3[1]	111	
4	10	Christmas recess
5	13	Christmas recess
6	198	
7[1]	331	
8	198	
9[1]	256	
10	239	
11[1]	210	
12	187	
13	154	

Students' opinions for each tape were obtained from a questionnaire administered in the library. Responses were averaged and standard deviations computed. An average response and standard deviation for each

[1]The weeks in which the phase examinations were presented.

question across all tapes also was computed. Table 3 shows these averages and standard deviations.

Students were asked to show their agreement or disagreement with the statements. These were treated as a measure of the reasons that motivated these students to view the videotapes. The frequencies and results obtained from administering the questionnaires are shown in Table 4.

Discussion

The objective of this part of the study was to evaluate the videotapes as a supplementary learning device. The first part of the evaluation process was to determine the usage patterns and perceived value of videotapes by examining the usage frequency of videotapes, the students' evaluations of each title as a learning device, and the reasons students spent their time viewing videotapes.

Zoology 155 is a multi-section course with more than one instructor. The videotapes, however, were made by only one of the instructors. It was thought that the usage frequencies might vary between classes taught by the instructor who made the tapes compared to another instructor. The results indicate that students who attended Zoology 155 in Fall, 1977, with the instructor who made the tapes used the tapes more often than did the students who attended Zoology 155 in Winter, 1978, with another instructor. Only 42 percent of the students who attended Zoology 155 in Winter, 1979, with Ms. Fassel as an instructor agreed on a statement saying that they preferred studying from tapes because the tapes use the same terminology the instructor used. This percentage supports the usage

Table 3. Summary of student opinions for Zoology 155 teletutor lectures (average response ± standard deviation)

Tape No.	Number	Question number (see Appendix B) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
300.0	22	3.7	3.8	6.2	7.8	7.7	4.1	3.1	7.5	3.9	6.6	6.8	3.1	4.4	6.7	4.5	7.7
		2.1	1.9	2.6	1.6	7.5	2.6	1.6	1.8	0.7	1.9	1.2	1.9	1.5	2.1	1.8	1.6
301.1	27	2.6	3.3	6.1	6.9	7.4	3.5	3.1	7.4	2.9	7.4	6.3	4.0	3.9	6.0	3.8	7.9
		1.5	0.9	3.0	2.7	1.9	1.8	1.8	1.7	1.4	1.2	3.1	2.1	1.5	1.9	1.5	1.6
301.2	21	3.2	3.7	6.4	7.1	7.2	4.1	3.4	7.3	4.1	7.1	5.9	4.5	4.1	5.5	4.4	7.7
		1.7	2.1	1.5	1.7	1.6	1.8	1.3	1.9	1.9	1.4	2.1	2.4	2.0	2.4	1.8	1.9
302.1	20	2.6	3.1	7.4	7.1	7.6	3.4	2.3	7.6	2.6	7.2	7.0	3.9	4.3	7.2	3.8	7.8
		1.9	2.1	1.3	1.9	1.5	1.5	1.0	1.7	1.2	1.2	1.6	2.3	1.5	1.7	1.6	1.3
302.2	19	2.3	3.8	7.3	7.5	7.5	3.7	2.6	7.3	3.2	7.3	6.2	4.2	4.8	6.3	4.3	8.1
		1.3	1.5	1.2	1.6	1.4	1.8	1.3	2.0	1.2	1.3	2.2	1.9	1.6	2.3	1.5	1.2
303.1	23	3.7	4.6	6.5	6.0	7.5	4.8	3.8	6.7	4.3	6.3	6.0	4.5	4.7	5.9	4.4	6.7
		2.1	2.4	1.9	2.1	1.5	1.9	1.5	2.3	1.7	2.0	1.9	2.1	2.2	2.4	1.6	1.9
303.2	23	3.8	5.2	5.0	5.2	6.9	6.2	4.9	5.3	5.5	4.9	5.5	4.4	4.7	5.3	5.4	5.7
		2.2	2.2	4.0	2.0	1.5	2.5	2.0	3.2	2.1	1.5	1.9	1.9	1.7	1.9	2.0	2.5
303.3	20	3.8	4.6	6.3	6.0	7.2	5.5	4.1	6.8	4.5	6.4	5.1	4.5	5.5	5.1	4.9	6.9
		1.9	2.0	1.7	2.0	1.3	2.0	2.1	1.3	1.9	2.0	2.3	1.0	2.2	2.0	1.6	1.6
303.4	20	3.6	4.0	6.0	5.4	7.4	6.0	4.2	6.6	4.9	6.0	5.7	4.7	6.0	5.0	5.1	5.9
		1.8	1.6	1.7	2.0	1.2	-0.2	1.3	-1.3	2.1	2.0	1.8	1.7	2.1	2.2	1.9	1.5
303.5	20	3.2	4.3	5.9	5.7	6.8	5.5	4.1	6.5	4.0	6.2	5.8	4.5	4.9	5.0	5.0	6.2
		2.0	1.7	1.5	2.1	1.7	2.4	1.8	1.9	1.9	2.1	2.0	2.3	2.2	2.5	2.3	2.2

Table 3. (Continued)

Tape No.	Number	Question number (see Appendix B) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
304.1	22	2.3	3.4	5.9	6.7	6.6	3.4	2.6	6.9	3.3	6.9	5.8	4.0	4.3	6.7	4.1	6.1
		1.1	1.9	2.9	2.0	1.8	1.7	1.3	2.1	1.3	1.6	2.3	0.9	1.9	1.7	1.5	1.9
304.2	18	3.2	3.6	6.4	6.7	7.4	3.8	3.2	6.4	3.4	6.3	6.2	4.4	4.5	6.2	4.6	7.2
		1.3	1.7	1.7	1.9	1.4	2.1	2.7	2.0	1.7	2.2	2.0	1.0	1.9	1.6	1.3	1.4
304.3	20	2.3	2.6	7.7	7.8	7.5	3.4	2.7	8.1	3.0	7.3	8.2	4.7	3.2	6.3	3.5	7.6
		1.6	1.6	1.5	1.2	1.6	2.1	1.5	0.5	1.4	1.9	1.8	1.5	1.6	2.1	1.4	1.4
305.1	18	3.6	3.7	6.3	7.1	7.6	4.3	3.7	6.8	4.0	7.1	6.4	4.4	4.6	6.1	4.5	7.5
		1.8	1.3	1.7	1.4	3.2	2.0	1.8	2.0	1.5	1.2	1.7	1.0	1.5	1.7	1.3	1.5
305.2	16	2.8	2.9	6.4	6.6	7.1	3.7	3.4	7.4	3.1	6.9	6.4	4.3	4.8	6.9	3.8	7.0
		1.8	2.3	1.5	3.2	1.5	2.5	1.6	1.5	1.6	1.7	2.0	1.5	1.5	1.3	1.4	1.6
305.3	14	4.1	4.0	6.0	5.8	7.3	5.1	4.0	6.2	4.5	5.6	6.0	4.7	4.8	5.2	4.9	5.8
		2.2	2.1	2.2	2.2	1.5	2.4	1.7	1.8	2.1	2.5	2.0	1.1	1.5	1.8	2.0	2.2
305.4	11	4.3	4.8	6.5	6.6	6.9	5.2	3.8	6.5	4.0	5.5	5.5	5.1	4.9	5.7	4.9	6.9
		1.6	1.7	0.7	1.1	1.8	0.9	1.5	1.6	1.5	1.5	1.0	1.9	1.9	1.2	2.5	1.2
306.1	16	2.4	2.9	7.1	7.0	7.3	3.1	3.1	7.6	2.9	7.6	6.6	3.8	4.8	6.8	4.4	8.2
		1.2	1.1	1.4	1.6	1.3	1.3	1.1	3.5	1.0	0.9	1.6	1.8	2.3	1.6	1.4	1.1
306.2	11	3.0	3.1	6.6	6.8	7.4	5.0	4.1	8.0	4.1	5.9	6.1	5.6	5.0	6.0	5.1	6.5
		1.2	1.4	1.8	1.7	1.3	1.6	1.5	0.9	1.7	1.7	2.0	1.4	1.7	2.0	2.2	3.5
306.3	15	3.1	3.1	6.1	6.4	7.3	4.0	3.3	7.2	3.7	6.1	6.5	4.4	4.4	5.8	4.4	7.7
		1.2	1.4	1.9	1.9	2.1	2.1	-1.3	1.7	1.3	2.1	1.7	1.4	1.4	1.8	1.1	1.5

Table 3. (Continued)

Tape No.	Number	Question number (see Appendix B) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
307.1	15	2.5	2.9	7.3	6.9	7.1	3.6	3.2	6.7	3.2	7.0	6.5	4.7	4.9	6.9	4.0	7.7
		1.8	1.2	1.2	1.6	-1.5	1.5	1.3	2.1	-1.5	1.6	1.6	1.3	2.1	1.5	1.6	1.0
307.2	13	3.5	3.4	6.5	6.5	7.8	4.2	3.5	7.5	3.4	6.8	6.2	4.3	4.7	5.9	4.5	7.5
		1.3	1.3	1.2	2.3	1.2	1.6	1.5	1.7	1.4	1.4	1.7	1.0	1.5	1.8	1.2	1.5
307.3	13	3.0	3.1	7.1	7.0	7.3	3.7	2.9	7.5	3.9	6.9	7.2	4.3	4.2	5.9	4.4	7.0
		1.8	1.0	1.1	1.8	2.0	1.2	0.8	1.8	1.5	1.2	1.1	2.1	1.6	2.1	1.9	2.7
307.4	11	3.5	3.1	7.2	7.8	6.4	3.4	3.6	7.5	3.4	5.4	5.4	5.1	4.4	6.3	5.1	6.9
		1.9	1.1	1.8	1.1	1.7	1.5	1.8	1.4	1.7	4.2	2.9	1.3	1.0	1.6	1.9	2.0
308.1	17	3.1	3.0	6.0	6.1	6.8	4.3	3.7	6.8	3.9	6.5	6.0	4.7	5.3	5.9	5.4	6.4
		1.6	1.1	1.8	1.6	1.7	1.7	1.6	2.2	1.9	1.5	1.6	1.4	1.6	1.6	2.9	3.1
308.2	14	3.1	3.6	6.2	6.5	7.4	4.6	3.8	6.6	4.6	6.1	6.5	4.7	6.0	5.4	4.5	6.9
		1.2	0.7	1.4	1.7	1.5	1.7	1.5	2.2	1.6	2.2	2.4	1.4	1.8	2.0	1.6	2.1
308.3	13	3.0	3.5	6.4	6.9	6.9	4.4	4.4	7.0	4.0	5.9	6.2	5.1	5.3	5.9	4.3	6.8
		1.0	1.3	1.8	1.9	2.1	1.9	1.7	2.0	1.8	1.9	1.9	1.9	-1.7	2.1	1.6	2.1
309.1	14	3.2	4.0	6.4	6.9	7.5	4.5	3.6	7.1	4.2	6.4	6.6	4.2	5.0	6.3	4.5	7.0
		1.8	3.4	2.3	2.5	1.4	2.2	1.5	1.5	2.1	2.1	2.0	2.0	2.5	2.2	2.6	1.9
309.2	11	3.4	3.7	6.5	6.5	7.7	4.5	3.3	7.1	4.6	5.9	6.2	4.9	4.5	6.0	4.5	7.2
		2.4	1.9	1.9	2.1	1.1	2.2	1.4	2.0	2.3	2.4	2.0	-1.6	2.3	1.9	2.2	1.7
309.3	12	3.3	3.3	6.6	6.2	6.0	4.1	3.3	7.0	4.1	6.9	6.6	3.5	4.4	6.7	4.4	7.3
		1.8	1.4	2.0	2.3	2.5	2.4	1.8	1.9	2.2	2.0	2.1	3.1	2.5	2.1	1.9	2.2
Average response		3.2	3.6	6.5	6.6	7.2	4.3	3.5	7.0	3.8	6.5	6.2	4.4	4.7	6.0	4.5	7.0
across all tapes		0.5	0.8	0.6	0.7	-0.4	0.8	0.6	1.5	0.7	0.7	0.6	0.5	0.6	0.6	0.5	0.7

Table 4. Number of students, and their percentages, agreed or disagreed on the questionnaire

Questionnaire statement	Number of students did not answer	agreed	disagreed
1. I viewed the tapes because I did not understand the lectures.	2	11 7.1%	146 92.9%
2. I viewed the tapes because the time scheduled for the lectures was not suitable for me.		37 23.3%	122 76.7%
3. I viewed the tapes because the instructor asked us to view them.	2	74 47.1%	83 52.9%
4. I viewed the tapes because they contain illustrations which help me to understand the material better.		124 77.9%	35 22%
5. I viewed the tapes because they allowed me to repeat parts that I did not understand.	2	135 85.9%	22 14%
6. I viewed the tapes each time I had to take a test.	1	41 25.9%	117 74.1%
7. I decided to view the tapes because the textbook was hard to understand.	2	19 12.1%	138 87.9%
8. I viewed the tapes because they were more helpful in answering the questions in the study guide than were the lectures.	3	54 34.6%	102 65.4%
9. I decided to view more of the tapes after I took the first examination.	1	66 41.8%	92 48.2%
10. I liked viewing the tapes because I could study at my own pace.	4	111 71.6%	44 28.4%
11. I liked viewing the tapes because I learn more when I hear and see the information than when I read it.	2	92 58.6%	65 41.4%
12. I liked viewing the tapes because they correlate better with the test questions than do the lectures.	3	36 23.1%	120 76.9%

Table 4. (Continued)

Questionnaire statement	Number of students did not answer	agreed	disagreed
13. I viewed the tapes because they stressed the important information.	2	81 51.6%	76 48.4%
14. I preferred viewing the tapes because the study guide assignments were too broad.	4	42 27.1%	113 72.9%
15. I viewed the tapes because they were more organized than the lectures.	27	10 7.6%	122 92.4%
16. From my experience, I found that many test questions were on the tapes and not in the textbook.	34	47 37.6%	78 62.4%
17. I preferred studying from tapes rather than the textbook because the tapes use the same terminology the instructor does.	31	54 42.2%	74 57.8%
18. I studied from the tapes because the text has more information than necessary for the Zoology 155 course.	30	61 47.3%	68 52.7%
19. I had to view the tapes because the text did not have the answers for the study guide questions.	31	57 44.5%	71 55.5%
20. My background in biology was weak before I took this course, and I thought viewing the tapes would help me to understand the material.	27	55 41.7%	77 58.3%

frequencies obtained in Fall, 1977, and Winter, 1978. Students who attended Zoology 155 with the same instructor presenting the tapes and teaching in the classroom saw the tapes as a resource consonant with what was expected of them. The high frequency of tape viewing in Fall, 1977, could be attributed also to the encouragement students received from the instructor to view the videotapes. This might not occur to the same degree when the instructor is a different person. This analysis might indicate that tapes were used more often with classroom lectures when students were taught by the same instructor who appeared on the tapes. But when another instructor taught the course, tapes were not used widely. The frequency of tapes viewed by students attending Zoology 155 in Winter, 1979, rejects the idea that the tapes might only be useful for classes taught by the instructor who made them.

When the use of each title was studied for Fall, 1977, tape number 304.1 (covering part of the muscular system) had the greatest use. Over 77% of the students attending the course in this quarter saw this tape. The two other tapes covering the muscular system, 304.2 and 304.3, also had high percentages of use (70% and 73%). When the students' comments on these three tapes (questionnaire 1, questions 2, 7, and 17, see Appendix B) were examined, only one student out of twenty-two students answered the questionnaire negatively indicating one term that was not clearly defined. The instructor in tape 304.2 also was reported as speaking too fast to allow students to take notes without stopping the tape continuously. Students' other comments indicate that the information and terms used in these tapes were suitable. An analysis of these comments indicates that

students who viewed these tapes were seeking answers to questions they had from the study guide. Tape number 304.3 was reported as being closer to answering all questions from the study guide than most of the other tapes. The tapes that were viewed least in Fall, 1977, included tape number 305.4 as well as the other tapes covering the circulatory system. Only twenty-five students (0.3% of students viewing tapes) viewed the four tapes covering this system. Students' comments provide an explanation for the low viewing. Some terms were reported as not well-defined, e.g., coronary circulation, arterioles, cell anemia, mononucleosis, mycloid leukemia, symphoid leukemia, and leucocytosis. In addition, some diagrams, pictures and drawings were reported as not being clearly understandable, e.g., the capillary diagram, the tubing demonstration, and the clotting diagram. The average response of students to most, if not all, the questions which evaluated this title were approximately neutral (between four and six). These responses indicate that although students did not rate this or the other tapes covering the circulatory system as highly understandable, they did not rate them as unintelligible. These results might explain the low frequency of use of these tapes. For more explanation, the instructor who authored the tapes and taught the course was interviewed. She indicated that the circulatory system was perceived by students as a difficult phase, and most retake the test for this phase several times to pass or improve their scores. Students might prefer to attend live lectures where they are able to get an instant feedback for their questions. This explanation is supported by Carlson who stressed

the deficiency of educational television when course materials students are expected to know get advanced and more complicated (Carlson, 1973).

In Winter, 1978, with a different classroom instructor, the usage frequency for the titles covering the circulatory system also was found to be the lowest compared to the other phases in that quarter. However, it was not as small as it was in Fall, 1977 (11.8 percent of all tapes viewed). If the frequency of tape viewing is an indicator of their usefulness, the videotapes covering the other phases are apparently more useful and understandable to the students than those dealing with the circulatory system.

When the frequency of videotape use each week in the Winter, 1978, was examined, the weeks in which tests were scheduled had the highest frequencies. This fact has not been reflected in students' responses to the questionnaire. In question 6 of this questionnaire, only forty-one students (26% of all responding) indicated that they viewed the tapes each time they had to take a test. Sixty-six students (42% of all responding) agreed with the statement that they decided to view more of the tapes after they took the first test.

The findings showed also that the week in which midterm grades were due had the highest frequency of tape use. This observation could be attributed to the fact that students were required to complete at least one phase by midterm, or a F midterm notice would be filed for them.

When the averages of student opinions about each tape were examined (Table 3), the results showed that students agreed that all tapes had diagrams, pictures and drawings which helped them understand the concepts

presented on the tapes. Tapes 302.2, 304.1, and 304.3 were judged the best in this concern. Tapes 305.3 and 305.4 were considered to be least helpful.

The new terms on tapes 304.3 and 306.1 were judged as clearly defined, while tapes 303.2, 303.1, 303.3, and 303.5 were evaluated as having terms not clearly defined. Tape 305.4 was considered to be the tape that had the most ill-defined terms.

Regarding the examples used in the videotapes to explain the concepts, only three tapes, 303.2, 303.5, and 304.1, were evaluated as neutral; i.e., not confusing but at the same time not clear. Tapes 303.2, 303.4, 303.5, 305.3, 308.3, and 309.1 were evaluated to be neutral regarding organization of information. When students were asked whether the tape content was easily understood, they evaluated fifteen tapes as neutral, while they found none of the other tapes very easy or very difficult. This means that all tapes were understandable by those students who viewed them. The tape that was evaluated the most difficult to understand was tape 303.2 (nervous system, Phase 2).

All tapes were evaluated as useful by students, except for tape 303.2 which was rated as neutral in usefulness. The examples given in the videotapes were considered sufficient except for tapes 303.2, 303.4, 308.2, 309.2, for which responses of students were neutral and ranged between 4.5 and 5.5.

Students did not agree that information presented on most tapes was so technical as to not help them understand concepts. Concerning the technicality of information, the responses of students were neutral for

tapes 303.2, 305.3, 305.4, 306.2, 308.4, 308.3, and 309.2. Students did not agree that large portions of the tapes could be deleted without affecting the information they wanted to learn from them. But students were neutral in their responses about deletion in some tapes, e.g., 303.2, 303.3, 303.4, 303.5, 304.1, and 307.4. These last responses could be attributed to one of four reasons. First, those tapes may present more information than students want to learn from the course. Second, those tapes may contain more information than what students heard in the live lectures. Third, those tapes may not have provided answers they were seeking to the study guide questions as shown in their responses to questions 13 and 15 in the questionnaire. The fourth reason may be the fact students perceived that the tapes did not correlate as well as live lectures to the test questions (76% of the students thought that the tapes did not correlate well with the test questions). Fourteen tapes were evaluated by students as neutral in helping them to determine the important information, while the other fifteen tapes were considered helpful in determining the important information. None of the tapes was considered a waste of time by students.

The reasons motivating most students to view the videotapes were traits that characterize learning from educational television. The first reason was that students could repeat the material which they did not understand as many times as they wanted (statement five in the questionnaire). The second reason was that tapes contain illustrations that helped students to understand the material better. This means that the objective of using outstanding media in the tapes which could not be used

successfully in the classroom was validated. The third reason for viewing was that students could study at their own pace. The fourth reason was that students found that they learned better when they received information through two channels (hearing and viewing) than through one channel (reading only) (statement eleven in the questionnaire). These results were expected and support the results obtained in previous research about learning from television (Senour, 1971; Chapman et al., 1977).

Fifty-one percent of the students who used the videotapes agreed that they viewed the tapes because they stressed important information. Also 45 percent of the students answering the questionnaire said that they felt their background in biology was weak, and they used video lectures to help them understand course material. Small percentages of students said that they viewed tapes because they did not understand lectures or the textbook (7% and 12% of the students answered the questionnaire). Forty-four percent of the students viewed televised lectures because the text did not have the answers for all the study guide questions. Twenty-three percent of the students who answered the questionnaire said that the time scheduled for live lectures was not suitable for them, and they viewed the tapes to replace these lectures. These results indicate that the video lectures have fulfilled the objective of providing an alternative instructional resource to live lectures.

CHAPTER V. RELATIONSHIP BETWEEN ACHIEVEMENT AND THE STUDY VARIABLES

Correlations with Scores Earned on each Phase

The second purpose of this study was to investigate the effect of videotape viewing in each phase on the achievement of students with different backgrounds and abilities. The first step taken to investigate this effect was to compute Pearson correlation matrices to explore the relationships between the score earned on each phase and the backgrounds (semesters of high school science and college biology credits), and abilities (Minnesota Scholastic Aptitude Test score, high school rank, and grade point average in college) of the students. Correlations also were used to describe the relationships between the frequency of videotape viewing in each phase and the background and ability variables. Tables 5 and 6 show these correlations.

Table 5 indicates that there are high correlations between the scores of students in each phase and the number of high school science credits, the Minnesota Scholastic Aptitude Test score, the high school rank, and grade point average. With the exception of television viewing, the study pattern that correlated highest with scores in each phase was use of the study guide. Studying from the textbook was negatively correlated to scores in all phases, while studying from lecture notes was poorly correlated to scores. The correlation matrix shows also that students who viewed videotapes more frequently achieved better scores than did students who used television less often. This relationship is applicable to all phases.

Table 5. Correlations for scores on phases[a]

Variables correlated to score	Phase score 1	2	3	4	5	6
HSSC	22(.006) [156][b]	13(.103) [155]	25(.001) [156]	10(.201) [155]	17(.034) [151]	19(.017) [153]
CBIO	20(.018) [134]	22(.010) [134]	22(.011) [134]	19(.029) [134]	19(.022) [133]	22(.013) [133]
HSR	-38(.000) [135]	-38(.000) [134]	-32(.000) [135]	-36(.000) [135]	-41(.000) [131]	-44(.000) [133]
MSAT	24(.008) [120]	31(.001) [119]	30(.001) [120]	36(.000) [119]	32(.000) [116]	30(.001) [117]
GPA	58(.000) [52]	66(.000) [151]	59(.000) [152]	57(.000) [152]	62(.000) [149]	64(.000) [150]
Lec notes	08(.388) [134]	03(.703) [134]	14(.102) [134]	11(.202) [134]	03(.722) [133]	08(.368) [133]
Text	-16(.053) [134]	-15(.079) [134]	-12(.156) [134]	-16(.066) [134]	-23(.009) [133]	-.20(.024) [133]
Study G.	25(.004) [134]	26(.003) [134]	29(.000) [134]	29(.001) [134]	27(.001) [133]	24(.006) [133]
SRTV1	26(.001) [160]	18(.020) [160]	15(.067) [160]	20(.012) [159]	20(.011) [155]	23(.003) [157]
SRTV2	20(.011) [160]	16(.040) [160]	13(.010) [160]	10(.195) [159]	13(.106) [155]	12(.149) [157]
SRTV3	29(.000) [160]	27(.001) [160]	29(.000) [160]	20(.013) [159]	22(.007) [155]	26(.001) [157]

[a]Correlations without decimals.

[b]( ) = significance level; [ ] = number of subjects.

Table 5. (Continued)

Variables correlated to score	Phase score 1	2	3	4	5	6
SRTV4	27(.000) [160]	27(.001) [160]	27(.000) [160]	30(.000) [159]	20(.012) [155]	27(.001) [157]
SRTV5	32(.000) [160]	31(.000) [160]	28(.000) [160]	32(.000) [159]	34(.000) [155]	34(.000) [157]
SRTV6	32(.000) [160]	30(.000) [159]	28(.000) [160]	34(.000) [159]	35(.000) [155]	34(.000) [157]
CATTV1	24(.002) [160]	15(.069) [159]	10(.232) [160]	16(.042) [159]	16(.052) [155]	19(.019) [157]
CATTV2	20(.013) [160]	15(.068) [159]	13(.099) [160]	12(.141) [159]	14(.093) [155]	11(.184) [157]
CATTV3	27(.000) [160]	26(.001) [159]	28(.000) [160]	15(.051) [159]	20(.011) [155]	23(.004) [157]
CATTV4	27(.001) [160]	24(.002) [159]	26(.001) [160]	29(.000) [159]	18(.025) [155]	26(.001) [157]
CATTV5	31(.000) [160]	30(.000) [159]	29(.000) [160]	31(.000) [159]	35(.000) [155]	32(.000) [157]
CATTV6	33(.000) [160]	31(.000) [159]	31(.000) [160]	34(.000) [159]	36(.000) [155]	35(.000) [157]

Table 6. Correlations for TV use[a] and their significance

Variables correlated to TV use	TV use in phases 1	2	3	4	5	6
HSSC	01	-02	05	06	06	07
	(.943)	(.732)	(.522)	(.424)	(.456)	(.372)
	[156][b]	[156]	[156]	[156]	[156]	[156]
CBIO	13	16	18	27	18	20
	(.122)	(.061)	(.034)	(.002)	(.033)	(.018)
	[134]	[134]	[134]	[134]	[134]	[134]
HSR	-05	06	-05	-11	-05	-07
	(.605)	(.512)	(.608)	(.206)	(.596)	(.396)
	[135]	[135]	[135]	[135]	[135]	[135]
MSAT	03	-08	03	07	16	12
	(.342)	(.382)	(.737)	(.476)	(.090)	(.189)
	[120]	[120]	[120]	[120]	[120]	[120]
GPA	21	24	25	28	35	34
	(.010)	(.003)	(.002)	(.000)	(.000)	(.000)
	[152]	[152]	[152]	[152]	[152]	[152]
TV preference	-17	-03	-01	02	-10	-04
	(.036)	(.679)	(.937)	(.810)	(.224)	(.610)
	[146]	[146]	[146]	[146]	[146]	[146]
Lec notes	-22	-20	-22	-27	-30	-21
	(.012)	(.022)	(.000)	(.002)	(.001)	(.017)
	[134]	[134]	[134]	[134]	[134]	[134]
Text	-08	-07	-13	-19	-16	-23
	(.348)	(.402)	(.134)	(.027)	(.058)	(.009)
	[134]	[134]	[134]	[134]	[134]	[134]
Study G.	17	06	30	29	43	34
	(.057)	(.500)	(.000)	(.001)	(.000)	(.000)
	[134]	[134]	[134]	[134]	[134]	[134]
opinion	56	47	61	55	60	60
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
	[134]	[134]	[134]	[134]	[134]	[134]

[a]Correlations without decimals.

[b]( ) - significance level; [ ] = number of subjects.

When students were divided into two groups, one group who used videotapes, and the other group who did not watch any of these tapes, and the correlations between the scores students achieved in each phase as one variable, and viewing or not viewing the tapes as a second variable (CATTV1...6) were studied, the results showed a significant positive correlation between video-cassette viewing in each phase and the scores students achieved on this phase ($p < .05$ in phases 1, 3, 4, 5, and 6; see Table 5).

Table 5 also shows that the correlations between TV viewing (both SRTV and CATTV variables) on each phase and the scores achieved on the other phases are positive and significant at the .05 level in most cases, while they are substantially significant in the others. It seems that viewing the videotapes in one phase helped students to achieve higher scores in the other phases.

Table 6 shows that viewing videotapes correlated highly with the time students spent working with the study guide. This fact held true for all phases except the second, in which the correlation between viewing videotapes and studying from the study guide was not significant. The correlation matrix also shows that students who had more biology credits in college or a high GPA spent more time viewing videotapes.

Students who had high MSAT scores and did not use videotapes to any great extent still achieved high scores on all phases. Also, students who had more high school science credits achieved better scores on all phases, even though they did not use the tapes significantly more. The students who had high high school ranks did not achieve high scores. Table 5 shows

negative and highly significant correlations between scores on all phases and high school rank. There were no significant correlations between high school rank and tape viewing. This means that students who had better high school ranks achieved better on all phases even without viewing the tapes.

There was a low correlation between the number of tapes viewed and preference for watching television as measured by students' responses to a questionnaire statement (I don't like to watch television) at the beginning of the course. This correlation supports results obtained in previous studies which reported that benefit from television is not related to students' attitudes toward television (Anderson, 1972; Janoscrat, 1976). A significant correlation between viewing the videocassette lectures and preference of watching television as reported by students was displayed in phase 1 ($p = .036$). This correlation, however, was negative; i.e., students who reported that they did not like watching television used the videotapes even more than the other students in this phase. Opinions about the usefulness of the video cassettes were computed from the responses of students to questions number 46-54 on the post-questionnaire. This questionnaire was administered at the end of the Fall Quarter, 1978, to the students in Zoology 155 who used the video cassettes. Because questions number 47 and 53 were stated in the negative form, students' responses to them were converted before computing opinion. The correlation between tape viewing and opinions toward the tapes was positive and statistically significant. The more time students spent viewing videotapes, the better were their opinions about them. There was

a consistent negative correlation between viewing videotapes and the time spent in studying from lecture notes or from the textbook. This negative correlation is high and significant in the case of lecture note use in all phases but is not significant for use of the textbook in the first three phases. This means that students who viewed more of the videotapes studied less from lecture notes and the textbook except in phases 1, 2, and 3 where the textbook was used in addition to viewing the videotapes.

Although studying from lecture notes was negatively correlated to studying from the videotapes, using lecture notes apparently did not affect students' scores in each phase based on a low or nonsignificant correlation in all phases.

To summarize, the study of the correlations showed that of the four study variables used only TV viewing and the study guide correlated significantly with the score. It would seem that viewing the television lectures in one phase helped students achieve higher scores in the other phases. Students who had high ability and/or were well prepared achieved higher scores in all phases, with or without using the television lectures. Students seemed to use the study guide with the videotapes and achieve higher scores. A negative correlation was found between textbook and score in three of the six phases.

Two variables, GPA and CBIO, correlated significantly with the number of video cassettes viewed. It seemed that high ability and well-prepared students viewed more of the tapes. The more tapes students viewed, the better opinion they had about them at the end of the course.

Effect of TV Viewing on Score on each Phase

To test the effect of TV viewing on achievement, the following null hypotheses were formulated:

1A. There is no significant difference in highest score achieved by students who had strong backgrounds and students who had weak backgrounds.

B. There is no significant difference in highest score achieved by students who viewed videotapes and those who did not.

C. There is no interaction between the students' background and videotape viewing habits.

2A. There is no significant difference in the highest score achieved by students who had high abilities and students who had low abilities.

B. There is no significant difference in highest score achieved by students who viewed the tapes and those who did not.

C. There is no interaction between the students' abilities and viewing of the tapes.

To test these hypotheses, students were divided into high and low groups using a median split according to the number of high school science semesters (HSSC), college biological science credits (CBIO), grade point average (GPA), Minnesota Scholastic Aptitude Test score (MSAT), and high school rank (HSR). This division created subgroups called Hi HSSC, Lo HSSC, Hi BIO, Lo BIO, Hi MSAT, Lo MSAT, Hi GPA, Lo GPA, Hi HSR, and Lo HSR. Two-by-two analyses of variance were used to compare achievement between these high and low subgroups and between students who used or did

not use the videotapes. Tables 7-16 show the means for the subgroups who viewed the television lectures and the subgroups who did not view the tapes in the six phases. The tables also show the level of significance of the main effect of TV viewing as an independent variable, and the main effect of HSSC, CBIO, MSAT, GPA, and HSR as the second independent variable.

Discussion of the ANOVA

The major objective of this part of the study was to evaluate the effect of TV viewing on different groups of students who had different backgrounds and abilities and to see if certain students would gain more than other students from viewing the videotapes for each phase.

Tables 7 through 12 show that HSSC affected score in the first three phases only. In these three phases, students who had more high school science preparation achieved better scores. Videotape viewing seemed to compensate for weak science background. The mean score which the Lo HSSC group obtained after viewing the videotapes exceeded the mean score achieved by the Hi HSSC group without viewing the tapes. In the six phases, the mean scores show that Lo HSSC group benefitted more from TV viewing than did the Hi HSSC group. The number of college biology credits affected score in four phases. In these phases, students who had more CBIO credits achieved better scores than students who had fewer credits. Like HSSC, the effect of CBIO on score tended to decrease in the last three phases. Videotape viewing helped the Lo CBIO group in all phases except phase 2, in achieving slightly higher mean scores than students in the

Table 7. Mean score for the different groups of students, and the probability for the independent variables and interaction between them, Phase 1

	No TV	TV	Probability		
			TV	VAR	Interaction
Hi HSSC	24.2[54][a]	24.9[41]	.00	.00	.06
Lo HSSC	21.9[34]	24.3[27]			
Hi CBIO	24.4[53]	25.2[36]	.01	.03	.60
Lo CBIO	23.2[41]	24.5[24]			
Hi MSAT	23.2[36]	25.8[20]	.00	.28	.14
Lo MSAT	23.2[38]	24.2[26]			
Hi GPA	25.3[28]	25.7[30]	.01	.00	.18
Lo GPA	22 5[63]	24.2[39]			
Hi HSR	21.7[37]	23.9[28]	.01	.00	.04
Lo HSR	24.8[41]	25.2[29]			

[a][ ] = number of subjects.

Hi CBIO group who did not use the videotapes. However, it seems that TV viewing benefitted the Hi CBIO group more than the Lo CBIO group.

These results suggest that videotape viewing especially helped students who had Lo HSSC backgrounds to achieve higher scores in all phases except phase 2.

The main effect of MSAT scores was significant in Phases 2, 3, 4, and 5 ($p < .05$). Videotape viewing helped the Lo MSAT group to achieve a mean score almost equal to or slightly higher than the mean score achieved by the Hi MSAT group without viewing the videotapes in Phases 1, 3, 4, 5, and

Table 8. Mean score for the different groups of students, and the probability for the independent variables and interaction between them, Phase 2

	No TV	TV	Probability		
			TV	VAR	Interaction
Hi HSSC	21.7[51][a]	22.0[44]	.06	.04	.08
Lo HSSC	19.5[29]	21.8[31]			
Hi CBIO	22.0[28]	22.8[41]	.49	.02	.43
Lo CBIO	21.1[39]	21.0[26]			
Hi MSAT	21.1[34]	23.9[21]	.06	.02	.01
Lo MSAT	21.0[33]	20.8[31]			
Hi GPA	23.0[24]	23.4[34]	.25	.00	.77
Lo GPA	20.1[43]	20.7[58]			
Hi HSR	19.6[33]	20.6[31]	.16	.00	.71
Lo HSR	22.3[39]	22.9[31]			

[a][ ] = number of subjects.

6. The Hi MSAT group gained the most from TV viewing in all phases. A significant interaction between students' abilities and TV viewing was found in Phase 2 ($p = .01$). The Lo MSAT group who used the videotapes achieved a lower mean score than Lo MSAT group who did not view the tapes.

The main effect of GPA was highly significant in determining score in all phases ($p = .00$). Also, the main effect of videotape viewing was highly significant in helping both Lo and Hi GPA groups to gain higher scores in Phases 1, 3, 4, 5, and 6, but not in Phase 2 where the difference in the mean scores achieved by the TV viewers and nonviewers was low.

Table 9. Mean score for the different groups of students, and the probability for the independent variables and interaction between them, Phase 3

	No TV	TV	Probability		
			TV	VAR	Interaction
Hi HSSC	22.1[49][a]	24.0[46]	.00	.00	.81
Lo HSCC	20.5[34]	22.1[27]			
Hi CBIO	22.8[25]	24.2[44]	.02	.01	.97
Lo CBIO	21.3[43]	22.7[22]			
Hi MSAT	21.9[34]	24.2[22]	.00	.05	.46
Lo MSAT	21.0[35]	22.4[29]			
Hi GPA	23.5[27]	24.6[31]	.00	.00	.39
Lo GPA	20.4[58]	22.4[44]			
Hi HSR	19.9[33]	22.4[32]	.00	.00	.30
Lo HSR	22.8[39]	24.2[31]			

[a][ ] = number of subjects.

The differences between the mean scores achieved in Phases 1, 3, 4, and 5 suggest that the Lo GPA group tended to benefit more from TV viewing than the Hi GPA group in those four phases.

High school rank had a main effect that was highly significant in determining score ($p = .00$) in all phases. TV viewing helped both Lo HSR and Hi HSR groups to achieve higher scores in all phases except Phase 2. An interaction between HSR and TV viewing was found in Phase 1, which indicates that the Hi HSR group, i.e., the lower students, differentially benefitted from TV viewing more than the other group. The mean scores

Table 10. Mean score for the different groups of students, and the probability for the independent variables and interaction between them, Phase 4

	No TV	TV	Probability		
			TV	VAR	Interaction
Hi HSSC	21.2[55][a]	22.5[40]	.00	.14	.04
Lo HSSC	19.5[41]	23.2[19]			
Hi CBIO	21.3[33]	23.5[36]	.01	.08	.33
Lo CBIO	20.7[47]	21.7[18]			
Hi MSAT	21.3[34]	23.7[21]	.00	.01	.45
Lo MSAT	19.9[41]	21.9[23]			
Hi GPA	22.9[28]	24.4[29]	.01	.00	.99
Lo GPA	19.6[71]	21.1[31]			
Hi HSR	19.1[43]	21.5[22]	.00	.00	.38
Lo HSR	21.9[42]	23.2[28]			

[a][ ] = number of subjects.

show that Hi HSR group benefitted more than Lo HSR group from TV viewing not only in Phase 1, but in all phases.

Students' perception of the videotapes covering Phase 2 (nervous system, tape numbers 303.1, 303.2, 303.3, 303.4, and 303.5) supports and interprets the nonsignificant effect of TV viewing in determining score in this phase. Students reported in their answers to questionnaire one that tape numbers 303.1, 303.2, and 303.5 had terms that were not clearly defined; tape number 303.5 was considered by students to have the most ill-defined terms. Tape numbers 303.2 and 303.5 were evaluated as neutral in

Table 11. Mean score for the different groups of students, and the probability for the independent variables and interaction between them, Phase 5

	No TV	TV	Probability		
			TV	VAR	Interaction
Hi HSSC	20.5[58][a]	22.7[36]	.00	.07	.16
Lo HSSC	18.9[40]	22.8[17]			
Hi CBIO	20.6[34]	23.5[34]	.00	.15	.11
Lo CBIO	20.4[48]	21.5[17]			
Hi MSAT	20.5[34]	23.7[19]	.00	.02	.33
Lo MSAT	19.3[43]	21.3[20]			
Hi GPA	22.1[30]	24.0[26]	.00	.00	.53
Lo GPA	19.0[71]	21.6[28]			
Hi HSR	18.6[43]	21.4[20]	.00	.00	.69
Lo HSR	21.3[42]	23.6[26]			

[a][ ] = number of subjects.

explanatory value, which may indicate that the examples were not sufficiently clear to help students to understand the concepts presented. Also, the organization of material in tape numbers 303.2, 303.4, and 303.5 was evaluated as neutral, while most of the other tapes were evaluated as well-organized. Tape number 303.2 was evaluated by students to be the most difficult tape to understand and was also the only tape evaluated as neutral when the usefulness of the tapes was considered. All other tapes were considered useful. Also, while examples given in the videotapes were considered generally sufficient, tape numbers 303.2 and 303.4 were among four

Table 12. Mean score for the different groups of students, and the probability for the independent variables and interaction between them, Phase 6

	No TV	TV	Probability		
			TV	VAR	Interaction
Hi HSSC	20.3[58][a]	22.2[37]	.00	.08	.07
Lo HSSC	18.6[40]	22.6[18]			
Hi CBIO	20.6[31]	23.1[37]	.00	.05	.13
Lo CBIO	20.1[49]	20.8[16]			
Hi MSAT	20.3[34]	23.0[19]	.00	.19	.32
Lo MSAT	19.9[44]	21.4[20]			
Hi GPA	21.2[30]	24.2[27]	.00	.00	.20
Lo GPA	19.0[71]	20.6[29]			
Hi HSR	18.8[44]	20.4[20]	.00	.00	.29
Lo HSR	20.8[43]	23.6[26]			

[a][ ] = number of subjects.

tapes perceived as not having enough examples to explain the material. Tape number 303.2 was evaluated as neutral concerning the technicality of information it presented. When students were asked if deletion of large parts from the tapes would affect the information they wanted to learn from them, their responses were not clear disagreement as for the other tapes, but they were neutral regarding tape numbers 303.2, 303.3, 303.4, and 303.5.

Videotape viewing in Phase 2, in contrast to the other phases, was not correlated to the use of the study guide (see Table 6). Another interpretation of the nonsignificant effect of videotape viewing in deter-

mining score in this phase could be attributed to this fact. Students did not combine videotape viewing and study guide use in their studying for this phase, which appears to be a condition for benefitting from videotape use.

This detailed discussion of the effects of the background and ability variables on students' scores on each phase and the ability of TV viewing to compensate for the weaknesses students had in background and ability may be summarized as follows:

1. In Phase 1, both science background and ability were significantly effective in determining score. TV viewing compensated for weak background and low ability.
2. In Phase 2, science background was significant at the .05 level in determining score. The main effect of ability was highly significant. Videotape viewing failed to compensate for weak background and low ability in this phase.
3. In Phase 3, background was significant in determining score at the .05 level for both HSSC and CBIO variables. Also, the ability variables were all significant at the .05 level. Videocassette viewing compensated for both weak background and low ability, but it seemed that the high ability group benefitted more than the low ability group did in this phase.
4. In Phase 4, background variables were not significant in determining score, where ability variables were highly significant. TV viewing helped all four groups, i.e., low and high background

groups and low and high ability groups, to achieve higher mean scores and compensated significantly for low ability.

5. In Phase 5, background effects were not significant, and ability variables were highly significant in determining score. TV viewing helped low background and ability groups to achieve significantly better scores. The low ability group achieved almost the same, if not better, mean scores than did the high ability group not using the video-cassette lectures.
6. In Phase 6, the HSSC background effect was not significant, but CBIO was significant at the .05 level. TV viewing compensated for weak backgrounds and helped both weak and strong background groups to achieve better mean scores. Ability as measured by GPA and HSR variables was highly significant in determining score, but was not significant in the case of the MSAT variable. TV viewing helped low ability students to achieve better scores, but it seems that high ability students benefitted more from TV viewing than did low ability students.

The conclusion which may be drawn from these results is that students who used the video-cassette lectures achieved better scores in all phases, whether they had low or high ability or different background preparation. High school science background had a tendency to affect the score at the beginning of the quarter, but as students progressed into the course, this effect began to decrease. The same tendency could be observed also in the effect of college biology credits.

A significant interaction between high school science and tape viewing was found in Phase 4 at the .05 level. Also, near significant interaction between those two variables was detected in Phases 1, 2, and 6 at .06, .08, and .06 levels, respectively. The interaction observed here is an ordinal interaction as defined by Cronbach and Snow (1977). The interaction in Phase 1 shows that the group that had a higher number of HSSC and viewed the tapes achieved the best mean score compared to the other three groups. In Phases 4 and 6, the group that had weak HSSC backgrounds achieved a better mean score than the other three groups.

Although one might assume that the same groups of students were used in the six different ANOVA analyses, it was possible that a TV user for one phase might be a nonuser in another. To determine whether the interaction was general throughout the course, three other two-by-two analyses of variance were conducted. The first analysis was between grade for the whole course as a dependent variable and HSSC and TV viewing as independent variables. The second analysis involved the final score achieved on the required final examination at the end of the quarter, as the dependent variable and HSSC and TV viewing as independent variables. The third analysis was between the sum of points a student achieved on the six phases, which represents 70% of the final grade in the course, as a dependent variable and HSSC and TV viewing as independent variables. The results are shown in Table 13.

These results show that students who had a high number of HSSC and viewed the tapes achieved better grades, final scores, and total points than the other three groups. High school science was highly significant

Table 13. Means of grade, score, and total points for Lo HSSC and Hi HSSC students, probability for the independent variables and their interaction

	No TV	TV	Probability		
			TV	VAR	Interaction
Grade					
Hi HSSC	2.83[29][a]	3.68[63]	.00	.01	.64
Lo HSSC	2.47[19]	2.14[35]			
Score					
Hi HSSC	41.6[29]	50.3[66]	.00	.00	.95
Lo HSSC	31.9[23]	40.3[38]			
Total points					
Hi HSCC	172.0[29]	188.8[66]	.01	.00	.52
Lo HSCC	137.7[23]	165.1[38]			

[a][ ] = number of subjects.

in determining grades, final scores, and number of points achieved by the students. This significant effect of HSSC on students' achievement through the whole quarter is consistent with the results obtained in the first three phases when ANOVA were conducted separately for each phase. The main effect of tape viewing was highly significant in these three analyses. Tape viewing helped students who had weak science backgrounds to achieve a mean grade higher than that scored by the group which had a good science background and did not view the tapes. Also, tape viewing helped the weak background group to achieve a mean final score almost the same as the score the Hi HSSC group achieved not viewing the tapes. The same

results were observed in the last analysis, and students with weak science backgrounds achieved significantly higher points when they viewed the tapes, and the mean points for this group increased from 137.8 to 165.11 with a difference of 27.33 points. The Hi HSSC group mean increased from 172 to 188.9, a difference of 16.9 points. These figures support the previous results showing that tape viewing compensated for weak preparation in high school.

A significant interaction between HSSC and TV viewing was expected in one of these three analyses because of the significant interactions which were observed between those two variables in four of the six phases. The results obtained show no significant interaction between HSSC and TV viewing. The interpretation was that the interaction effect was not generally significant through all the course.

Another purpose of this study was to identify the characteristics of the groups of students who used the videotapes. The third hypothesis of this study was stated in the null form as:

A. There is no difference in the number of tapes viewed by groups of students who had different backgrounds.

B. There is no difference in the number of tapes viewed by groups of students who had different abilities.

C. There is no interaction effect between students' abilities and students' backgrounds on tape viewing.

The background variable used to test this hypothesis was the number of hours in college biology a student studied before or concurrent to taking Zoology 155 (CBIO). Grade point average (GPA) was used as an indicator of student ability. These variables were chosen after reviewing the Pearson correlation analysis that was run between tape viewing and all the back-

ground and ability variables involved in this study (see Table 5, p. 60). Students were divided into Lo and Hi GPA groups and Lo and Hi CBIO groups using median splits. A two-by-two analysis of variance in which the number of tapes viewed in all phases was the dependent variable and the number of college biology credits and the grade point average as the independent variables was carried out. Table 14 shows the mean number of tapes viewed through the whole quarter of 1978 by the four groups who had different abilities (Lo and Hi GPA) and different backgrounds (Lo and Hi CBIO). The means in this table are underestimated because students who did not view any tapes were included.

Table 14. Means of the number of tapes viewed through the whole quarter, and the significance of GPA and CBIO in determining the number of tapes viewed

			Probability		
	Lo GPA	Hi GPA	GPA	CBIO	Interaction
Lo CBIO	6.7 [48][a]	11.0 [17]	.06	.00	.97
Hi CBIO	13.0 [38]	17.0 [31]			

[a] [ ] = number of subjects.

Table 14 shows that the main effect of GPA on student viewing of tapes through the whole quarter was not significant at .05 level, although it was substantial. The main effect of the number of college biology credits was highly significant in determining the number of tapes viewed ($p < .01$). Students who studied more biology courses in college before or concurrent to taking Zoology 155 viewed significantly more tapes than did students who took fewer biology courses. The group of students who had

more than four credits of college biology and who achieved higher grade point averages at the end of the Fall Quarter of 1978 viewed the most videotapes. The Pearson correlation matrix showed that students who viewed more tapes also spent more time studying from the study guide and less time using the text and did better in the course. It also seems true that the more college biology credits students obtain, the more they are interested in learning about biology from all material resources available in this course. No significant interaction was detected between GPA and CBIO in this analysis.

To accommodate the approach used in this study--investigating the use of videotapes in each separate phase--additional two-by-two analyses of variance were performed, in which the number of videotapes students viewed in each phase was the dependent variable. Grade point average (GPA) and number of college biology credits (CBIO) were the independent variables. When the distributions of the numbers of tapes viewed in each phase were examined for homogeneity, they were not normally distributed. A square root transformation of the number of tapes viewed was used to attain homogeneity. Table 15 shows the transformed means of the number of tapes viewed in each phase by groups of students who had different backgrounds and abilities and the significance of the main effects of GPA, CBIO, and their interaction.

Table 15 shows that neither grade point average (GPA) main effect nor number of college biology credits main effect was significant in determining the number of tapes viewed on the first phase. Perhaps students who viewed those tapes saw them for curiosity, as this course would be the

Table 15. Means of number of tapes viewed in each phase, and the significance of GPA and CBIO in determining the number of tapes viewed

Phase		Lo GPA	Hi GPA	Probability		
				GPA	CBIO	Interaction
1	Lo CBIO	.5[48][a]	.7[17]	.15	.10	.94
	Hi CBIO	.7[38]	.9[31]			
3	Lo CBIO	.7[48]	1.0[17]	.29	.04	.72
	Hi CBIO	1.1[38]	1.3[31]			
3	Lo CBIO	.6[48]	.9[17]	.35	.00	.41
	Hi CBIO	1.3[38]	1.3[31]			
4	Lo CBIO	.4[48]	.7[17]	.05	.00	.77
	Hi CBIO	.8[38]	1.2[31]			
5	Lo CBIO	.4[48]	.9[17]	.04	.02	.79
	Hi CBIO	.9[38]	1.3[31]			
6	Lo CBIO	.4[48]	.6[17]	.03	.00	.32
	Hi CBIO	.8[38]	1.4[31]			

[a][ ] = number of subjects.

first for many of them to be taught using this system of instruction. Backgrounds or abilities did not influence the reasons for wanting to explore this method of instruction. But this insignificant effect of GPA and CBIO does not deny the fact that students who had more CBIO credits and achieved a higher grade point average (more than 3.00) viewed more tapes than the other groups of students did. In Phases 2 and 3, the main effect of CBIO was significant at the .05 level, while GPA was not sig-

nificantly effective in determining the number of tapes students viewed in these two phases. The main effect of GPA was significant in phases four, five, and six, and this significance could be explained by either one or both of the following reasons:

1. Students who aspired to higher grades were not satisfied with the grades they obtained in the first three phases and, therefore, decided to spend more time and effort in achieving their goals.
2. Those students realized after using the tapes in the first three phases that viewing these video-cassettes helped them to answer the test questions and, therefore, viewed more tapes and achieved better grades.

This second explanation was supported by the students' responses to the questionnaire which investigated the reasons for viewing the tapes. Fifty-eight percent of the students agreed that they decided to view more tapes after they took the first examination. The main effect of CBIO was highly significant in determining the number of tapes students viewed in phases four, five, and six ($p < .05$). It held true through all the phases that students who had more college biology credits and achieved better grade point averages at the end of the quarter had viewed more tapes than had the other three groups. Interaction between GPA and CBIO was found insignificant in all cases. According to these findings, the following table shows when hypothesis three was accepted or rejected through the six phases.

Table 16. Summary of the results obtained from the analyses conducted to investigate hypothesis three

Phase	Hypothesis three		
	A	B	C
1	accepted	accepted	accepted
2	rejected	accepted	accepted
3	rejected	accepted	accepted
4	rejected	rejected	accepted
5	rejected	rejected	accepted
6	rejected	rejected	accepted

Effect of Information Resources on Achievement

The last purpose of this study was to investigate the effect of the study guide, the lecture notes, and the textbook in determining the achievement of students. Because these information resources could differentially benefit students with different abilities and backgrounds, students were divided in this investigation into low and high ability and background groups using median splits. Because of the constraint of time, a decision was made to use only HSR as a measure of the students' abilities. This variable was a significant predictor in Latta et al. (1978) study and correlated significantly high with score achieved in all phases. A new variable was thus used to represent students' backgrounds. This variable, which was called background (BKG), was computed by dividing the number of college credits in biology by 3, to convert the credits to the number of quarters attended and then adding this number to the number of

the high school science semesters a student attended. Achievement of students was measured by the total points and computed by summing up the highest scores a student achieved in all six phases. Students whose HSR was less or equal to 19 were considered a high ability group. Students who ranked higher than 19 were considered a low ability group. Also, students who had more than 5.33 semesters of science were considered a high background group. Students who had equal to or lower than this number of semesters were the low background group.

The hypotheses investigated are stated below:

1A. There is no significant difference in points achieved between students who spent many hours or fewer hours studying from the lecture notes, the textbook, the study guide, and the videotapes.

B. There is no significant difference in points achieved between students who had low and high ability.

C. There is no significant interaction between the students' abilities and the information resource they used.

2A. There is no significant difference in points achieved between students who spent long hours or fewer hours studying from the lecture notes, the textbook, the study guide, and the videotapes.

B. There is no significant difference in points achieved between students who had low or high backgrounds.

C. There is no significant interaction between the students' backgrounds and the information resource they used.

A Pearson correlation matrix was computed between lecture notes, study guide, textbook, videotape viewing, students' backgrounds, students' abilities, and the total points achieved for students who had low and high abilities (Table 17) and low and high backgrounds (Table 18).

Table 17. Correlations for study resources and achievement for low HSR and high HSR students[a]

	Lec Notes	Text	Study guide	TV	BKG	HSR	PTS
Lec Notes		-34 (.007)	.03 (.83)	-32 (.01)	05 (.72)	-14 (.28)	24 (.06)
Text	-07 (.62)		-07 (.57)	-03 (.82)	17 (.19)	23 (.08)	-24 (.06)
Study G.	07 (.69)	27 (.05)		43 (.001)	33 (.01)	-25 (.05)	58 (.00)
TV	-25 (.07)	-19 (.17)	21 (.14)		25 (.05)	-20 (.13)	32 (.01)
BKG	-02 (.91)	05 (.72)	-11 (.44)	08 (.57)		-07 (.60)	39 (.002)
HSR	-09 (.49)	24 (.09)	-06 (.65)	07 (.63)	14 (.32)		-37 (.003)
PTS	-06 (.67)	-04 (.79)	08 (.59)	35 (.01)	19 (.16)	03 (.83)	

High HSR

Low HSR

[a]Correlations without decimals. ( ) = significance level. For low HSR, n = 60 students (list wise deletion was used). For high ISR, n = 52 students (list wise deletion was used).

Table 18. Correlations between study resources and achievement for low BKG and high BKG students[a]

	Lec Notes	Text	Study guide	TV	BKG	HSR	PTS
Lec Notes		-17 (.17)	08 (.51)	-35 (.00)	-20 (.10)	-.01 (.91)	11 (.39)
Text	-25 (.09)		-11 (.36)	-21 (.09)	04 (.78)	19 (.13)	-32 (.01)
Study G.	-03 (.87)	37 (.01)		43 (.00)	11 (.39)	-25 (.04)	55 (.00)
TV	-23 (.12)	-002 (.99)	12 (.43)		07 (.59)	-12 (.33)	28 (.07)
BKG	19 (.22)	12 (.42)	19 (.22)	-26 (.08)		-02 (.85)	29 (.02)
HSR	-03 (.83)	19 (.19)	09 (.56)	16 (.28)	-04 (.79)		-52 (.00)
PTS	03 (.85)	-06 (.70)	13 (.38)	27 (.07)	-12 (.43)	-16 (.29)	

Low background

High background

[a]Correlations without decimals. ( ) = significance level. For high background, n = 67 (list wise deletion was used). For low background, n = 45 (list wise deletion was used).

Discussion of the Correlations

Table 17 shows that high ability students' achievement was highly correlated to the time spent using the study guide and the videotapes. The effects of studying from lectures notes on total points was substantial for this group. Studying from the textbook correlated negatively to students' achievement. High ability students who studied more from lecture notes spent less time studying from the text or watching the videotapes. Students who used the study guide heavily seemed to spend more time viewing videotapes.

The low ability group achievement was highly correlated to videotape viewing. None of the other three information resources helped this group achieve higher points. Students in this group who studied more from the study guide spent more time studying from the textbook.

In Table 18, the high background group achievement was correlated significantly to the time spent in using the study guide. Videotape viewing correlated with points achieved at the .07 level. Again, studying from the textbook correlated negatively with achievement. Students who viewed the tapes more spent more time using the study guide and less time using the lecture notes.

Students who had weak science backgrounds achieved better scores when they spent more time viewing the tapes. Videotape viewing is the only variable of the four information resources that was substantially correlated to achievement. A significant correlation was found between the time spent studying from the text and the study guide.

The conclusion that could be drawn from these results is that students who had good science backgrounds and abilities benefitted the most

from using the study guide. High ability students seemed to be able to benefit from lecture notes. This could be due to their ability to understand the material presented in lectures and (or) to their ability to take meaningful notes from these lectures. Videotape viewing helped both groups of students who had high abilities and high science backgrounds to achieve higher scores, while studying from the textbook had a negative effect on their achievement. This negative effect was not predicted, and one possible explanation for it could be that the text was not oriented to answering questions in the tests. Students who had low abilities and backgrounds benefitted only from videotape viewing and not from the use of other study materials.

Test of Hypotheses

To test the hypotheses stated previously, eight two-way analyses of variance were carried out. In these analyses, students were divided using the median split into low and high groups according to their abilities, backgrounds, and the use of the information resources. Tables 19 and 20 show the means of points students with different abilities and backgrounds achieved when using the different sources of information.

Results obtained indicate that abilities affected the achievement of students significantly. Of the four information sources, only videotape viewing had a significant effect on points achieved ($p = .01$). Investigating the means shows that studying from lecture notes was beneficial only for the high ability group. The textbook helped low ability students to achieve higher scores, even though the gain was not significant. From

Table 19. Means of total points, significance of main effect and interaction of the study resources for students who had low and high high school ranks

	Lo HSR	Hi HSR	Significance Var	Significance HSR	Significance Interaction
Lo Notes	188.6[31][a]	178.9[24]	.18	.00	.04
Hi Notes	203.6[29]	174.6[28]			
Lo Text	203.2[29]	175.0[26]	.18	.00	.05
Hi Text	189.0[31]	178.2[26]			
Lo Study G.	179.9[24]	175.2[25]	.26	.01	.10
Hi Study G.	184.4[46]	150.2[40]			
No TV	168.3[25]	146.1[22]	.01	.01	.92
TV	190.9[45]	166.9[43]			

[a][ ] = number of subjects.

the correlation matrix (Table 17), low ability students who spent more time studying from the text combined their studies from the text with the study guide. There was no significant correlation between the study guide and the textbook for the high ability students. This might be another reason for the negative effect of the text on their achievement. Time spent using the study guide seemed to be more fruitful for the high ability group than for the low ability group. Videotape viewing helped both low and high ability groups to achieve better scores.

Results in Table 20 indicate that the study guide, the text, and videotape viewing had a significant main effect. Also, the main effect of students' backgrounds was highly significant ($p < .01$). The means of

Table 20. Means of total points, significance of main effect, and interactions of study resources for students who had different backgrounds

	Lo BKG	Hi BKG	Significance		
			Var	BKG	Interaction
Lo Notes	177.9[29][a]	190.8[33]	.31	.002	.78
Hi Notes	181.1[34]	196.4[34]			
Lo Text	183.4[35]	200.0[30]	.02	.001	.74
Hi Text	174.8[28]	188.5[37]			
Lo Study G.	176.5[33]	180.9[29]	.001	.003	.05
Hi Study G.	182.9[30]	203.4[38]			
No TV	169.5[24]	184.1[15]	.002	.007	.67
TV	185.8[39]	196.4[52]			

[a][ ] = number of subjects.

points achieved by groups of different backgrounds show that the gain in score achieved by using the lecture notes was not significant. Studying from the textbook had a significantly negative effect on points. The study guide was more beneficial for the high background group, while TV viewing was more helpful for the low background group.

The conclusion that could be drawn from these results is that videotape viewing was the most beneficial source of information for students who had low abilities or low backgrounds. These results support the results obtained when videotape viewing effectiveness was investigated using the phase by phase approach, and indicate the usefulness of TV viewing for students with low abilities and backgrounds. These results also are

consistent with the results Dolphin obtained when he evaluated TV viewing effect on achievement (Dolphin, 1980).

Table 19 shows significant interactions between students' abilities and the information sources used. These interactions are illustrated in Figures 1-4. Studying from the lecture notes was differentially beneficial for high ability students. The interaction between students' abilities and the lecture notes was significant at the .03 level. Figure 1 shows this interaction. Low ability students did not gain from studying the lecture notes. These findings could mean that low ability students do not benefit from large enrollment lectures as much as high ability students do, and consequently different methods of teaching should be provided for them if they have to achieve the objectives desired from the course. The interaction between students' abilities and use of textbook was also significant at the .05 level. The high ability group did not use the study guide to help them through their studying from the text, and the time they spent with the text had a negative effect on their performance. Figure 2 shows that the high ability group achieved higher points when they did not use the text. Low ability students used the study guide with the text but the gain was almost negligible.

The interaction between HSR and the study guide was not significant at the .05 level, but was substantial ($p = .10$) (Figure 3). The high ability group tended to benefit from using the study guide. The high ability students used the study guide with the videotapes and achieved higher points.

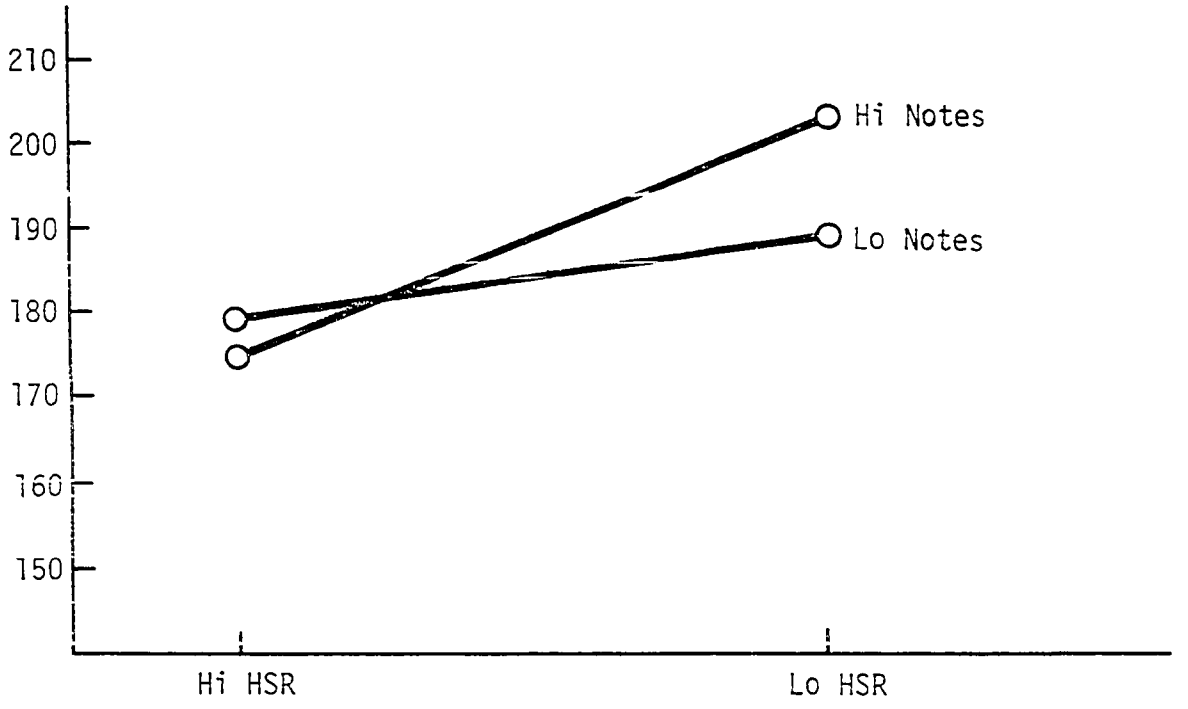

Figure 1. Effect of lecture notes on the achievement of low and high HSR students

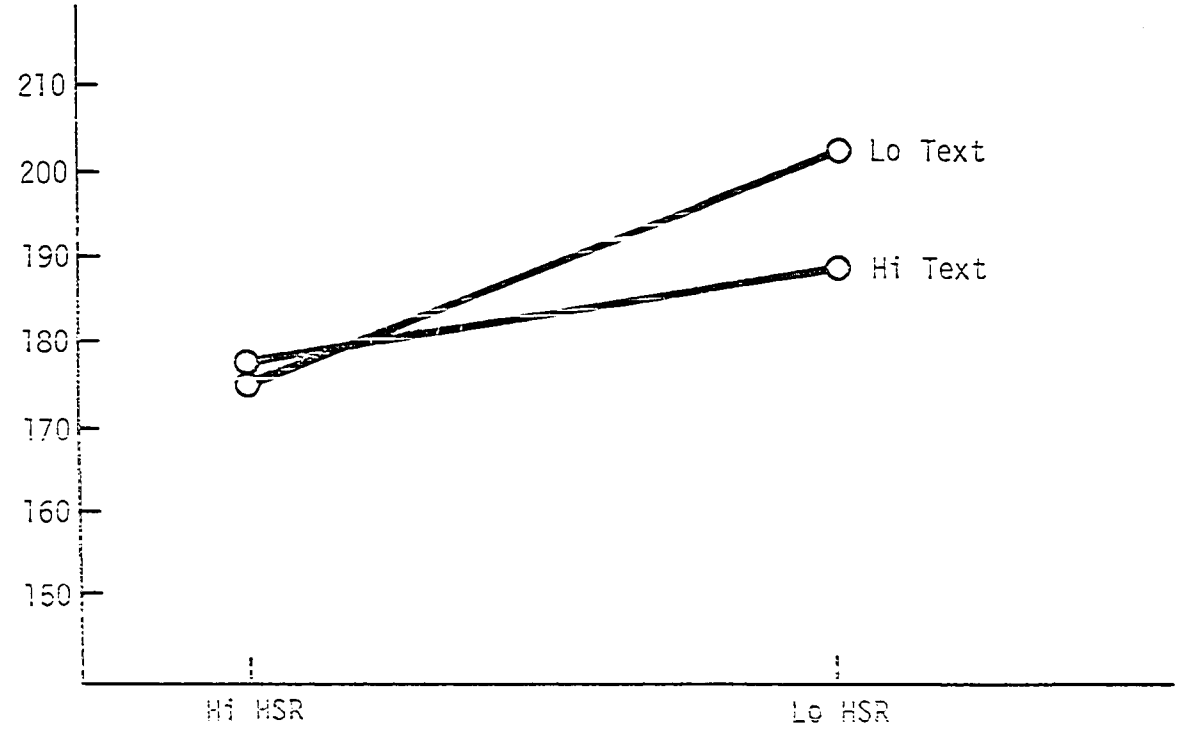

Figure 2. Effect of the textbook on the achievement of low and high HSR students

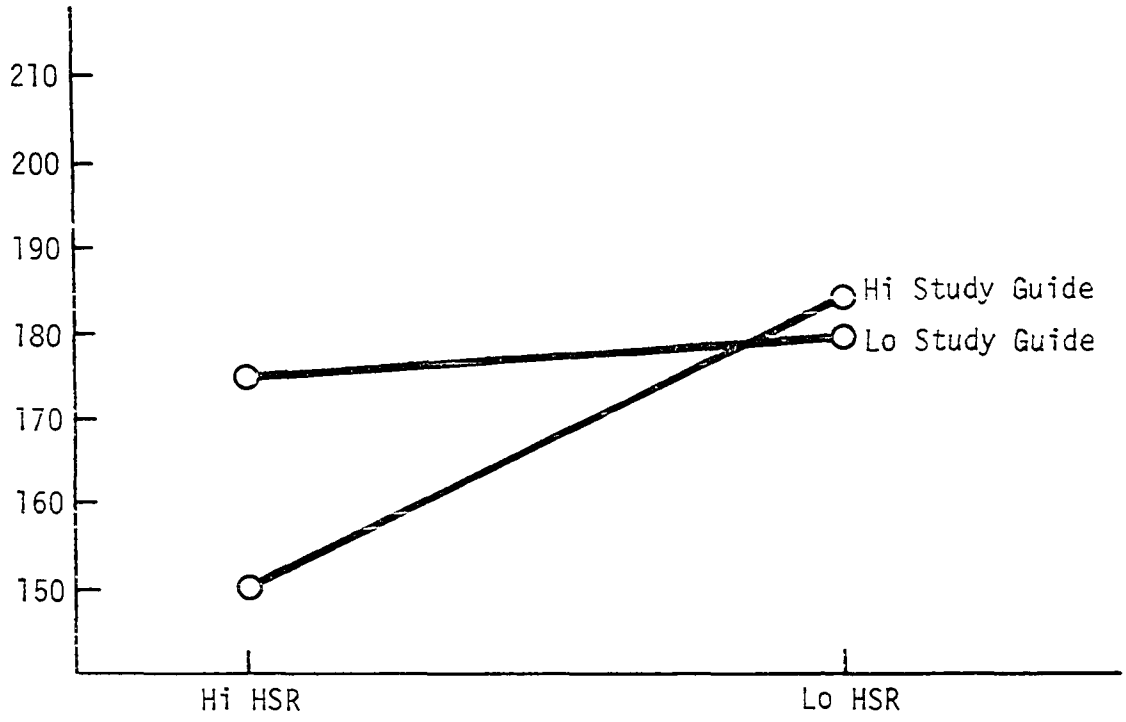

Figure 3. Effect of the study guide on the achievement of low and high HSR students

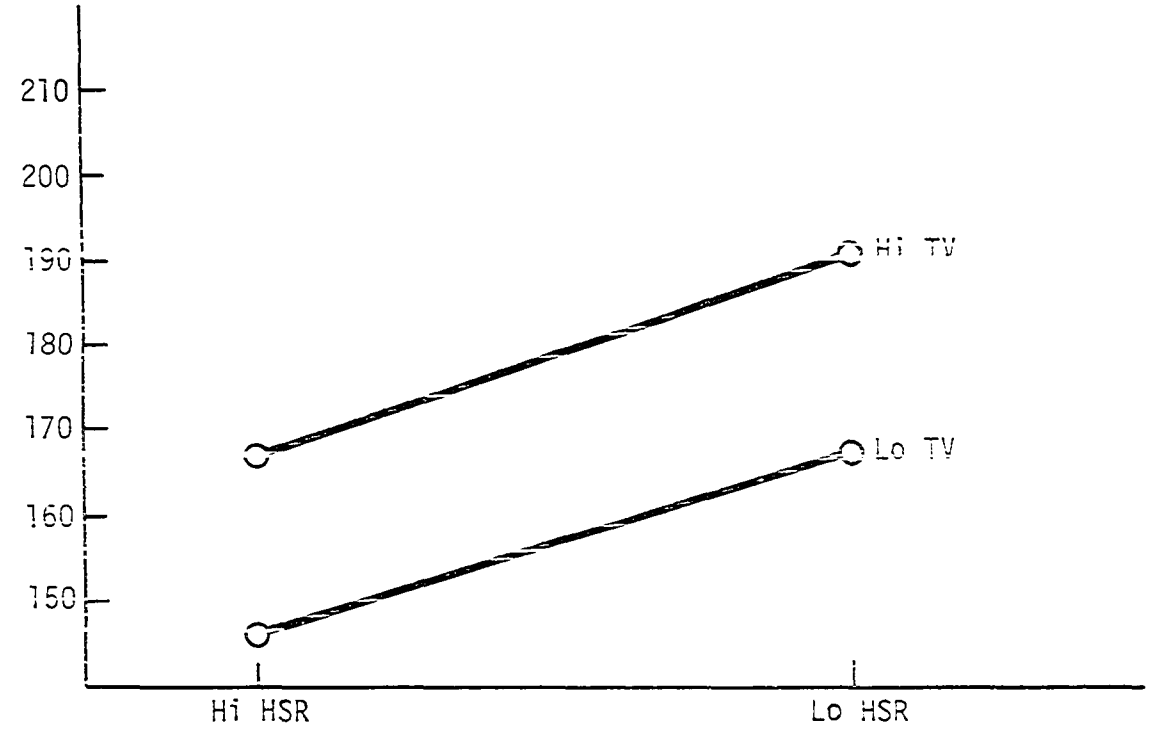

Figure 4. Effect of the videotapes on the achievement of low and high HSR students

Figures 5-8 show the gain in points students of different backgrounds achieved and the interactions between background and the information resources. The interaction between students' backgrounds and the study guide was significant at the .05 level. The high background group differentially benefitted from using the study guide. They combined viewing videotapes with using the study guide, while the low background group combined the study guide with the textbook. This means that they tried to answer the questions in the study guide from the text, but it seems that this was not a successful strategy. However, a nonsignificant correlation was found between points and the study guide. High background students benefitted from using the study guide and the videotapes, while the low background group benefitted only from viewing the videotapes.

To summarize, the high ability group benefitted from using lecture notes, the study guide, and videotape viewing. The low ability group benefitted only from videotape viewing. Also, the high background group benefitted from the study guide and TV viewing, while the low background group benefitted more from videotape viewing. The question thus became one of identifying what information sources benefitted the low and high ability groups and the low and high background groups. This question was answered from the results obtained from the step-wise regression analyses. Tables 21 and 22 show these results.

In these tables, R^2 indicates the amount of variance in points, which is attributable to the different information sources. Thirty-three percent of the variance in points achieved by high ability group is explained by use of the study guide. Lecture notes come as the second predictor in

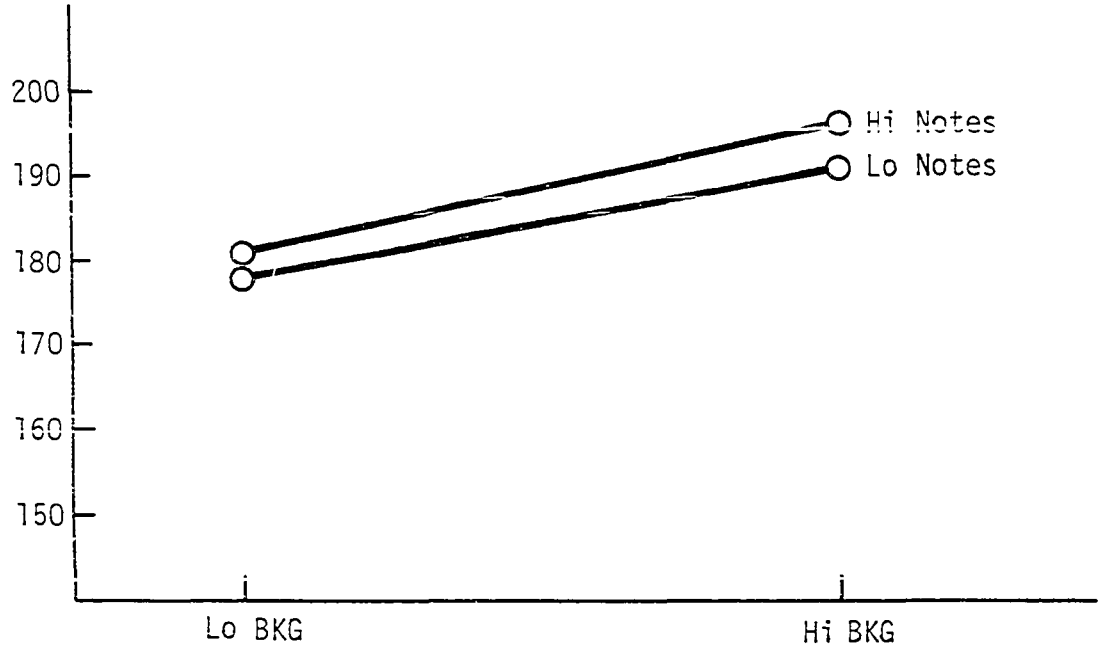

Figure 5. Effect of lecture notes on the achievement of low and high background students

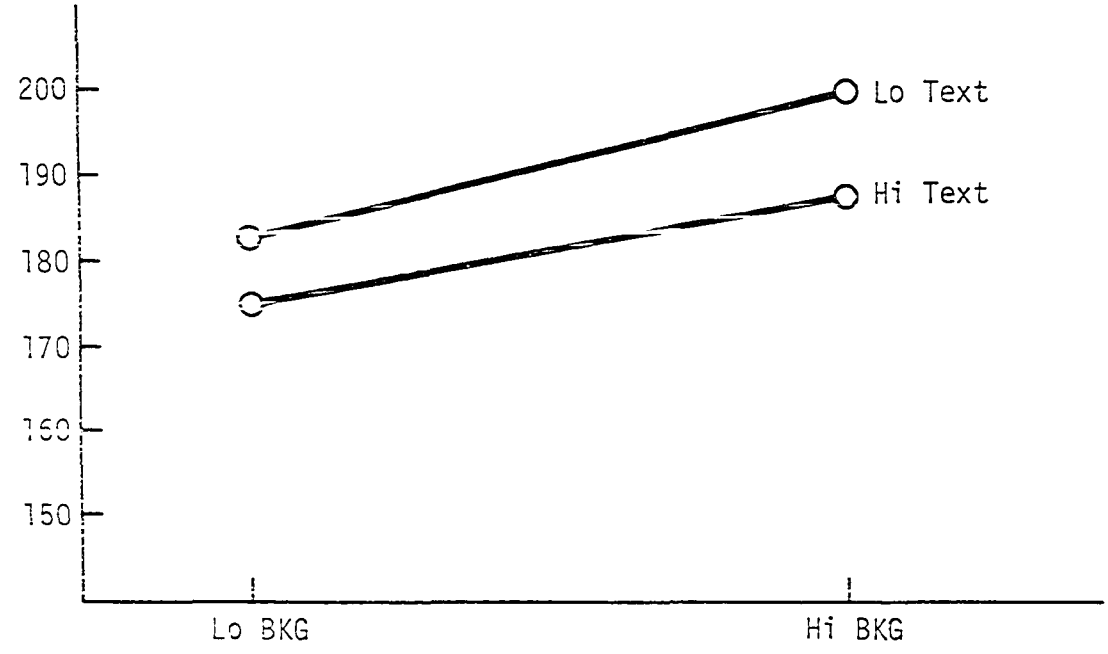

Figure 6. Effect of the textbook on the achievement of low and high background students

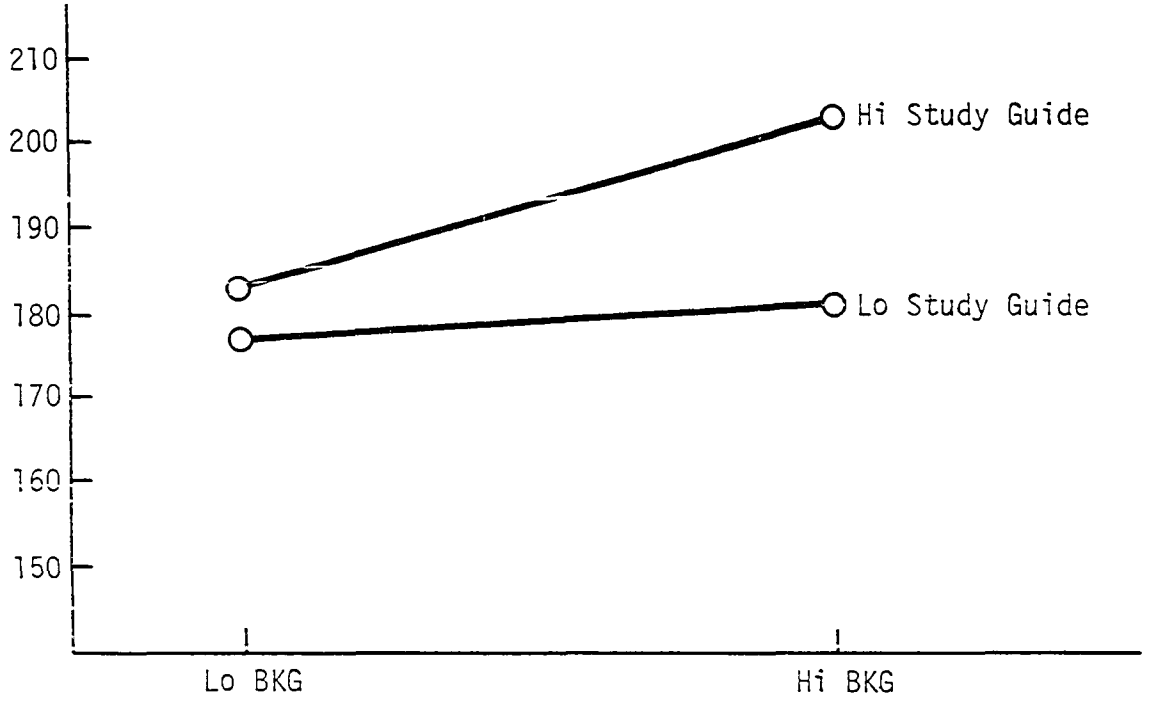

Figure 7. Effect of the study guide on the achievement of low and high background students

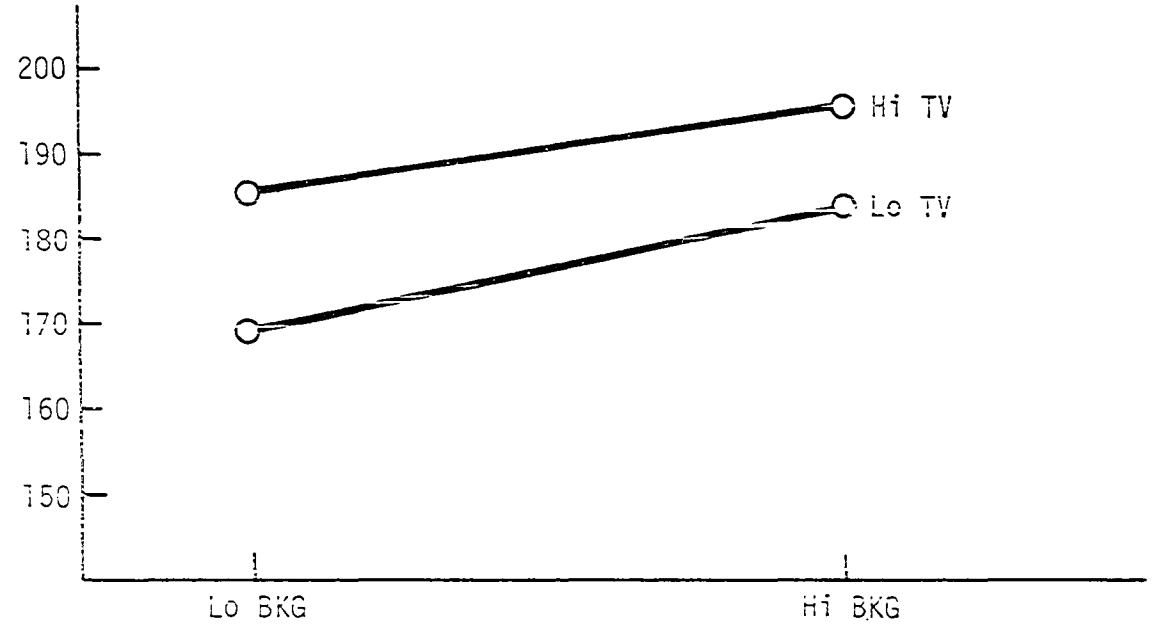

Figure 8. Effect of the videotapes on the achievement of low and high background students

Table 21. Step-wise regression analyses of points for low and high ability groups

	R^2	
	High HSR(n=70)	Low HSR(n=60)
Lecture notes	-	.05
Textbook	.003	.01
Study guide	.002	.33
TV viewing	.16	.03
Total R^2	.165	.42

Table 22. Step-wise regression analyses for points of low and high background groups

	R^2	
	Low background(n=63)	High background(n=67)
Lecture notes	.001	.0004
Textbook	.01	.07
Study guide	.02	.30
TV viewing	.14	-
Total R^2	.171	.37

the regression equation, followed by TV viewing and last by the textbook. For the low ability group, TV viewing is the first predictor of points, with sixteen percent of the variance in points achieved by this group attributable to TV viewing. The three remaining sources of information have almost zero R^2s.

Table 22 shows that for the high background group, 30 percent of the variance in points achieved is attributed to use of the study guide. The textbook explained 7 percent of the variance. TV viewing explained about 14 percent of the variance in points achieved by the low background group. The study guide is the second predictor, and finally the lecture notes.

The conclusion that could be drawn from these results is that better students benefit from using the study guide with the videotapes, while students who have low abilities or backgrounds benefit from TV viewing. These results are consistent with the results obtained before from the ANOVA analyses and also shows that Lo HSR and Hi BKG students were more predictable.

The Television-Study Guide Strategy

The strategy of using the study guide combined with the television lectures was investigated. A two-by-two analysis of variance was carried out in which the total number of points was the dependent variable, where the times spent using the study guide and television lectures were the independent variables. The subjects were divided into low TV, high TV, low study guide, and high study guide groups. Table 23 shows the results obtained and the mean score for each of these four groups.

To better understand the strategy effect on students' achievement, three other analyses of covariance were carried out. In these analyses, score was the criterion variable, while TV and study guide use were the independent variables. In the first analysis, HSR and BKG variables were controlled. In the second analysis, HSR was controlled and in the last

Table 23. Significance of the main effects and the interaction of TV viewing and the study guide and the means of total points for the groups

	Lo Study G.	Hi Study G.	Significance		
			TV	Study G.	Interaction
Lo TV	176.7[37][a]	187.2[27]	.05	.002	.4
Hi TV	181.4[25]	199.2[41]			

[a][ ] = number of subjects.

analysis BKG variable was controlled. Table 24 shows the significance of the main effect of TV viewing and the study guide on achievement in the three different analyses of covariance.

Table 24. Significance of the main effects and interactions of TV viewing and the study guide controlling for background and ability variables

	Significance of the main effect of			
Analysis	TV	Study G.	Interaction	Variables controlled
1[112][a]	.09	.009	.91	HSR and BKG
2[112]	.06	.006	.86	HSR
3[130]	.05	.008	.59	BKG

[a][ ] = number of subjects.

Discussion

Results in Table 23 indicate that both TV and study guide main effects were significant at the .05 level. The interaction between them was not significant. As expected, students who used both achieved higher mean scores than did the other three groups. The same results were obtained in the other three analyses in Table 24, except that TV main effect did not reach significance at the .05 level in the first two analyses, even though they were substantially significant.

The conclusion that could be drawn from these results is that the strategy of using the television lectures to answer the study guide questions was effective in helping students achieve higher scores regardless of their abilities or backgrounds, and therefore students should be motivated to use such a plan.

CHAPTER VI. DISCUSSION AND SUMMARY OF RESULTS

Discussion

Frequency of use of the videotapes

This study compared the usage frequencies of videotapes in two different quarters in Zoology 155 which was taught by the PAS system by two different instructors. Results showed that students used the television lectures whether they included their instructor or not, even though they used them more when their own instructor presented the tapes.

Some tapes were viewed by more than 75 percent of the students attending the course, while others were viewed by only 10 percent of the students. Students tended to spend more time viewing the video-cassettes in the weeks they had tests. The number of students who viewed the tapes tended to decrease toward the end of the quarter, compared to the number of students who viewed them at the beginning of the quarter. The television lectures in Phase 3 were viewed most often, while Phase 4 tapes were used the least. The quality of all videotapes was judged by students to be satisfactory except the tapes covering Phase 2 which received the most criticism from students.

The reasons students gave for viewing the television lectures were the opportunity to view the tapes as often as necessary and to study the illustrations on the tapes which increased their understanding of the course material. Another reason reported for viewing the video-cassettes was the opportunity to study at their own pace. This reason has appeared as one of the favorable features of individualized instruction in other studies (Senour,

1971; Chapman, Holloway, and Kelly, 1977). The last reason given for viewing the television lectures was that students believed that they could learn more when they had the opportunity to see and listen to the course material presented to them instead of using one sensory channel like hearing the instructor or seeing it in a textbook.

Perceptions of students clearly indicated the usefulness of the videotapes, in helping students understand the course material. Further, the television lectures provided the course information for about 23 percent of the students attending in Fall, 1978, who did not go to the lectures because of conflicts between their schedules and the lectures. Providing these tapes for the students to use on their own time was an important feature, for about one-fourth of the students enrolled in the course. Another important goal that was fulfilled by providing the television lectures was to help students who had weak backgrounds in biology to study independently to compensate for their deficiencies. Forty-one percent of the students enrolled in the course reported that they viewed the tapes to help them remedy background deficiencies.

It is interesting to note that there was no significant correlation between the time students spent viewing the television lectures and their preference for watching television. It seems that students who did not consider television their preferred medium of receiving information used the videotapes as often as the other students did. In this study, students who viewed more of the tapes had a more positive opinion toward them. This result supports the conclusion reached earlier which indicated

that attitudes of students become more favorable toward educational television after they have experience with it (Schramm, 1970).

The effect of the videotapes on achievement

The preliminary step in studying the effect television lectures have on the achievement of different groups of students was to calculate the correlations between television viewing and achievement on each phase. The correlation was significant in all six phases. Students who spent more time viewing videotapes seemed to spend less time using the textbook or studying from their lecture notes and more time answering the study guide questions in all phases except Phase 2. ANOVA analyses confirmed those results. The background variables (HSSC and CBIO) affected score significantly in the first three phases, while their effect was substantial in the last three phases. This decreased effect of background on score would be interpreted in two ways. The first is that the learning of material in these phases is not related to the material students learned in high school. The other explanation is that when students proceeded through the course, they became acquainted with the biology facts and terminology and their high school background became less influential. Ability variables were effective in determining score in all phases. High ability students achieved higher scores than low ability students did in all cases.

When students were divided into low and high ability groups, TV viewing helped both groups achieve higher mean scores in all phases except Phase 2. It was not differentially beneficial. In Phase 2, video cassette viewing was not beneficial even though groups who viewed the tapes

in this phase achieved higher mean scores. But the gain in these means was not large enough to be significant. It is important to mention that students' comments on the videotapes in Phase 2 were less positive than for the other tapes. The quality of these tapes seems to need more investigation using students' comments as an indicator of their deficiencies. Students who viewed television lectures also used the study guide heavily in all phases except Phase 2. It can not be determined from the results obtained in this study why students did not combine use of the study guide with viewing tapes in this phase, and answering this question may help understand the deficiencies in those tapes.

A substantial interaction was detected between HSSC and TV viewing in four of the six phases (Phase numbers 1, 2, 4, and 6) ($p < .10$). In these four phases, students with weak HSSC background benefitted more from TV viewing than did students with strong HSSC background. The conclusion drawn from these results was that TV viewing has a tendency to compensate for weak high school science backgrounds in those four phases.

Students using the videotapes

Only GPA and CBIO variables correlated significantly to the number of television lectures viewed. Students who had studied more college biology invested more time in viewing television. Also, students who achieved higher grade point averages at the end of Fall, 1978 quarter viewed more tapes. The students who viewed the videotapes the least are those who had lower abilities and weaker college biology backgrounds. This result was not predicted. It is more logical to think that students with weak backgrounds would watch more videotapes to compensate for their weaknessess.

Also, 41 percent of the students reported in the questionnaire that they viewed the tapes because they felt that they had weak science backgrounds. It is possible that those students are not the students who really had weak backgrounds in science, but were students who were more worried about their science preparation and aware of the requirements for high grades in this course.

When the use of the tapes was investigated phase by phase, the same results were obtained. The high GPA group of students who had a stronger biology background viewed more television lectures than the other groups did in all phases. It seemed also that students who studied more CBIO courses were willing to learn more, which could be due to their majors; a study investigating the effect of majors on the number of video cassettes viewed would help in understanding students' study styles.

The study styles

Students studying Zoology 155 in Fall, 1978, had available for use four information sources: the textbook, the study guide, the video cassettes, and their own notes from the lectures. The preliminary study of the relationship between those study variables and achievement for groups of students with low or high ability and weak or strong background showed that the high ability students were the only group who were able to use their lecture notes effectively to help them achieve higher mean scores. The other groups were either unable to understand the information presented by the instructor or unable to take useful notes from which to study.

It also seemed that the high ability group was able to use the questions in the study guide to achieve higher scores. These students were probably more able to locate and understand the information needed to answer the study guide questions and, therefore, achieved higher scores than the low ability students did. High ability students answered the study guide questions either from their lecture notes or from viewing the video cassettes. Low ability students tried to answer the questions from the textbook, but it seemed that this strategy did not help them achieve higher scores, and the time invested in answering the questions was not fruitful. Students from this group who used the television lectures benefitted significantly from them, even though they did not use the study guide with them. It would be interesting to investigate the full potential of the videotapes by studying their effect on those students who use them with the study guide.

Students with a good science background used the video-cassettes to answer the study guide questions and again this strategy was beneficial for this group. These students, unlike high ability students, were not able to benefit from studying their lecture notes. Therefore, it is possible to conclude that the high ability group of students was the only group that was able to benefit from attending large lectures.

Students with a weak science background tried to answer the study guide questions from the textbook but this process was not successful. The time they reported in using the study guide was not related to achievement. The time they spent studying from the text was negatively correlated to the score achieved. The only information source that helped

the Lo BKG group was the television lectures, even though students did not use the study guide with them. Investigating tape viewing effects on Lo BKG students when they use the study guide with the tapes would help understand the potential of television as a medium of instruction for this group.

Interaction between lecture notes and HSR (significant at the .03 level) indicates that Hi HSR students differentially benefitted from using the lecture notes. The Lo HSR students who invested their time in the lecture notes achieved lower mean scores than those achieved by Lo HSR students who spent less time using them.

The textbook main effect was not significant, but it has a negative effect on achievement, especially for high ability students. This negative effect changed when the low ability students used the text with the study guide. Instead, students gained higher mean scores, even though the gain in score was not significant.

The interaction between the textbook reading and HSR was significant at the .05 level and it was differentially helpful for low ability students. A substantial interaction between HSR and the study guide indicated that when high ability students knew the study objectives represented in the study guide questions, they were more able than low ability students to achieve those objectives. Also, the significant interaction between background and the study guide suggested that students with better science backgrounds differentially achieved higher scores when using the study guide. It is necessary to mention that the two groups (Hi HSR and Hi BKG) who differentially benefitted from the study guide used it with

the television lectures, while the other two groups (Lo HSR and Lo BKG) used the study guide with the textbook.

For Lo HSR and Hi BKG students, time invested in answering the study guide questions was the first predictor of score in regression equations involved the four information sources. On the other hand, the time spent viewing the videotapes was the strongest predicting variable of score for Hi HSR and Lo BKG groups of students.

In conclusion, the strategy adopted by Lo HSR and Hi BKG students in this course was the use of television lectures and the study guide questions to help them achieve higher scores. The strategy used by Hi HSR and Lo BKG groups to help them achieve higher scores, however, was viewing the video-cassettes.

Emerging from the results discussed are some other questions needing more investigation, such as these: Would the study guide have this tremendous effect on Hi BKG and Lo HSR students if they used it with the textbook instead of the television lectures? Is their high achievement due to the use of the videotapes only? Was it the combination of the study guide with these tapes, i.e., what would happen if they only used the videotapes like Lo BKG and Hi HSR students? Another question that needs answering is whether textbook use would have the same negative effect on achievement if the Lo HSR and Hi BKG groups used it with the study guide. Why is there a negative effect of the textbook? Is the strategy of using the videotapes with the study guide the best strategy to use for the high ability and well-prepared students? And are the high scores they achieved due to this strategy or to the students' high abilities and good

science preparation? Are there any other strategies that could be used by Lo BKG and Hi HSR students that excel the TV viewing strategy they used?

Comparison of the results

This study is one of several studies which were carried out to evaluate the Phase Achievement System (PAS). These evaluative studies used data collected about the three courses Biology 101, Biology 103, and Zoology 155. The work most related to this study was carried out by Stinard (1980). In his work, he compares the effect of PAS system with the traditional system of testing on students' achievement in Zoology 155 using comparative and attribute by treatment interaction methods of analysis. In addition to comparing the effect of the two instructional systems, Stinard also evaluated the usefulness of the information sources students used at the time he began his study. At this time, the videotape lectures were not yet in use. Therefore, the current study, in evaluating the videotapes as a learning medium, could be considered as an extension of the Stinard study. This study evaluated the television lectures using the data collected about students who were taught by the PAS system only, while the tapes could be used on demand by all students attending Zoology 155 whether they were using the PAS system or the traditional system of instruction. Therefore, another possible area of further study could include the effect of the TV lectures on students' achievement who were taught by the traditional system of instruction.

Stinard found no significant difference in achievement between the two groups who were taught by the PAS and traditional systems of instruction. Now with the TV lectures in use, it will be interesting to deter-

mine if the difference between the two systems is the same, i.e., insignificant or if television will be more beneficial for PAS students with their opportunity to repeat taking the phase tests and using the videocassettes to remediate their weaknesses. From the results obtained about TV effect, there is a possibility that the advantages of the television lectures interact with the testing system students use in PAS and help them achieve better scores than students who use the traditional system of instruction do.

Despite the insignificant difference between PAS and traditional systems concerning general achievement, Stinard upon further investigation showed that the PAS system was differentially beneficial for female students with weak HSSC backgrounds. They reported spending more time on the course and completing more of the reading assignments. Because gender was not one of the entry variables investigated in this study, further investigation is needed to understand the study strategies useful to each gender. The substantial interactions found between TV viewing and HSSC in four of the six phases of the course could turn out to be significant interactions if students were divided according to their genders.

Stinard (1980) also reports that effort students invested in the study guide tended to be associated with higher grades. Further analysis of the study guide effect on achievement in this study, as discussed above, showed that the study guide was differentially beneficial for Lo HSR and Hi BKG groups of students, where it appeared as the first predictor of score. The study guide was not beneficial for Hi HSR and Lo BKG groups, and this was interpreted to be due to the strategy these two

groups used to answer the study guide questions from the textbook, a technique which did not prove successful in achieving higher scores.

The compensatory effect of PAS on female students with weak science backgrounds in the Stinard study was attributed to the fact that those students spent more time studying for the course. In this study, only time spent viewing the videotapes was investigated. It was measured by the number of tapes students checked out in the library. This method provided an indication of the time students spent viewing the television lectures. But because successful or high ability students process information more efficiently and take less time to accomplish a given cognitive task, it is possible that some students spent longer hours repeating and studying the material. Therefore, it is hard to define the reasons behind the students' higher achievement after viewing the television lectures from the data obtained. The question then that still needs an answer is whether the higher achievement associated with TV viewing is due to the quality of the tapes, or whether it is due to the greater effort and time the students spent using these videotapes. A third possibility is if it is a result of the interaction of all these features that characterize the PAS system now as a system which provides for individualized instruction as well as individualized testing. A better method of measuring effort and time in an empirical study may answer these questions more precisely.

Another deficiency in this study concerning the data used was in measuring high school science background. The number of semesters a student studied in high school was the measure used, assuming that learning science is a valid and positive function of the number of courses

attended. A better measure could be found by using a composite score indicating the number of courses attended and the grades obtained.

In investigating the factors that affected the use of the different study variables, Stinard tried to predict the study variable a student used with 17 entry variables. The result reported was that none of those entry variables by itself explained more than 5 percent of the variance in any of the study variables. This study investigates the relationship between background and ability variables and the use of the videotapes. The number of college biology credits and college GPA were the only two variables which were correlated significantly to TV viewing. This significant correlation was found in the last four phases for both variables but not in the first phase. In the second phase, CBIO was significant, while GPA was not. This may mean that at the beginning of the course students viewing the television lectures had different backgrounds and abilities, and that they viewed them to explore a new method of instruction. But after the first part, only students who were planning to achieve high grades viewed them.

Stinard concluded from his study that neither PAS nor the traditional system holds special benefit for lower or higher ability students, supporting the previous results obtained from aptitude trait interaction research. In both sections, the brighter students were found to be doing considerably better than the less bright students were. In this study also, brighter and better prepared students achieved higher scores, however, TV viewing as one component of the PAS system helped low ability students and weak science preparation students to achieve almost the same

mean score bright and well-prepared students achieved without using the television lectures.

In a study at Stanford University, Gibbons and his colleagues (1975) found that televised instruction has an advantage for students of low abilities or marginal preparation. In their study, the videotapes were used to replace lectures with the provision of discussion groups. In PAS, the videotapes were not meant to replace lectures, but the results obtained support Gibbons' results. In this study, the television lectures tended to compensate for students' weak science background and helped low ability students to achieve a mean score comparable to that achieved by the high ability group which did not use television.

At the University of California, Fisher and her colleagues (1976) also found significant differences in achievement between the group of students taught by the videotapes and the two control groups taught by the traditional method. No interactions were reported between the instructional methods used and students' backgrounds as measured by their knowledge of the course material before starting the course. At the University of Maryland, Linder and Golman (1976) used videotapes with other media to replace large lectures in teaching a general zoology course. They reported improvement in students' achievement after using this instructional system compared to their achievement in previous semesters. The researchers did not investigate the interactions between their instructional system and the students' abilities or backgrounds. The system was evaluated comparing the average achievement of students who used or did not use the system. These results are similar to the results obtained from this study

and other previous studies in that they provide evidence that instructional television in general, and the videotapes in particular, could be a successful medium for providing course information for students on an individual basis in colleges and universities. Myers' study (1975) at the University of Florida also supports the previous results that show television can be used to remedy students' background. Results obtained indicate that students who had poor background in mathematics performed better than expected on the basis of pretests they answered after attending a weekly television program in solving quantitative chemical problems.

In the studies mentioned prior to the individualization of instruction, however, evaluation of the instructional system was based upon group analyses. The use of average achievement of students has tended to result in insignificant differences in many of these studies. The Aptitude-Treatment Interaction (ATI) model presented by Cronbach and Snow (1977) is one alternative to group analyses. This technique presumes that individual differences in aptitudes affect students' achievement and that a teaching method could be useful for one group of students and not for another, depending on their aptitudes. Researchers are encouraged to investigate the interactions between methods of teaching and students' aptitudes. If an interaction of aptitude and instructional treatment is discovered, then steps could be taken to assign students to the most appropriate learning regimen on the basis of a suitable pretest, given that those students have aptitudes similar to the aptitudes of students on whom the original study was based.

In ATI research, three groups of variables have frequently been used: the cognitive variables, the affect variables, and the study behavior variables. Interest in study behavior as a predictor of academic achievement for students who have different aptitudes has emerged with increased interest in maximizing academic success (Tollefson et al., 1979). In this study, the effect of study time outside the classroom, i.e., the study behavior variables, on students' achievement was studied. Interactions between study strategies adopted by students and their aptitudes also were investigated.

Allen (1975) after reviewing ATI research indicated that lower mental ability students benefit more from active participation in the learning process. Green (1979) also found that low ability and low confidence students perform better in structured situations. In colleges and universities where students attend large lectures, the opportunities to participate in the learning process and receive feedback in the classrooms are rare. In this study, results obtained indicate that only high ability students differentially benefit from attending large lectures. The interaction between students' aptitude and instructional treatment (large lectures) was significant. Allen and Green support the findings of this study and explain why low ability students did not benefit from studying from their lecture notes, while they benefitted more from viewing the well-organized and structured videotapes.

Anderson (1977) compared different study behaviors of students when using instructional television. He found no difference in students' learning from television when they used different methods of note taking.

No evidence of interaction was reported. Allen (1975) indicated that high mental ability students may benefit more than low ability students do from presentations by complex, fixed-paced mediums like television and motion pictures. In this study, the opposite results were obtained. Low ability students benefitted more than high ability students did from videotape viewing. Also, high ability students benefitted from viewing those videotapes.

Kulik, Jaksa, and Kulik (1978) reported a study involving PSI which investigated the effect of the study guide questions on students' achievement. In the study, they reported that students who were provided with study questions scored 12 percent higher than those who were not given study questions (Sanchez-Sosa et al., 1978). Santogrossi and Colussy (1976) found that the use of study questions increased the likelihood that students would pass unit quizzes on the first attempt. In both of these studies, the effect of study guide questions on the final examination was not demonstrated. Unfortunately, in this study investigating the effect of the study guide used only the total points earned on the six phases as the criterion variable, while its effect on the final examination was not investigated. Therefore, it would be interesting to know the effect of the different study variables on students' achievement on the final examination as well as on their retention of the material, as well as their ability to apply the skills they learned.

In the study reported herein, the study guide was found differentially beneficial for high ability and good science background students, while the low ability and weak background students were unable to benefit

from providing the study guide questions. These results conflict with one of the tentative generalizations reached by Allen (1975) after reviewing some of the aptitude treatment interaction studies. He stated that low mental ability students benefit more than do high ability individuals when questions related to the instructional material are provided for them. In a recent study, Holliday and his colleagues (1978) investigated the effect of providing verbatim study questions adjunct to a science textbook on students' achievement. The results obtained indicated that low verbal performers who were provided with the text and no study questions scored significantly higher on the posttest than did those low verbal learners who were provided with the text and study questions, while higher verbal students were unaffected by such questions. Clearly these results are different from results obtained in this study in which the study guide was the first predictor of score achieved by high ability and well-prepared students.

In conventional systems of instruction, the textbook is the essential, and in many cases, the only source of information for students. It is assumed that the more time students spend studying from the text, the higher grades they achieve. But in PSI systems, students usually have more than one source of information and one of these resources, with its unique characteristics, could be better than the textbook in helping students with different aptitudes to achieve higher scores. In this case, spending more time studying from the textbook could be a reason for lower achievement compared to the use of the other sources, as found in this study.

The model adopted in this study has the background and ability variables as the entry variables; the information sources, i.e., the text, the videotapes, the lectures, and the study guide, as the intermediate processes variables; and the total points achieved on the six phases of the course as the outcome variable. The objective of the study was to investigate the relationship between these different variables and the effect of the entry and the study variables on the outcome.

In general, it is possible to conclude that the ability variables, even with using an individualized system of instruction, still have a significant effect on students' achievement. In almost all cases, students who had high abilities achieved higher scores than did students who had low abilities. Attempts to meet the aptitude differences moderated the differences in achievement between groups of students who had different aptitudes. Television viewing helped low ability students achieve a mean score comparable to that achieved by the high ability group which did not use the videotapes. Also, television lectures tended to compensate for students' weak backgrounds in four of the six phases of the course.

Conclusion

The personalized system of instruction proved to be effective, and students taught by PSI system achieved better in most studies when they were compared to students taught by the conventional system of instruction. The Aptitude Treatment research indicates the superiority of PSI system with high aptitude students as with low aptitude students.

Different methods were used to provide course information for the students on an individual basis. Audio and videotapes were among those methods widely used in individualized systems of instruction in colleges and universities. Research on instructional television and videotapes showed that this medium could be used successfully to achieve the goals of those systems. In the PAS system, videotape viewing proved to be beneficial for all groups of students who had different abilities and backgrounds. Television lectures helped low ability and poorly prepared students to achieve mean scores that were comparable to the mean scores obtained by high ability and well-prepared students who did not use them. The other information sources were not beneficial for those two groups. It seemed that the only group of students who could benefit from large lectures was the high ability group. Therefore, it is recommended that instructors of Zoology 155 should seek different ways to motivate their students to spend more time viewing the tapes, especially the low ability and poorly prepared students. Viewing video-cassettes was not required by all students. Instead, the cassettes were on demand in the library. In this study, it was found that the high ability and well-prepared students used them more often than did the low ability and poorly prepared students. Therefore, motivating students to use the video-cassettes should be an important task instructors should be aware of. It is important also that the teacher recommends that low ability and poorly prepared students use the study guide with the television lectures. It was proved that using those two resources together is a successful strategy adopted only by the high ability and well-prepared students, while further analysis

showed that this strategy could be beneficial for all students and not only for those two groups.

Kulik and Kulik (1979) have indicated that studies reviewed earlier about teaching strategies focused on the time students spent in classrooms, while time they spend studying on their own outside of the classroom could have a greater influence on students' achievement in college courses than classroom instruction.

Results obtained in this study indicated that low ability and weak science background students benefitted from the videotape viewing, while high ability and well-prepared students benefitted from viewing the videotapes and using the study guide, while studying from the lecture notes was not significantly beneficial for any group. Those results support Kulik's argument and indicate the importance of investigating students' study behaviors and how they use and distribute their study time out of the classroom.

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APPENDIX A. THE POST-QUESTIONNAIRE DEVELOPED AND USED BY THE PROJECT PERSONNEL

COURSE QUESTIONNAIRE

Print your name and social security number in the appropriate boxes on the answer sheet. Blacken the spaces corresponding to the letters and numbers in the columns beneath. Fill in the course and section number.

The real use of an evaluation is to improve the course for future students. For that reason, we would like to use your experience in this course as the basis for evaluations which may strongly influence how we structure the course in the future. These questionnaires will be analyzed by an independent agency after course grades are awarded. Please be honest in your response.

1. How many hours per week did you spend on this course outside of class? (1) 1 hr; (2) 2 hrs; (3) 3 hrs; (4) 4 hrs; (5) 5 hrs; (6) 6 hrs; (7) 7 hrs; (8) 9-10 hrs; (9) more than 10 hrs

2. How many lectures did you not attend during this quarter? (1) 0-1; (1) 2-3; (3) 4-5; (4) 6-7; (5) 8-9; (6) 10-11; (7) 12-13; (8) 14-15; (9) 16-17 or more

We are interested in how you spent your time outside of class. Assuming that all outside time spent is equal to 100%, what % of your outside study time went toward use of:

3. Lecture notes: (1) 0-10%; (2) 11-20%; (3) 21-30%; (4) 31-40%; (5) 41-50%; (6) 51-60%; (7) 61-70%; (8) 71-80%; (9) 81% or greater

4. Textbook - Use scale above.

5. Tape viewing - Use scale above.

6. Approximately what fraction of the suggested textbook readings did you read during the quarter? (1) 0-10%; (2) 11-20%; (3) 21-30%; (4) 31-40%; (5) 41-50%; (6) 51-60%; (7) 61-70%; (8) 71-80%; (9) 81% or greater

7. Approximately what fraction of the questions in the study guide did you conscientiously answer? Use preceding scale.

8. How many quarter hours credit have you had in other college level biological science courses concurrent with or prior to this course? (1) none; (2) 2 cr.; (3) 3 cr.; (4) 4 cr.; (5) 5 cr.; (6) 6 cr.; (7) 7 cr.; (8) 8 cr.; (9) 9 or more cr.

9. There is a companion lab course for this lecture section (either Biol. 105 for Biol. 101 or Zool. 156 for Zool. 155). Are you currently enrolled in the companion lab course? (1) Yes; (2) No

Please use the following scale to indicate your opinion on each of the statements which follow. Mark your answers on the answer sheet. Do not leave any blank spaces. Do not use response zero (0).

1	2	3	4	5	6	7	8	9
(Strong disagreement=1)				(Neutral-5)				(Strongly agree=9)

10. I felt that I had to do all of the assigned readings in order to do well in this course.

11. Compared to other courses at ISU, the tests in this course were more threatening.

12. Too much emphasis was placed on testing and grades in this course.

13. During the course, my interest in biology increased.

14. In this course, cramming for tests was the most effective means of obtaining a high grade.

15. The tests were an adequate measure of my knowledge and will allow the instructor to assign me the grade I deserve.

16. The grade standards in this course are too high.

17. I felt that I had to answer all of the study guide questions in order to do well in this course.

18. I think this is one of the better courses I have had in science.

19. I felt that I could determine my grade in this course more than in most ISU courses.

20. I adjusted my study during the course according to the test scores I received.

21. I perceived that I had freedom in this course to arrange my study schedule to accommodate my interests and the demands placed on me by other courses.

22. Frequent attendance in this class is essential to good learning.

23. Compared to other courses I took this quarter, I spent too much time on this course for the credit assigned.

24. The lectures were not useful.

25. This course forced me to regard myself as being unable to comprehend the basic concepts of biology/zoology.

26. I felt the study guide was helpful.

27. This has been a very difficult course.

28. I would prefer to take tests at my own pace rather than as required midterms.

29. I feel that I have learned the relevant content of this course.

30. My final grade will be limited because I lack a science background.

31. I would recommend that other students take this course.

32. This course had enough flexibility to help all kinds of students to learn.

33. Because of the course organization, I frequently did not know what was expected of me.

34. A reasonable amount of material was covered in this course.

35. The format of this course allowed me to learn at my own pace.

36. I liked the testing methods used in this course.

37. The classroom instructor contributed to my interest in this subject.

38. The instructor does not stress important material.

39. The instructor makes good use of examples and illustrations.

40. The instructor does not inspire class confidence by his knowledge of the subject material.

41. The instructor has given me new viewpoints and appreciations.

42. The instructor is not clear and understandable in his explanations.

43. The instructor did not show sensitivity to individual interests and abilities.

44. The instructor promoted and expected self-discipline on the part of students.

45. I do not like to watch television.

NOTE: If you did not use a videotape lecture this quarter, then skip the following questions.

46. The television tapes helped me learn biology/zoology.

47. I did not think the television tapes were useful.

48. I would recommend that other students look at television tapes.

49. The television tapes coordinated well with the lecture.

50. The television tapes helped me learn difficult concepts.

51. The television tapes should be available to students in the future.

52. I would like to see more courses have television supplements.

53. The television tapes were boring and a waste of time.

54. The television tapes give you the background needed to understand the concepts taught in this course.

APPENDIX B. THE PRELIMINARY AND REVISED QUESTIONNAIRES THAT WERE DEVELOPED AND USED TO EVALUATE THE VIDEOTAPES AND INVESTIGATE THE REASONS FOR VIEWING THEM

THE PRELIMINARY QUESTIONNAIRE THAT WAS USED BY THE PROJECT PERSONNEL TO EVALUATE THE VIDEOTAPES

PLEASE COMPLETE AFTER VIEWING TAPE

INTRODUCTION. Your help is needed in evaluating the Teletutor tapes used in this course. Would you take a few minutes after viewing this tape to complete this form? We will use your comments to decide the value of this type of instruction and to revise any tape lectures that are faulty.

Tape Number: VC____._

Today's Date: _____

Section No.: _____

1. Would you recommend this tape to other students in the course? (check one)

strongly recommend ___
recommend ___
not recommend ___
strongly not recommend ___

2. What would you guess the average student in this course would say about the level of difficulty of this particular tape? (check one)

much too difficult ___
too difficult ___
about right ___
too easy ___
much too easy ___

3. You viewed this tape because you had some specific needs. What proportion of your needs were met by this tape? (check one)

80 - 100% ___
60 - 80% ___
40 - 60% ___
20 - 40% ___
0 - 20% ___

4. Please list what you feel are the major strengths of this tape.

5. Please list what you feel are the major weaknesses of this tape.

6. How would you grade this particular tape on the basis of overall quality? (check one)

A ____
B ____
C ____
D ____
F ____

Write any other comments you might have on the back of this form.

THE PRELIMINARY OPEN ENDED QUESTIONNAIRE TO INVESTIGATE REASONS FOR VIEWING THE VIDEOCASSETTE LECTURES

We are trying to determine the quality of the videotapes and the other instructional materials for the course Zoology 155. You can help by stating the reasons that made you use those tapes.

Please read first the following categories and then list your reasons for using tapes under the suitable categories.

I am using the videocassettes because of:

1. Reasons related to attending or not attending the classroom lectures.

2. Reasons related to the instructor's method of covering and presenting the information in the classroom lectures.

3. Reasons related to Dr. Forbes' method of covering and presenting the information on the tapes.

4. Reasons related to difficulties in understanding the reading assignment in the textbook.

5. Reasons related to the method of testing.

6. Reasons related to the technological advantages of using the tapes, like holding the picture for more time, rewinding, skipping parts of the tape, and/or availability of tapes at your convenience.

7. Reasons related to answering questions in the study guide.

8. Other reasons (please specify).

THE REVISED QUESTIONNAIRE TO EVALUATE

THE VIDEOCASSETTE LECTURES

PLEASE COMPLETE AFTER VIEWING TAPE

Tape Number: VC ____._

Introduction. We are trying to evaluate the tapes you are watching in Zoology 155. Your opinion will help us in this evaluation. Please indicate your opinion by circling a number from 1 to 9 on the scale that follows each statement--1 means strongly agree, 5 means neutral, and 9 means strongly disagree.

1. There are enough diagrams, pictures, and drawings in this tape to illustrate the concepts.

1 2 3 4 5 6 7 8 9
strongly agree — neutral — strongly disagree

2. The new terms presented in this tape are clearly defined. If your answer for this statement is more than 5, then please list the terms you feel are not clearly defined in the following space.

1 2 3 4 5 6 7 8 9
strongly agree — neutral — strongly disagree

3. The examples used in explaining concepts in this tape are confusing.

1 2 3 4 5 6 7 8 9
strongly agree — neutral — strongly disagree

4. The information presented on the tape is poorly organized.

1 2 3 4 5 6 7 8 9
strongly agree — neutral — strongly disagree

5. Dr. Forbes presented the information too slowly.

1 2 3 4 5 6 7 8 9
strongly agree — neutral — strongly disagree

6. For me, the information on this tape was easy to understand.

1 2 3 4 5 6 7 8 9
strongly agree — neutral — strongly disagree

7. The diagrams, pictures, and drawings used in this tape are easily understood. If your answer is more than 5, then list the diagrams, pictures, and drawings which were difficult to understand in the following space.

1 2 3 4 5 6 7 8 9
strongly agree — neutral — strongly disagree

8. I would rate the overall quality of this tape as not useful.

1 2 3 4 5 6 7 8 9
strongly agree — neutral — strongly disagree

9. The examples given in this tape were enough to help me understand the information presented.

1 2 3 4 5 6 7 8 9
strongly agree — neutral — strongly disagree

10. The information presented in this tape was very technical and did not help me understand the concepts.

1 2 3 4 5 6 7 8 9
strongly agree — neutral — strongly disagree

11. A large portion of this tape could be deleted without affecting the information I wanted to learn from it.

1 2 3 4 5 6 7 8 9
strongly agree — neutral — strongly disagree

12. This tape covers most of the lecture.

1 2 3 4 5 6 7 8 9
strongly agree — neutral — strongly disagree

13. Viewing the tape helped me to answer most of the study guide questions.

1 2 3 4 5 6 7 8 9
strongly agree — neutral — strongly disagree

14. I found it difficult to determine the important information even after viewing the tape.

1 2 3 4 5 6 7 8 9
strongly agree — neutral — strongly disagree

15. This tape helped me to understand most of the questions I had in mind before viewing it.

1 2 3 4 5 6 7 8 9
strongly agree — neutral — strongly disagree

16. This tape is a waste of my time.

1 2 3 4 5 6 7 8 9
strongly agree — neutral — strongly disagree

17. Please list any suggestions you have to improve this tape in the following space.

THE REVISED QUESTIONNAIRE TO INVESTIGATE STUDENTS' REASONS TO VIEW THE VIDEOTAPES

TAPE USE QUESTIONNAIRE

Introduction. We would like to ask your help in determining the reasons why students view videotapes. Please indicate your agreement or disagreement on each of the following statements by checking either Agree or Disagree.

1. I viewed the tapes because I did not understand the lectures. Agree ____ Disagree ____

2. I viewed the tapes because the time scheduled for the lectures was not suitable for me. Agree ____ Disagree ____

3. I viewed the tapes because the instructor asked us to view them. Agree ____ Disagree ____

4. I viewed the tapes because they contain illustrations which help me to understand the material better. Agree ____ Disagree ____

5. I viewed the tapes because they allowed me to repeat parts that I did not understand. Agree ____ Disagree ____

6. I viewed the tapes each time I had to take a test. Agree ____ Disagree ____

7. I decided to view the tapes because the textbook was hard to understand. Agree ____ Disagree ____

8. I viewed the tapes because they were more helpful in answering the questions in the study guide than were the lectures. Agree ____ Disagree ____

9. I decided to view more of the tapes after I took the first exam. Agree ____ Disagree ____

10. I liked viewing the tapes because I could study at my own pace. Agree ____ Disagree ____

11. I liked viewing the tapes because I learn more when I hear and see the information than when I read it. Agree ____ Disagree ____

12. I liked viewing the tapes because they correlate better with the test questions than do the lectures. Agree ____ Disagree ____

13. I viewed the tapes because they stressed the important information. Agree ____ Disagree ____

14. I preferred viewing the tapes because the study assignments were too broad. Agree ____ Disagree ____

15. I viewed the tapes because they were more organized than the lectures. Agree ____ Disagree ____

16. From my experience, I found that many test questions were on the tapes and not in the textbook. Agree ____ Disagree ____

17. I preferred studying from tapes rather than the textbook because the tapes use the same terminology the instructor uses. Agree ____

18. I studied from the tapes because the text has more information than necessary for the Zoology 155 course. Agree ____ Disagree ____

19. I had to view the tapes because the text did not have the answers for all the study guide questions. Agree ____ Disagree ____

20. My background in biology was weak before I took this course, and I thought viewing the tapes would help me understand the material. Agree ____ Disagree ____

APPENDIX C. THE DISTRIBUTION OF THE VIDEOTAPES FOR ZOOLOGY 155

IOWA STATE UNIVERSITY
TELETUTOR PROJECT TAPE TITLES

Zoology 155

Phase	Unit	Title	Videotape No.
1	1 - Body Organization	Body Organization (30 min.)	VC0300.0
	2 - Integumentary System	Integumentary System, Part I (30 min.)	VC0301.1
		Integumentary System, Part II (25 min.)	VC0301.2
2	3 - Nervous System	Nervous System, Part I (20 min.)	VC0303.1
		Nervous System, Part II (25 min.)	VC0303.2
		Nervous System, Part III (40 min.)	VC0303.3
		Nervous System, Part IV (30 min.)	VC0303.4
		Nervous System, Part V (35 min.)	VC0303.5
3	4 - Skeletal System	Skeletal System, Part I (30 min.)	VC0302.1
		Skeletal System, Part II (40 min.)	VC0302.2
	5 - Muscular System	Muscular System, Part I (20 min.)	VC0304.1
		Muscular System, Part II (20 min.)	VC0304.2
		Muscular System, Part III (25 min.)	VC0304.3
4	6 - Circulatory System	Circulatory System, Part I (25 min.)	VC0305.1
		Circulatory System, Part II (25 min.)	VC0305.2
		Circulatory System, Part III (30 min.)	VC0305.3
		Circulatory System, Part IV (25 min.)	VC0305.4
5	7 - Digestive System	Digestive System, Part I (30 min.)	VC0306.1
		Digestive System, Part II (30 min.)	VC0306.2
		Digestive System, Part III (25 min.)	VC0306.3
	8 - Respiratory System	Respiratory System, Part I (25 min.)	VC0307.1
		Respiratory System, Part II (20 min.)	VC0307.2
		Respiratory System, Part III (30 min.)	VC0307.3
		Adaptation and Acclimation in Human Populations (30 min.)	VC0307.4
6	9 - Urinary System	Urinary System, Part I (15 min.)	VC0308.1
		Urinary System, Part II (25 min.)	VC0308.2
		Urinary System, Part III (25 min.)	VC0308.3
	10 - Reproductive System	Female Reproductive System, Part I (20 min.)	VC0309.1
		Female Reproductive System, Part II (25 min.)	VC0309.2
		Male Reproductive System (25 min.)	VC0309.3