A SELF-INSTRUCTIONAL PACKAGE AS AN ALTERNATIVE TO LECTURING IN A MEXICAN UNIVERSITY

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ABSTRACT

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The purpose of this study was to determine the effectiveness of a self-instructional package for teaching the course in scientific method to first year students at the University of Aguascalientes in Mexico as compared to traditional classroom instruction in scientific method.

The package included two units from the regular course in scientific method. The medium was print and included words and diagrams presented in a booklet.

Subjects for this study were 72 first year university students, Spanish speaking, enrolled in the bachelor's programs in education and public health at the University of Aguascalientes.

The research design was a two-way repeated measures design with two treatment groups -- one receiving the self-instructional package and one receiving classroom instruction -- and an immediate posttest and a delayed posttest as the repeated factor.

Other variables investigated to determine their effect on the dependent variables were: learning style preference; sex; age and time spent working with the package. An analysis of covariance was performed
using the pretest scores as a covariate. The group using the package performed significantly better on the immediate posttest \((p = .004)\) than the group under classroom instruction. No significant differences between groups were found on the delayed posttest. A significant two-way interaction \((p = .001)\) was found between learning style preference and treatment; students with a high preference for working alone did best using the package and least well under classroom instruction, and students with a low preference for working alone did least well using the package and best under classroom instruction.

Time spent working on the package correlated significantly \((r = .55, p = .005)\) with posttest scores.

Student evaluations of the self-instructional package were extremely favourable.
Acknowledgments

This study was made possible through the help extended by the following people, to whom I am grateful: Janice Richman, my thesis adviser, who helped me from the initial up to the concluding part of this study; Renato Sobrevinas who gave me the needed moral support; the authorities of the University of Aguascalientes who gave me the permission to undertake this study in the university, provided the subjects, and all the assistance I needed; and the students who participated in this study.

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CHAPTER I

Introduction

Despite numerous scholarly studies that point out the need to design different teaching methods and instruments in a way that agrees with the learners' preferences and characteristics (Coop & Brown, 1970; Pask, 1976; Dunn & Dunn, 1978; Greco & McClung, 1979), the lecture method remains widely used as the principal instruction medium in many schools.

The lecture method is not always the most effective technique for transmitting information for all types of students (McLeish, 1968). According to Dunn and Dunn (1978), only between two to four students in each group of ten learn best by listening. However, it seems that the use of audiovisual materials to support the lecture enhances understanding and retention (Broadwell, 1980).

These findings suggest that students' learning improves when they use their different senses. While some students prefer to learn by reading, others prefer to learn by listening and observing.

Individual differences among learners are many and diverse; consequently, it becomes difficult for an educator to determine which types of media presentation to employ to certain group of learners, if he ignores the students' preferences and traits (Gagné & Briggs, 1974).

Generally, students are presented information about a subject matter by means of the traditional classroom lecture. Many students, however, strongly prefer another way of receiving instruction. This is especially so if the mode of instruction jibes with their personal
characteristics (Pask, 1976).

Thus, research-based findings so far emphasize the need for educators to devote a substantial portion of their planning to the "discovery" of the students' qualities and inclinations. Doing this would enable educators to use the most appropriate presentation techniques to bring about the greatest learning among their students.

A self-instructional package is one such a teaching presentation which can help facilitate learning if the characteristics of the students are taken into account. This can be a teaching technique which gives a variety of student characteristics the recognition due them.

Statement of the Problem

The nine-year-old University of Aguascalientes in Mexico has 20 Bachelor Programs in diverse disciplines, and four technical programs. The university will be offering five other Bachelor's Programs next September (1982).

This year (1981), the total population in the university is 2,720 students enrolled in the Bachelor's Programs, and 407 enrolled in the technical programs. This means 3,127 university students all in all.

The University of Aguascalientes follows a "Development Plan" which makes projections related to and dictated by its growth and by its burgeoning student population. Its development programs focus on needed human resources and material resources as well.

The university follows an academic policy of requiring all new students in the Bachelor's Programs - regardless of the program they
are in -- to enroll in certain basic and compulsory courses. These courses include logic, mathematics, speed reading, methods of study and the course called scientific method. These courses are compulsory because it is believed that their content can provide the students with vital tools that will enable them to study more efficiently and to undertake more adequate research by knowing the necessary steps involved in any research process.

The freshmen population affected by this academic policy (i.e., enrolling in certain required courses) number about 886 students in 1981. This population increases every year since new programs are being implemented. If we divide these 886 students into groups of 30 students, we would have 29 groups, which would mean 29 professors for each compulsory course. This is a situation the university can ill afford.

In the University of Aguascalientes -- as in any other university -- it is imperative that the professors spend some of their time preparing for their classes, conducting research and advising the students. If the professors were to teach the same course in more than one class, they would spend a great deal of their time working in the classroom, repeating the same lecture and instructions over and over again.

This would be an ideal situation in which new teaching methods or new teaching instruments can be tried out, to determine if adopting them would lessen the teaching load teachers presently bear.

The Purpose of the Study

It is the intent of this study to determine whether a print self-instructional package could both perform the role of a classroom teacher
and still present the material as effectively as, if not more so, than the traditional class lecture, according to the situation previously described at the University of Aguascalientes. Additionally, the study seeks to ascertain whether factors such as learning style preference, age, and sex of the students influence the outcomes of both modes of presenting information to the students.

Another purpose of this study is to motivate other teachers in the University of Aguascalientes to develop their own package, using the package in this study as a model, if it is shown to be effective.

Objectives of the Study

The objectives of this study are as follows:

1) To produce an appropriate print self-instructional package on the scientific method for first-year students at the University of Aguascalientes in Mexico.

2) To analyze and evaluate the effectiveness and appeal of the package by applying it to a group of freshmen students, assisted by a tutor.

3) To analyze and compare the outcomes of the group studying with the package and an equivalent group receiving traditional class instruction.

4) To determine if factors such as learning style preference, age, and sex of the students affect the outcomes of the performance of either group.

5) To acquaint university authorities with the possible advantages and disadvantages of using this particular instrument to individualize learning.
CHAPTER II

Review of the Literature

Individualized Instruction

In the last 50 years advantages offered by individualized instruction have been widely discussed in studies, books, seminars and dissertations. Although the benefits that can be derived from individualized instruction have been outlined, many educators still follow the traditional mode of instruction, the lecture method.

Educators such as Bloom (1971), Gagné and Briggs (1974), Rowntree (1976) and Mitchell (1980) have recognized the need for individualization of instruction, some of them proposing concrete theories and effective instruments.

Individualized Instruction, according to Cook and Glaser (1971) "... is essentially the adaptation of instructional practices to individual requirements. Three major factors are involved, each of which defines a set of variables in the system: i) educational goals; ii) individual capabilities and iii) instructional means" (p. 95).

This implies that in any educational situation, there are a great variety of possibilities such as the presence of different types of students with different capabilities, and the availability of many techniques that the educators must adopt according to educational goals and individual capabilities.

According to Makarchuck (Note 1), individualized instruction need not be the same as teaching students individually since "... An
Instructional system is individualized when the traits of each student play a major part in the selection of materials, procedures and time" (p.5).

Viewed under the light of our complex technological society, conventional educational ways become inadequate and obsolete. Educators must think in terms of providing appropriate instructional alternatives for the individual student (Bishop, 1971). The characteristics and points of view of a student are very different from those of his peers with whom he must share standard classroom teaching. His individual experiences can be better tapped and exploited if individualized teaching instruments are used (Mitchell, 1980, p. 48).

Even though some teachers continue to employ the "chalk-talk" type of instruction as a main teaching technique, there have been several efforts to individualize instruction. Recently, instructional methods and organizational patterns in all educational levels, especially in elementary and secondary levels (Bishop, 1971) have reflected a strong desire to develop and implement more effective techniques according to the individual differences and individual needs of the students.

Individualization needs an organization that permits the students to enroll only in activities which are appropriate to their individual differences, and to their own style and rate of learning (Mitchell, 1980; Bishop, 1971; Greco and McClung, 1979; Coop and Brown, 1970).

Under this type of organization that emphasizes individual instruction, the students' independence is promoted; the students are given the chance to study beyond the regular curriculum they follow; and the maximum use of instructional resources is encouraged (Bishop, 1971).
Individualized Instruction and Learning Style

It is clear that a class is composed of groups of students that represent different backgrounds, capabilities, preferences and learning styles (Mitchell, 1980; Bishop, 1971; Pask, 1976; Dunn & Dunn, 1978). This consideration underlines the need for educators to individualize instruction so that instruction can be more realistic and capable of producing learning gains.

The call for increased research in topics related to the interaction between specific individual characteristics and instructional design elements continues (Allen, 1975; Clark, 1975; Pask, 1976; Dunn & Dunn, 1978). A major emphasis has been the importance of the design of instructional materials and techniques for specific learner groups (Greco and McClung, 1979).

Pask (1976) points out the importance of knowing students' learning style and their preference for a specific way of subject matter presentation, when he says: "... Normally students receive subject matter presented in only one particular way, yet they consistently prefer a particular type of learning strategy, when given a choice. If the teaching strategy is matched to the same type of learning style, the students will learn more quickly and retain the information for longer..." (p. 132).

Coop and Brown (1970) suggest that "... no one teaching method would be best for all students since students vary greatly in their cognitive functioning. Some teaching methods may favor one type of students while other teaching methods might facilitate the achievement of a different type of students" (p. 401).
Dunn and Dunn (1978) experimented on matching some special student qualities and preferences with certain teaching methods. Interestingly enough, they found that students with special characteristics prefer certain teaching methods in agreement with their learning styles. The next task is to try to construct new teaching techniques that reflect the characteristics of specific groups of learners.

Dunn and Dunn report research data that yield at least eighteen categories that, when bunched into groups suggest that learners are affected by four stimuli. An outcome of this classification is determining the students' qualities and considering a matching teaching instrument based on a diagnosis learning style (see figure 1).

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<tr>
<th>Stimuli</th>
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<td>Environment</td>
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<td>Time</td>
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<td>Mobility</td>
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Figure 1. Stimuli and elements for a 'diagnosis learning style'.

Adapted from: Teaching students through their individual learning styles. by Dunn, R. and Dunn, K. Reston Virginia: A Prentice - Hall Company, 1978 (p.4).
An explanation of how the stimuli and elements influence a student's learning preferences follows:

**Sound**
- Some students can study with noise, others need silence while studying. This aspect is related to the time and place they prefer to study.

**Light**
- Light is a factor that appears to affect fewer people than does sound. However, it is important to consider this factor in the obtained results, because some students, for example, cannot read for long periods of time in the classroom or library. One reason is that artificial light is used in those places, and some students can read and see better using natural light. This is related to the place and time they prefer to study.

**Temperature**
- Some students prefer working by themselves because they do not like to work in warm, crowded and small classrooms where they are uncomfortable. They prefer cool places to study.

**Design**
- This aspect refers to the place of study, how formal or informal it is. Some students can study better in the library. Others can do it better while relaxing at home enjoying a cup of coffee.

**Motivation**
- Some students need to be heavily motivated externally to learn, while others do not need much because they are internally motivated.
Persistence

When given a task to complete, some students study hard and ask teachers and other students for help until they have finished their work. Others who have short attention spans, do not continue because they cannot work for long periods of time on anything.

Responsibility

Whether students are able to take responsibility for their work is a very important factor to consider regarding success in studying with a self-instructional package. Assuming responsibility is a characteristic which is easier to find more often in collegiate students.

Structure

The preference for structure while studying depends a lot on the organization of knowledge in the minds of the students. Some of them like to go from simple to complex things. The amount and kind of study have to be related to the personal cognitive structure of the students.

Sociological Elements

Students can learn in a variety of social patterns. Each student has his preference that includes working alone, with one or two friends, with a small group or as a part of a team. It is important to identify how each student learns and try to assign their work according to their preference and style.

Physical Elements

Although students may learn best through different senses, some schools and universities continue to utilize lecture as a principal teaching method.
when, according to Dunn and Dunn (1978), only between two and four students in each group of ten learn best by listening. Some students prefer learning by reading and they could be more effective learners studying through a print self-instructional package. Other students can learn best by listening and watching at the same time. For them learning could be easier through a sound slide presentation or a television program. It is important to know the student's preferences in order to use the correct teaching method or the right instrument according to the student's preferences and strong points.

By intake, Dunn and Dunn mean the need for some students to eat something while they are studying. This need can be important because students use up energy which they need to recover while studying. If these students were allowed to eat something, the results could be better. If the teacher is using lectures as the only teaching method it is difficult for students to satisfy this necessity. But, if they are studying on their own at home, it could be certainly easier for them.

Some students can study better in the morning. Other students can do it better in the afternoon,
perhaps after taking a nap, and others prefer to do it at night when everything is silent. This is another characteristic that could be accommodated by using print packages. They can be used anytime and anywhere.

While attending a lecture in the classroom, students have to be quiet and silent. Some students like this. However, others need to move (i.e., standing up, changing sitting positions, etc.) very often. In this case they need to learn using a different teaching instrument.

Dunn and Dunn suggested some essential and some secondary characteristics that students must possess in order to be successful while studying, using print self-instructional materials.

The essential characteristics are:

- Internal motivation
- Persistence
- Responsibility
- Need for structure
- Need to work alone
- Visual orientation
- Preference for reading
- Positive attitude toward interacting with a tutor

The secondary characteristics are:

- Sound
- Light
- Temperature
- Design
- A need for intake
- Appropriate time of day
- Need for mobility
Students whose preferences correspond to the characteristics presented above will probably learn easier if they study with print self-instructional packages.

**Self-Instructional Packages**

According to Rowntree (1976), "... self instruction is a situation in which students are usually working as individuals, using a package of written or recorded or photographed learning materials. In the self-instruction situation students receive little or no direct face-to-face tuition." (p. 12).

A self-instructional package can be viewed as falling under the category of 'Distance Study' which Moore (1975) defines as "... learning supported by those teaching methods in which because of the physical separateness of learners and teachers, the interactive, as well as the preactive phase of teaching, is conducted through print, mechanical, or electronic devices" (p. 5).

It can also be classified as a form of 'Distance Education' which "... covers the various forms of study at all levels which are not under the continuous, immediate supervision of tutors present with their students in lecture rooms or on the same premises, but which nevertheless, benefit from the planning, guidance and tuition of a tutorial organisation" (Holmberg, 1977).

Within the scope of 'Distance Education' or 'Distance Study' can be found the following:

- Computer assisted instruction (CAI)
- Educational Television (ETV)
- teaching machines
- sound-slide presentations
- modules
- learning packages
- programmed learning, among others.
The earlier views on the outstanding features of a self-instructional package, then point out that a self-instructional package is a collection of materials organized in a manner which permits the students to learn by themselves, with the minimum participation, or total absence of the teacher (Wilkinson, 1979).

Talbert (1968) emphasized the role of the student in the learning packages when he said "... the learning package is student oriented. It tells the student what he is going to do. The package puts the responsibility for learning where it belongs: on the student" (p. 21).

Learning packages are designed to operate with a minimum of teaching contact but retaining optimum learning efficiency (Wilkinson, 1976).

Learning packages can include many types of materials presented by itself as one material or in combination with other materials to facilitate learning among the students. These materials could be:

a) Materials to be read (instructions, information, etc.)
b) Materials to be listened to (audio tape, records, etc.)
c) Materials to be looked at (pictures, slides, diagrams, graphs, etc.)
d) Materials to be looked at and listened to (television program, sound-slide, etc.)
e) Materials to work with (models, computer program, apparatus, etc.)

The selection of one of these materials alone or in combination with others depends on the objectives of the package and the emphasis that the teacher puts in the package (Wilkinson, 1976; Manwaring, 1976). Dunn and Dunn (1978) pointed out some advantages of the use of instructional packages for different types of learners:
Because students work independently (or with a friend) and the materials are self-corrective, the packages can meet the needs of learners on several academic levels - youngsters with learning disabilities who require special attention; slow learners who need more time to grasp new material; average youngsters who prefer working on their own or for shorter or longer blocks of time; advanced students who are capable of progressing faster than their peers; and any interested student who wants to learn about a topic, concept, or skill at the moment when he or she desires, not when the teacher is able to get to the subject. Packages don't take up much classroom space, and they are particularly well suited to home study (pp. 256-257).

According to Wilkinson (1976), learning packages present some advantages which could help offer possible solutions to the problems usually encountered in higher education. These advantages include the following:

1. They increase the availability of courses despite problems of small numbers, accommodation, timetabling and shortage of skilled lecturers.
2. They provide opportunities for 'learning from a distance'.
3. They provide opportunity for educational expansion despite financial stricture.
4. They allow options to be offered to meet a wider range of interests.
5. They can offer a greater variety of learning experiences, thus allowing selection according to individual styles of learning.
6. They allow students to learn at their own pace and in their own time. (p. 312).

A familiar situation that occurs in many educational institutions in Mexico and in other parts of the world is that modern teaching aids (e.g., computers, television, etc.) are expensive, and hence, cannot be acquired easily by many schools. This is further complicated by a growing student population that outnumbers the teachers. Thus schools rely heavily on the print self - instructional packages, which in this situation, appears to have great potential.

Print self - instructional packages have several advantages as
medium of instruction which include:

- The material to be learned is more readily available in the self-instructional package than in the lecture method of instruction. The student can use the package without having to attend the class according to his preference. It is especially useful for students who have to absent themselves from school for some reason (Manwaring, 1976; Wilkinson, 1979).

- No special equipment is required. It can be used anytime and anywhere. Students can bring the package to the library, to their homes or to any place they want to study (Manwaning, 1976; Moore et al., 1977-78).

- Students can work on the content of the package intensively or slowly, depending on their style and capabilities. This is because the material is presented in short units which students can cover according to their necessities (Rowntree, 1976; Manwaring, 1976).

- The material presented in the package allows the students to return to it as many times as necessary.

- The material presented in the package also gives the students feedback allowing them to judge their own performance. This helps the student to establish an active interaction with the package. This interaction motivates students to pursue further study (Manwaring, 1976).

- Working by themselves enables students to assume more responsibility for their learning activities.

- The package usually provides effective and attractive instruction for diverse types of students (Cowan, 1976).

- The package can help bring about a high level of mastery of the subject matter, while presenting the materials to be learned in
an attractive way (Qheung, Note 2).

There are also some advantages for teachers who use learning packages as medium of instruction. It does not follow that a teacher who is going to work with a group using a self - instructional package will be relieved of his regular work once he distributes the materials to the students. Possibly he will have more work, but this will permit him to engage in more varied and creative enterprises instead of spending all his time teaching the same things over and over in the classroom. It is productively and economically advantageous.

Farley and Moore (1975) suggest some tasks that teachers can engage in while working with a self - instructional package to guide the students, and at the same time while exercising some other productive functions. The tasks include:

- Evaluating and editing packages.
- Developing new packages.
- Working with teaching teams.
- Planning lectures, demonstrations, discussions.
- Searching for and acquiring additional resources.
- Keeping a record of students' performance.
- Participating in other academic activities in the institution.
- Working with other personnel, administrators, etc.
- Individualizing instruction.

Open University Recommendations for Constructing Print Self-Instructional Packages

Rowntree (1976) -- in an open University self - instructional guide to the use of self - instructionnal materials -- points out that print self - instructional packages must contain four fundamental aspects, the inclusion of which ensures that the advantages mentioned earlier can be present in an individualized learning situation. These aspects follow:
Selection - This refers to the selection of the necessary materials the students will work with, to achieve the objectives.

Structure - The selected materials should be assembled in some instructional way to facilitate learning, keeping in mind that if guided, students will learn by themselves.

Supervision - This refers to the need for the teacher to keep track of the students' progress. Supervision can be done either face to face (i.e., between tutor and students) or through exercises or questions that students are asked to answer in written exercises. Rowntree, calls this scheme 'tutorial-in-print'.

Support - After reviewing the selection, the structure and the supervision (that were discussed earlier), the teacher decides if additional materials are still needed that supplement the content of the self-instructional materials.

According to Rowntree (1976) preparation of a print self-instructional package entails several steps:

1) Once the students who will work with the package have been selected, clearly specify the characteristics of this target audience. The students' age, sex and background must likewise be defined. It should also be clarified if the students' involvement in the self-instructional activity will be compulsory or optional.

2) Locate the sources of information on the topic of the lesson.

Once the topic is delineated, the next step is to look for sources of information about the topic. It can be done through:
- a subject matter expert's assistance
- books
- articles in journals
- newspapers and pertinent publications

3) Review the 'literature' on the subject.
This task is an important phase in the production of a valuable and reliable package.

4) Establish the general aims of the lesson.
By 'aims' is meant a short statement of why this particular material will be taught and what, in very general terms, the teacher hopes to achieve in the end.

5) Identify the constraints.
A constraint is any factor which might interfere with or limit the achievement of a goal (i.e., time available, funds at the teacher's disposal, material and human resources, etc.).

6) Choose the specific content of the package.
Following the review of 'literature' on the topic, and after establishing the general aims, the next task is selecting the content of the package.

7) Prepare a set of objectives for the lesson discussed in the package.
After finally choosing the content the designer should decide what the students will do with the content of the package. The specific learning objectives defined in terms of behaviors the students will be expected to perform, should be included at the beginning of the package.

8) Decide on the order of presentation.
It is important to establish an order of presentation which the teacher preparing the materials can follow while setting up the order, the characteristics of the students, the nature of the content of the package and the objectives should also be borne in mind. Toward
this end, some recommended techniques are: concept map, looking for hierarchies, or constructing a 'flow diagram'.

9) Estimate students' workload.

Following the construction of a diagram to illustrate the order of presentation, the next step is to approximate the length of time it will take the students to study the material. Rowntree (1976) puts forward some recommendations that would facilitate this task. One is to consider the approximate number of words (by calculating 360 words for typed page) contained in the package and determine the difficulty level of the materials.

Need for Tutoring While Using Self - Instructional Materials

Despite all the advantages and recommendations presented earlier, Wilkinson (1979) in a study involving students learning with these materials suggested that working with a self - instructional package can sometimes become boring and taxing. This is more so the case when motivation and self-discipline are low.

The reason for this problem is that all self - instructional materials have some imperfections. (Wilkinson, 1979). This is the fundamental reason for the presence of a tutor who can help solve possible problems that may emerge.

In the Wilkinson (1979) study, students were asked to work on a self - instructional package where a questionnaire was administered to determine students' attitude toward the materials. Fifty-six percent of the students thought the materials were sometimes boring; thirty percent thought the materials were dehumanizing; sixty-seven percent did not
always understand the materials; and forty-two percent felt they did not have enough confidence to work with the materials alone.

While using the materials, sixty-eight percent felt they would have welcomed opportunities to discuss some points with another person.

Romiszowski (1970) found no difference between the results achieved by groups studying with a self-instructional text on their own without any tutorial assistance, and groups receiving normal classroom based group instruction. However, he found differences in the same comparison while utilizing tutorial assistance in the self-instructional part.

Wilkinspn (1976) believes that the presence of tutor/learner contact is a necessary factor in any learning situation.

The interaction between tutor and student helps bring about communication. On the one hand, the tutor wants the student to put to good use the ideas discussed in the package, while the student, on the other hand, appreciates getting feedback from the tutor — about what he has done.

According to Rowntree (1976) "... it is an article of faith among educators (with considerable backing from research findings) that such learning -- active learning with feedback -- is both more interesting and more durable than just listening (or just reading)". (pp. 152-153).

Thus, if a self-instructional package is to be developed, it will probably be most effective when used in conjunction with a tutor or a tutorial assistance.
CHAPTER III

Method

Subjects

Population: The population for this study was made up of 886 freshmen enrolled in any Bachelor's program in the University of Aguascalientes in Mexico.

These freshmen were male and female, Spanish-speaking, and generally between 17 to 25 years of age except for three students who were over 30 years of age.

Sample: From the entire freshmen population, 72 students were chosen as subjects in this study.

The 72 subjects were assigned to two different groups:

1) The experimental group
2) The control group

The experimental group consisted of freshmen enrolled in the Bachelor's program in Education during the first semester of 1981. The first-year students numbered 48 in all, male and female, 17 to 39 years of age and Spanish speaking.

The control group in this study was made up of 24 students enrolled in the Bachelor's program in Public Health during the first semester of 1981. They were male and female, aged between 17 to 31, and Spanish-speaking.

Both groups used in this study were similar in the sense that:
1) both were composed of students enrolled in Bachelor's programs during the same semester; 2) they were similar in age; 3) both sexes were represented in the two groups; 4) it was expected that both groups had the same level of academic preparation. Although they come from different high schools, they were all in their first year at the university; 5) they come from similar socio-economic background.

The two groups were randomly chosen from among 30 groups of first year students enrolled in several Bachelor's programs offered by the University of Aguascalientes. The two intact classes were randomly assigned to one or the other treatment group.

**Research Design**

The experimental design of this study can be diagrammatically represented as follows:

<table>
<thead>
<tr>
<th></th>
<th>Pretest</th>
<th>Treatment</th>
<th>Immediate Posttest</th>
<th>Delayed Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Package</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n=48</td>
<td>O₁</td>
<td>X₁</td>
<td>O₃</td>
<td>O₅</td>
</tr>
<tr>
<td><strong>Class</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n=24</td>
<td>O₂</td>
<td>X₂</td>
<td>O₄</td>
<td>O₆</td>
</tr>
</tbody>
</table>

Where:

- \( X₁ \) = treatment 1 - Individualized package
- \( X₂ \) = treatment 2 - Traditional classroom instruction
- \( O₁ \) = observation 1 - Pretest package group
- \( O₂ \) = observation 2 - Pretest classroom group
- \( O₃ \) = observation 3 - Immediate posttest package group
- \( O₄ \) = observation 4 - Immediate posttest classroom group
- \( O₅ \) = observation 5 - Delayed posttest package group
- \( O₆ \) = observation 6 - Delayed posttest classroom group

Intact classes were assigned to the treatments. However, the two groups included in the study were randomly selected from 30 groups.
The following comparisons were undertaken using the analysis of covariance:

- $O_3$ vs. $O_4$ using pretest scores ($O_1$ and $O_2$) as a covariate.
- $O_5$ vs. $O_6$ using pretest scores ($O_1$ and $O_2$) as a covariate.

The following comparisons were undertaken using the paired t-test for dependent samples:

- $O_3$ vs. $O_5$
- $O_4$ vs. $O_6$

### Operational Definition of Variables

The variables used in this study follow:

**Independent**

- Method of instruction: a print self-instructional package vs. traditional teaching

These two methods of instruction will be compared to find out which produces better results.

**Dependent**

- Performance on posttest and delayed posttest

The posttest will help determine if the objectives of each method of instruction are realized. The delayed posttest will help determine the extent to which the students retain the information acquired after a two week delay of time.

**Moderator**

- Sex

Some groups in the University of Aguascalientes are predominantly made up of male or female.
students. For example, the agronomy program is all male, while the nursing program is all female. Thus, if sex affects the outcomes, this would enable administrators to prescribe the package for the group that best responded to it.

**Age**

Another potential moderating variable that might differentially affect results is age. Older students would probably be more responsible and study by themselves, while younger students would probably prefer the traditional class lectures. The study will try to ascertain whether age interacts with the different methods of instruction.

**Learning Style**

The results of many studies (Coop & Brown, 1970; Pask, 1976; Dunn & Dunn, 1978; Greco & McClung, 1979) suggest that if the learning style preferences of the students are matched with a teaching method according to students' characteristics, performance will improve. Learning style preference will be measured by the learning style questionnaire developed especially for this purpose using variables identified through the literature review.

The effect of learning style preferences on performance under each method of instruction
will be examined. If any effects are found, it would be possible to administer the learning style questionnaire to prospective students and steer them toward individualized or classroom instruction depending on their responses to the questionnaire.

**Time spent working with the package**

One of the advantages of self-instructional packages is that students can work at their own pace (Manwaring, 1976; Wilkinson, 1976).

If students spend more time working with the package, it is probably because they need more time. And if they spend less time with the package, it may be because they need less time to complete the learning activity.

This study will likewise seek to find out if time spent working with the package affects the outcomes.

**Hypotheses**

**H₁**

The individualized group (i.e., students using the package) will score higher on the posttest than the classroom group (i.e., students receiving traditional classroom instruction).

The result stated above is expected because individualized instruction has been shown to be effective. It permits students to take part in activities which are appropriate to their individual differences, and to their own style and rate of learning (Coop & Brown, 1970; Bishop, 1971; Greco & McClung, 1979; Mitchell, 1980).
The lecture method meanwhile, has been found to be ineffective in transmitting information (McLeish, 1968). Since students using the package will learn by themselves while spending with the package only the time that they need, it is expected that the results will turn out to be better. Pretest scores and age will be used as covariates if found to be significantly related to posttest scores, in order to equalize the groups for their initial background knowledge of scientific method.

$H_2$ Students using the package will score higher in the delayed posttest than students receiving traditional teaching.

The materials contained in the package used in this study are organized with the end in view of producing better learning for a longer period of time.

It is expected that students using the package will store the information longer and recall it better than students receiving traditional teaching.

Pretest scores and age will be used as covariates, if found to be significantly related to posttest scores, in order to equalize the groups for their initial background knowledge of scientific method.

$H_3$ Moderator variables such as learning style, age and sex of the students will affect the scores differentially in the two treatment groups.

It is expected that learning style of the students will affect the scores differentially in the two treatment groups. This is because it has been suggested in many studies that students learn in a variety of ways which make them prefer certain teaching

This researcher is interested to determine if factors such as age and sex affect scores in the posttest by comparing the outcomes in the two treatment groups.

There will be a significant positive relationship between time spent working on the package and scores on the posttests.

One of the advantages of individualized instruction is that students can set aside only the time that they really need to work on the materials.

If motivated, students would likely spend more time and reread the materials until they feel that they fully understand the materials read.

In general it is expected that, students who spend more time on the package will score better in both posttests.

Materials

To obtain the data for this study, the following materials were used:

Package: A 91-page print self-instructional package which contained words and diagrams — was planned, developed, implemented and evaluated in this study. The topic discussed was scientific method. The contents of this package were based on the program of the regular course in scientific method which is taught to students who are in their first year at the University of Aguascalientes in Mexico.

The format followed in the preparation and development of the package was taken from an Open University packaged course intended for
teachers in higher education who wish to produce self-instructional materials for their students (Rowntree, 1976).

The Open University format on organizational style recommended by Rowntree (1976) was followed in the preparation of the self-instructional materials.

The print self-instructional package contained the following integrative parts:

1) **Objectives** - The objectives are the ends that the students are expected to achieve after reading the self-instructional package. The objectives are closely related to the content of the package and they indicate the kind of change (behavior) the students must achieve at the end of the learning experience (Bloom, 1974; Mager, 1975) (See appendix A).

2) **Study Guide** - The package includes a study guide which explains to the students the use of the material. More specifically, it concerns the following:
   - How to work with the package to obtain the best results.
   - How to read the information more effectively.
   - How to answer the questions in the exercises and how to compare the learner's answers with the correct answers which are included as feedback after each question.
   (See appendix A).

3) **Flow chart summary of the lesson** - This part is a graphic
representation of the steps to follow while working on the package. The purpose of this flow chart was to give the students a visual representation of the steps to follow in order to complete the self-instructional package (Popham and Baker, 1970) (See appendix A).

4) General Introduction - The general introduction is an overview of the role of science and technology in society and man's role in the growth and development of science and technology. The main purpose of this section was to present the subject matter of the package and to make the students mentally receptive to the information contained in the lesson.

5) Two sections of study - The first section was about a) science and common sense, b) technology, and c) the divisions of science, namely formal, factual, social and natural sciences, among others.

The second section was about scientific research; the scientific method, and the steps involved in the scientific method.

Each section contained the following:

a) An introduction to the specific topic of the section.

This introduction was designed to make the student receptive to the specific knowledge discussed, so that they would be able to assimilate it easily.

b) Information about the content of the section.

This was the most important part in the package because it contained
the knowledge necessary for the achievement of the objective.

The information was presented to the students in short paragraphs following Rowntree's (1976) suggestions. In addition some suggestions forwarded by Gagné (1977), Popham and Baker (1970), Drumheller (1971) and Kemp (1980), on presentation of knowledge via individualized learning were followed. These suggestions included:

- Going from the simple to the complex
- Repetition to move concepts from short term memory to long term memory
- The formation of a chain with other knowledge the students acquired earlier.
- The use of attractive and encouraging formats for the students.
- Presentation of alternative ways of accomplishing objectives.
- Permitting students to practice with the material to bring about better understanding.
- Giving the students the responsibility of determining their study rate.

C) Examples related to the theme.

The purpose of the examples included in the package was to help the students understand the concepts presented by citing specific examples to reinforce the knowledge.

e.g.

Technology is the application of science. Technology is used mainly to improve the conditions of human life through the development of materials, equipment and processes that serve specific purposes.
Champagne, Klopfer and Anderson (1979) said that science describes the world as it really is, while technology reconstructs the world to serve human necessities.

An example of science is:

A description or explanation of a natural phenomenon

An example of technology is:

The invention of a more efficient car or a more effective medicine to cure cancer.

---

d) Two exercises.

Each one made up of 9 or 10 questions related to the information. These exercises were intended to enable the students to work and practice with the learning materials. This is one of the necessary conditions to improve learning. (Rowntree, 1976; Gagné, 1977; Kemp, 1980).

Some of the questions required a single-word answer while others presented problem solving that required elaborate answers.

e) Feedback for each of the questions.

Feedback is an important factor in the design of the self-instructional package because it allows the student to know if his answer was correct. In effect, it may act as a positive reinforcer. (Mitchell, 1980; Manwaring, 1976). If the student's answer is not correct, the feedback provides the correct answer, thus helping the student realize what further information is necessary to improve his grasp of the concepts.

An example follows:

Question - Is Mathematics a factual science?

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Mathematics is not a factual science. It is a formal science. Remember that formal sciences are rational, systematic, and verifiable, but they are not objective. They do not give us any information about reality. They are abstract and deal with ideal entities which exist only in the human mind.

Mathematics and Logic are examples of formal sciences.

Examples of factual sciences are: Biology, Chemistry and Physics (Package, p. 28).

f) **Summary of the specific topic reviewed in each section.**

The summary is an essential component of individualized learning materials because it covers the main points discussed in the different sections of the package. This is related to the factor repetition mentioned earlier (Gagné, 1977; Kemp, 1980) which is an important aspect to consider in the learning process. This is especially the case with self-instructional materials.

g) **Supplementary materials.**

In addition to the package, the students were provided with some articles and additional reading assignments. This was considered important since the strategy is meant to give the students a wider perspective of the topic.

The chapters and articles are as follows:


Instructions for the students to read these supplementary materials were explicitly given in certain parts of the package which were related to the knowledge acquired in the package. The purpose of this supplementary material was to provide the students with additional information on the topic discussed in the package.

**Instruments**

**Test** A 5 page pretest was prepared and later administered to measure the knowledge of the students before studying the package. Its purpose was to approximate the level of prior knowledge they had on the topic before the treatment to determine the actual knowledge they can acquire after studying the package.

The pretest consists of 2 multiple choice items as well as 6 true - false (this involved a special format in which false statements were corrected by replacing words) (See appendix B), 10 matching columns, 5 short - answer items and 2 open - ended questions (See appendix B).

The same test was given following the treatments as an immediate posttest and again after a delay of two weeks as a delayed posttest.

**Learning style questionnaire.** A 5 page questionnaire was constructed
to identify the students' learning style. Learning style refers to the learners' preferences and needs while they are studying.

The learning style questionnaire was developed based on the essential and secondary characteristics identified by Dunn and Dunn (1978) as being necessary for students who study with print self-instructional materials and tutors if they are to be successful.

The essential characteristics are:

- Internal motivation
- Persistence
- Responsibility
- Need for structure
- Need to work alone
- Visual orientation
- Preference for reading
- Positive attitude toward interacting with a tutor

The secondary characteristics (characteristics to which print self-instructional materials can be accommodated) are:

- Sound
- Light
- Temperature
- Design
- A need for intake
- Approximate time of day
- Need for mobility

The questionnaire administered in this study to find out the students' learning style and preferences was based on all of the above characteristics identified by Dunn and Dunn (1978). This questionnaire is made up of multiple-choice items, and it was tried out on a pilot group of 20 students prior to its application in this study. Some revisions and additions were made following the suggestions and recommendations of these 20 students in order to improve it before it was used in this study (see Appendix C).
Evaluation form. A 2 page rating scale was also prepared to measure the students' attitude toward different components of the package such as objectives, content, organization, presentation, motivation, instructions, vocabulary, exercises and supplementary materials. It was prepared as a 5 point scale where 1 was the rating given to a feature that was considered least positive and 5 was the rating given if the feature was felt to be most positive (See appendix D).

Formative Evaluation

Formative evaluation was undertaken once the materials were completed. The purpose of this stage was to improve upon the instructional materials by presenting them to an equivalent group of students (i.e., students with the same qualities and studying under conditions similar to the subjects of this study). (Popham, 1973; Baker & Alkin, 1973).

The package was presented to three undergraduate, Spanish-speaking students studying in Montreal. The pretest and posttest were also administered to these three students. They called this researcher's attention to the following weaknesses:

- Some words were difficult to understand
- Some examples were not clear enough
- Some instructions were difficult to follow
- Too little information about some topics
- Some questions were very difficult to answer
- Some questions were too easy, and hence, had to be changed

Following their suggestions, changes and adjustments were made in the package itself as well as in the pretest and posttest.

Three University of Aguascalientes professors (subject matter experts) also reviewed the package and found that it met with their approval.
Procedure

As previously stated, a pretest and a questionnaire were administered initially to determine previous knowledge about the topic and students' learning style, before distributing the package to the individualized group and before instruction for the classroom group was commenced. A posttest and delayed posttest (identical to the pretest) were administered to both groups after they studied the package and after receiving instruction on the Scientific Method in class.

This process was followed according to the schedule approved by the authorities at the University of Aguascalientes.

The entire experiment took place from September 7 up to September 29, 1981. The delayed posttest was administered 2 weeks later (October 13th, 1981). In the first week of September, the materials were readied for distribution to the students, and the two classes were randomly chosen from the population of first-year classes in scientific method.

On September 7th, the pretest and Learning Style questionnaire were administered to the individualized group and the classroom group.

The self-instructional package was distributed to the individualized group the following day. The students in this group were told that they should be able to complete the package in about 20 hours. They were also informed that they could organize their time any way they wish provided that they finished studying the package after 3 weeks. The schedule was set up this way for the university's convenience to correspond to the students' workload of 4 hours a week for a class and additional time outside. It is important to mention that the students were enrolled in other courses at the same time.
The classes for the classroom group started the same day under the instruction of this researcher, who is the author of the package as well.

The individualized group -- while studying the package -- could ask for advice as many times as they had to. The researcher gave advice to the students and encouraged them to do a good job during the 3-week session.

It is important to mention that the mark obtained in the immediate posttest was taken as one third of the regular course in scientific method. This was planned with the end in view of further motivating the students to study the package.

This study was planned to incorporate the presence of a tutor as an important factor in this type of self-instructional experience. The presence of a tutor -- motivating, advising and encouraging the students (individually) to work at their best -- was considered to be especially important because the subjects in this study were in their first year at the university and hence, not accustomed to working by themselves. It was thought that it would be important for the students to know that a tutor was available for anything they might want to ask regarding the self-instructional package.

Since this study was planned as just described, the fact that nobody asked for advice during the first 6 days made it desirable for the researcher to think of something that could help the adviser know about the progress of the students on a regular basis, as well as the problems they encountered while working on the materials.

A graph was created which was used to motivate the students, while enabling the adviser to keep track of the students' progress.
The graph made and used to record students' progress is illustrated in Figure 2.

![Graph](image)

Figure 2: Example of the graph used in the study to keep track of the students' progress.

The graph was made of cardboard, 55 by 35 centimeters in size. It was placed in a strategic place in the home room of the individualized group. The researcher always kept a copy of the progress graph to guard against possible student tampering of the one in the classroom.

The students were asked to go twice a week to mark how far they have gone in the graph and to talk with the adviser about their accomplishment in studying the package.

The graph was very helpful in motivating the students to work with the package. By looking at how their classmates were faring, the subjects realized whether they should go faster or not. Using the graph was very
motivating, according to the students who were interviewed following their completion of their learning activity.

However, the students did not ask for help as often as it was expected. Out of 48 students in the individualized group:

1 student sought this researcher's assistance 4 times.
4 students sought this researcher's assistance 3 times.
8 students sought this researcher's assistance 2 times.
8 students sought this researcher's assistance 1 time.
27 students, did not solicit any help.

A day before the posttest was administered, the adviser had an individual interview with each one of the students belonging to the individualized group. Some of the topics covered in the interview included:

- The number of hours they spent working on the materials
- What their feelings were toward the package
- Whether or not they liked to work with this instrument
- If they worked on the materials at their best
- Why they did not ask for help (this applied particularly to the 27 students who never asked for help)

All of them answered this last question saying that they did not ask for help because the package was very clear, and the contents were very well explained. They also said that the steps to follow while working on the materials and the supplementary materials were likewise clear.

The classroom group held their class regularly, 4 hours a week. The content taught during the classes was exactly the same as that which the package contained. This researcher served as adviser of the students in the individualized group and classroom teacher. The class was presented in the form of lectures using the blackboard and some of the articles, given in the package as supplementary materials as the only teaching aids.
A posttest was administered to the students of both groups the same day separately, in their regular class schedule.

The rating scale to evaluate the package was given to the students right after they finished answering the posttest.

The delayed posttest was administered to them 2 weeks later in the same manner as the posttest.
CHAPTER IV

Results

Analysis

Means and standard deviations for data in both treatments (students receiving the package and students receiving traditional classroom instruction) were calculated, including data yielded by the immediate and delayed posttests. Data were then submitted to an analysis of covariance using the pretest scores as a covariate. To ensure that the assumptions of the analysis of covariance were met, the homogeneity of variance between the two treatment groups on both the immediate and delayed posttest was tested. This was important to examine because the two treatment groups were of unequal size (n=24 and n=48).

In addition, multiple regression between the pretest and posttest measures were run separately for each treatment group to determine whether the slopes were homogeneous, further justifying the use of analysis of covariance.

The dependent t-test between pretest and immediate posttest scores was performed separately for each treatment group to determine whether the treatments significantly increased learning, as measured by the change in test scores.

The dependent t-test between immediate and delayed posttest scores was performed separately for each treatment group. The results of the t-tests indicate whether there were significant differences in posttest...
scores over time.

In addition, secondary hypotheses about the effect of moderator variables such as age, sex and learning style preference on the treatments were investigated by calculating and comparing the correlation coefficients between the moderator variables and the posttest scores for each treatment group. A second method of investigating the relationship between the moderator variables and the effects of the treatment was to use a separate 2-way analysis of covariance for each moderator variable (again using the pretest scores as a covariate) and examining the 2-way interaction between the moderator variable and the treatment variable. These hypotheses involving the moderator variables were analysed separately for the immediate posttest and the delayed posttest.

The means of the treatment groups at each level of the moderator variable are presented for the moderator variables: age, sex, and learning style preference.

The correlation coefficients between time spent working with the package and the scores in the immediate posttest and the delayed posttest were computed for the group receiving the package. The significance of each correlation coefficient was ascertained.

The coefficient alpha reliability and test retest reliability were estimated to evaluate the posttest used in this study. Likewise, item discrimination and item difficulty indices were calculated for each item in the posttest.

Means and standard deviations of the rating scale used to evaluate the package were also calculated and presented.
Hypotheses One and Two

The first hypothesis—that students using the individualized package would score higher on the immediate posttest than students receiving traditional classroom instruction when pretest scores were taken into account—was confirmed.

The second hypothesis—that students using the individualized package would score higher on the delayed posttest than students receiving traditional classroom instruction when pretest scores were taken into account—was not confirmed.

An analysis of covariance was run using pretest scores as a covariate. The assumption of homogeneity of variance between the two treatment groups was met for both the immediate posttest (F=1.62, df=23, 47, p>.05— not significant) and the delayed posttest (F=1.18, df=23, 47 p>.05 — not significant).

The means and standard deviations for the two treatment groups are presented in Table 1.

Table 1
Means and standard deviations of pretest, immediate and delayed posttests for both treatment groups.

<table>
<thead>
<tr>
<th></th>
<th>Individualized group n = 48</th>
<th>Classroom group n = 24</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean standard deviation</td>
<td>Mean standard deviation</td>
</tr>
<tr>
<td>Posttest</td>
<td>9.31  4.27</td>
<td>4.37  4.92</td>
</tr>
<tr>
<td>Immediate Posttest</td>
<td>34.77  2.44</td>
<td>31.75  3.11</td>
</tr>
<tr>
<td>Delayed Posttest</td>
<td>33.56  3.00</td>
<td>31.37  3.27</td>
</tr>
</tbody>
</table>
The assumption of the homogeneity of regression was tested by comparing the slopes obtained between the two treatment groups. This was done running separate multiple regressions for each group using pretest and both posttests scores. The slopes, ranging from .2 to .8, are presented in Table 2.

By examining the 95% confidence intervals associated with each slope, the assumption of common slopes was found to be tenable on both the immediate and delayed posttest.

| Table 2 |
|------------------|------------------|
| Slopes and 95% confidence intervals for the slopes, between pretest and immediate and delayed posttest scores |

<table>
<thead>
<tr>
<th></th>
<th>Individualized group</th>
<th>Classroom instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=48</td>
<td>n=24</td>
</tr>
<tr>
<td>Slope</td>
<td>95%</td>
<td>95%</td>
</tr>
<tr>
<td>Immediate Posttest</td>
<td>Slope: .18</td>
<td>Slope: .13</td>
</tr>
<tr>
<td></td>
<td>Confidence-Internal: .02 to .34</td>
<td>Confidence Internal: -.21 to .47</td>
</tr>
<tr>
<td>Delayed Posttest</td>
<td>Slope: .18</td>
<td>Slope: .12</td>
</tr>
<tr>
<td></td>
<td>Confidence-Internal: -.02 to .38</td>
<td>Confidence Internal: -.23 to .48</td>
</tr>
</tbody>
</table>

The results of the analysis of covariance presented in Table 3 indicate significant differences (p=.004) between the two treatments on the immediate posttest when the pretest scores are used as a covariate. The pretest scores were found to have a significant effect (p=.001) when used as a covariate.
Table 3
Results of the analysis of covariance on the immediate posttest using pretest scores as a covariate

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Sum of squares</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
<th>Significance of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covariate (Pretest)</td>
<td>120.232</td>
<td>1</td>
<td>120.232</td>
<td>17.667</td>
<td>.001</td>
</tr>
<tr>
<td>Treatments</td>
<td>59.177</td>
<td>1</td>
<td>59.177</td>
<td>8.696</td>
<td>.004</td>
</tr>
<tr>
<td>Residual</td>
<td>469.577</td>
<td>69</td>
<td>6.805</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>648.986</td>
<td>71</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The analysis of covariance performed on the delayed posttest scores were not significant (p=.119). (See Table 4). However, had the pretest scores not been included as a covariate, significant differences would have been found on the delayed posttest (p=.006) as well as the immediate posttest (p=.001).

Table 4
Results of the analysis of covariance on the delayed posttest using pretest scores as a covariate

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Sum of squares</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
<th>Significance of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covariate (Pretest)</td>
<td>86.806</td>
<td>1</td>
<td>86.806</td>
<td>9.415</td>
<td>.003</td>
</tr>
<tr>
<td>Treatments</td>
<td>22.994</td>
<td>1</td>
<td>22.994</td>
<td>2.494</td>
<td>.119</td>
</tr>
<tr>
<td>Residual</td>
<td>636.200</td>
<td>69</td>
<td>9.220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>746.000</td>
<td>71</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Examination of the means revealed that the students who studied using the package obtained significantly better results than the students receiving the traditional classroom instruction. The means and adjusted means are presented in Table 5.

Table 5
Means and adjusted means for both treatment groups

<table>
<thead>
<tr>
<th></th>
<th>Individualized group</th>
<th>Classroom group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Means</td>
<td>34.77</td>
<td>31.75</td>
</tr>
<tr>
<td>Adjusted means</td>
<td>34.50</td>
<td>32.29</td>
</tr>
</tbody>
</table>

The dependent t-test between pretest and immediate posttest scores was performed separately for each treatment group. The results showed a significant increase in learning according to the change in the test scores for both treatment groups. (See Tables 6 and 7).

Table 6
Results of the dependent t-test between the pretest and the immediate posttest for the individualized group

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Difference mean</th>
<th>t-value</th>
<th>Degrees of freedom</th>
<th>2 tail prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>9.31</td>
<td>4.27</td>
<td>-25.46</td>
<td>-41.97</td>
<td>47</td>
<td>.000</td>
</tr>
<tr>
<td>Immediate Posttest</td>
<td>34.77</td>
<td>2.44</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 7

Results of the dependent t-test between the pretest and the immediate posttest for the classroom group

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Difference mean</th>
<th>t-value</th>
<th>Degrees of freedom</th>
<th>2-tail prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>4.37</td>
<td>4.02</td>
<td>-27.37</td>
<td>-28.83</td>
<td>23</td>
<td>.000</td>
</tr>
<tr>
<td>Immediate Posttest</td>
<td>31.75</td>
<td>3.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The dependent t-test was also performed between the pretest and the delayed posttest for each treatment group. Both differences were significant at the .001 level. The results are presented in Tables 8 and 9.

Table 8

Results of the dependent t-test between the pretest and the delayed posttest for the individualized group

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Difference mean</th>
<th>t-value</th>
<th>Degrees of freedom</th>
<th>2-tail prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>9.31</td>
<td>4.27</td>
<td>-24.25</td>
<td>-37.00</td>
<td>47</td>
<td>.000</td>
</tr>
<tr>
<td>Delayed Posttest</td>
<td>33.56</td>
<td>3.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 9

Results of the dependent t-test between the pretest and the delayed posttest for the classroom group

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Difference mean</th>
<th>t-value</th>
<th>Degrees of freedom</th>
<th>2-tail prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>4.37</td>
<td>4.02</td>
<td>-27.00</td>
<td>-27.66</td>
<td>23</td>
<td>.000</td>
</tr>
<tr>
<td>Delayed Posttest</td>
<td>31.37</td>
<td>3.26</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The dependent t-test between immediate posttest and delayed posttest showed a significant decrease in learning according to the change in test scores in the individualized group. However, there is a non significant decrease for the same comparison in the classroom group. (See Tables 10 and 11).

Table 10

Results of the dependent t-test between the immediate posttest and the delayed posttest for the individualized group

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Difference mean</th>
<th>t-value</th>
<th>Degrees of freedom</th>
<th>2-tail prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate Posttest</td>
<td>34.77</td>
<td>2.44</td>
<td>-1.21</td>
<td>5.47</td>
<td>47</td>
<td>.000</td>
</tr>
<tr>
<td>Delayed Posttest</td>
<td>33.56</td>
<td>3.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 11

Results of the dependent t-test between the immediate posttest and the delayed posttest for the classroom group

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Difference Mean</th>
<th>t-value</th>
<th>Degrees of Freedom</th>
<th>2-tail Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate Posttest</td>
<td>31.75</td>
<td>3.10</td>
<td>.37</td>
<td>1.16</td>
<td>23</td>
<td>.258</td>
</tr>
<tr>
<td>Delayed Posttest</td>
<td>31.37</td>
<td>3.27</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hypothesis Three

The third hypothesis - that variables such as learning style, age and sex of students would affect posttest scores differentially in the two treatment groups - was confirmed in part.

The results will be reported separately for each one of the variables mentioned (i.e., learning style, age and sex).

Learning Style preferences

Students were divided into three groups according to the results obtained in the questionnaire administered to the students for purposes of determining learning style preferences (See appendix C).

First group - Students who showed strong preference for studying with a print self-instructional package.

Second group - Students who can study using a print self-instructional package, but who would also like to receive the information through another teaching method.
Third group - Students who would strongly dislike using a print self-instructional package, preferring instead to receive the information from other kinds of materials or teaching methods.

The distribution of the subjects in these three groups is presented in Table 12.

Table 12
Distribution of the subjects in three learning style groups

<table>
<thead>
<tr>
<th>Learning style group</th>
<th>Individualized group</th>
<th>Classroom group</th>
</tr>
</thead>
<tbody>
<tr>
<td>First group</td>
<td>22</td>
<td>8</td>
</tr>
<tr>
<td>Second group</td>
<td>19</td>
<td>10</td>
</tr>
<tr>
<td>Third group</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>( n = 48 )</td>
<td>( n = 24 ) = 72 subjects</td>
</tr>
</tbody>
</table>

The results derived from this study indicate significant relationships between the learning style group and the scores on both the immediate and delayed posttests for each treatment group. However, the results were exactly the opposite for each treatment group, as will be discussed later.

Two methods of investigating the relationship between learning style preference and treatments were used in the analysis:

a) the correlation coefficients between learning style group and the posttest scores were calculated and compared for the two treatment groups.
b) the two-way interaction between learning style and treatment was examined.

Correlation. There was a significant negative correlation of -.55 (p<.005) between the learning style group and the immediate posttest scores and a significant negative correlation of -.46 (p<.005) between the learning style group and the delayed posttest scores of the group studying with the package (See Table 13).

The negative sign of the correlation demonstrates that high scores on the posttests were paired with low scores on the Learning Style questionnaire, indicating that those who preferred learning with self-instructional materials (e.g., learning style preference = 1) actually did better on the posttest.

On the other hand, there was a significant positive correlation of .66 (p<.005) between the learning style group and the immediate posttest scores and there was a significant positive correlation .59 (p<.005) between the learning style group and the delayed posttest scores in the group receiving the classroom instruction.

The positive sign of the correlation demonstrates that high scores on the posttest were paired with high scores on the Learning Style questionnaire, indicating that those who preferred learning with the traditional classroom situation (e.g., learning style preference = 3) actually did better on the posttests.
Table 13

Correlations between learning style group and posttests for both treatment groups

<table>
<thead>
<tr>
<th></th>
<th>Individualized groups</th>
<th>Classroom group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate Posttest</td>
<td>( r = -0.55 )</td>
<td>( r = 0.66 )</td>
</tr>
<tr>
<td>Delayed Posttest</td>
<td>( r = -0.46 )</td>
<td>( r = 0.59 )</td>
</tr>
</tbody>
</table>

Two-way interaction. Average score on the posttests of the students in each treatment group divided up according to learning style preference is presented in Table 14.

Table 14

Students' average score on the posttests in each treatment group divided up according to Learning Style preference

<table>
<thead>
<tr>
<th>Learning Style Group</th>
<th>Individualized Group</th>
<th>Classroom Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Immediate Posttest</td>
<td>Group Posttest</td>
</tr>
<tr>
<td>First group</td>
<td>35.86</td>
<td>34.64</td>
</tr>
<tr>
<td>Second group</td>
<td>34.63</td>
<td>33.53</td>
</tr>
<tr>
<td>Third group</td>
<td>31.71</td>
<td>30.28</td>
</tr>
</tbody>
</table>
The results of the two-way analysis of variance between treatment and learning style group indicates that there is a significant two-way interaction between the treatments (i.e., learning with the package and the lecture method) and the learning style preference of students (1, 2 or 3).

The two-way interaction is significant at the .001 level in both immediate ($F_{2,66} = 20.097$) and delayed posttests ($F_{2,66} = 13.001$). Even when pretest scores are adjusted for by analysis of covariance procedures, this two-way interaction is still significant at the .001 level. ($F_{2,65} = 17.935$ for the immediate and $F_{2,65} = 11.385$ for the delayed posttest).

Graph illustration the two-way interaction between treatment and learning style group on the immediate posttest is presented in Figure 3.

Figure 3. Two way interaction between treatment and learning style group for immediate posttest

- First group = like individualized learning
- Second group = neutral
- Third group = dislike individualized learning
Graph 4 illustrates the two-way interaction between treatment and learning style group on the delayed posttest.

Figure 4. Two way interaction between treatment and learning style group for delayed posttest.

First group = like individualized learning.
Second group = neutral
Third group = dislike individualized learning
The distribution of students according to age is presented in Table 15.

Table 15
Distribution of subjects according to age in both treatment groups

<table>
<thead>
<tr>
<th>Years old</th>
<th>Frequencies</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Individualized group</td>
<td>Classroom group</td>
</tr>
<tr>
<td>17</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>18</td>
<td>3</td>
</tr>
<tr>
<td>19</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>21</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>22</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>23</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>24</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>25</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>28</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>29</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>31</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>32</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>39</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

n = 48 n = 24 ≤ 72 subjects
Median age = Med = 19 Med = 20

Students in both group (i.e., those studying with the package and those receiving classroom lecture) tended to concentrate in the 18 to 20 age bracket.

In the group studying with the package a great number of students
was located in the 18 year old group, while in the group receiving traditional lecture, the 20 year old group constituted the bigger number.

The correlation coefficients between age and the immediate and delayed posttest scores were calculated and compared for the two treatment groups. The results are presented in Table 16.

Table 16

Correlations between age and posttest for both treatment groups

<table>
<thead>
<tr>
<th></th>
<th>Individualized group</th>
<th>Classroom group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate Posttest</td>
<td>$r = .067$</td>
<td>$r = .069$</td>
</tr>
<tr>
<td>Delayed Posttest</td>
<td>$r = .036$</td>
<td>$r = .076$</td>
</tr>
</tbody>
</table>

The results of the correlation are not statistically significant. This means that age does not appear to be a factor which affects the students' performance in a linear manner.

In order to see if a non-linear relationship between age and treatment exists, students were grouped into three different levels according to age. The average of the scores in the immediate and delayed posttest indicates that in the group where students studied with the package, older students performed better than their younger counterparts, while in the group where students received classroom lecture, it was the opposite. This difference, although interesting was not found to be statistically significant when measured by a two-way interaction between age and treatment on either the immediate posttest ($p = .544$) or the delayed
posttest (p = .935).

The average score of the subjects according to age is presented in Table 17.

### Table 17

Average score of subjects according to age in both treatment groups

<table>
<thead>
<tr>
<th>Group of Age</th>
<th>Individualized Group</th>
<th>Classroom Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Immediate Posttest</td>
<td>Group Posttest</td>
</tr>
<tr>
<td>First group Under 20</td>
<td>34.82</td>
<td>33.69</td>
</tr>
<tr>
<td>Second group between 20 and 25</td>
<td>34.44</td>
<td>33.19</td>
</tr>
<tr>
<td>Third group over 25</td>
<td>36.00</td>
<td>34.33</td>
</tr>
</tbody>
</table>
A graphic representation is shown in Figure 5.

Figure 5. Graph of immediate posttest means broken down by treatment and age.
First group - students under 20
Second group - students between 20 and 25
Third group - students over 25
Figure 6: Graph of delayed posttest means broken down by treatment and age.
First group - students under 20
Second group - students between 20 and 25
Third group - students over 25

Sex

Sex is another variable examined in this study to determine whether it affects the results obtained in the study.

Table 18
Distribution of the subjects according to sex

<table>
<thead>
<tr>
<th>Sex</th>
<th>Individualized group</th>
<th>Classroom group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>Female</td>
<td>33</td>
<td>11</td>
</tr>
<tr>
<td>n = 48</td>
<td></td>
<td>n = 24</td>
</tr>
</tbody>
</table>
The correlation coefficients between the sex of the subjects and the scores on the immediate posttest as well as the delayed posttest were calculated. The results are presented in Table 19.

<table>
<thead>
<tr>
<th></th>
<th>Individualized group</th>
<th>Classroom group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate Posttest</td>
<td>$r = .141$</td>
<td>$r' = -.089$</td>
</tr>
<tr>
<td>Delayed Posttest</td>
<td>$r = .052$</td>
<td>$r = -.082$</td>
</tr>
</tbody>
</table>

None of the correlation coefficients were significant.

Taking into account the average score of the students according to their sex, the results indicate that female students studying with the package obtained slightly better results than the male students. In the group receiving a traditional class lecture, however, male students obtained slightly better results than female. Examining the two-way interaction between sex and treatments leads to the conclusion that this interaction was not significant on either the immediate posttest ($p = .361$) or the delayed posttest ($p = .596$).
The average score of the subjects according to sex is presented in Table 20.

Table 20
Average score of the subjects according to sex in both treatment groups

<table>
<thead>
<tr>
<th>Sex</th>
<th>Individualized group</th>
<th>Classroom group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Immediate Posttest</td>
<td>Delayed Posttest</td>
</tr>
<tr>
<td>Male</td>
<td>34.26</td>
<td>33.33</td>
</tr>
<tr>
<td>Female</td>
<td>35.00</td>
<td>33.36</td>
</tr>
</tbody>
</table>

The results are presented graphically in Figure 5.

Figure 7. Graph of immediate posttest means broken down by treatment and sex.
Hypothesis Four

The fourth hypothesis - that students who spend more time working with the package would score higher on the posttest than students who spend less time with the package - was confirmed.

A positive correlation of .55 was observed between the time spent working with the package and the scores obtained by the students. This correlation coefficient was significantly different from 0 at the .005 level.

The time students spend working with the package is also an important variable to consider in this study; the rationale behind this is the widely-held belief that students using an individualized technique can learn better because they have the option to study at their own pace (Gagné and Briggs, 1974; Kemp, 1980; Mitchell, 1980) and thus, if they need more time to master the materials, they can follow this option.

The students in the individualized group were told before the
distribution of the package that the approximate time to work with the package was about 20 hours. However, they were also told that they could spend more or less than 20 hours according to their preferences. Moreover, they were instructed to finish studying it within three weeks because of the constraints imposed by the university where the study was undertaken.

For interpretation purposes, students were divided in four groups according to the number of hours they spent working with the package. A distribution of the students according to these four groups and the average score on the immediate and delayed posttest are presented in table 21. The average time spent by students while working with the package was 25.58 hours.

Table 21

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of hours</th>
<th>Number of students</th>
<th>Mean on the immediate posttest</th>
<th>Mean on the delayed posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st group</td>
<td>15 - 20</td>
<td>8</td>
<td>31.62</td>
<td>29.62</td>
</tr>
<tr>
<td>2nd group</td>
<td>21 - 25</td>
<td>16</td>
<td>34.68</td>
<td>33.12</td>
</tr>
<tr>
<td>3rd group</td>
<td>26 - 30</td>
<td>18</td>
<td>35.89</td>
<td>35.22</td>
</tr>
<tr>
<td>4th group</td>
<td>31 - 35</td>
<td>6</td>
<td>35.83</td>
<td>35.00</td>
</tr>
</tbody>
</table>

A graphic representation of this distribution is presented in Figure 9.
Figure 9. Illustration of the relationship between both posttests and the number of hours spent working with the package.

Note: First group = 15 to 20 hours
     Second group = 21 to 25 hours
     Third group = 26 to 30 hours
     Fourth group = 31 to 35 hours

Evaluation of the self-instructional package

The self-instructional package which was planned and implemented in this study, was also evaluated by the students who used it.

An evaluation form consisting of 10 five-point rating scale and 3 open-ended questions which required answers to be supplied by the respondent was presented to the students in order to determine their attitude toward the materials they worked with. Copies of the evaluation form in both English and Spanish are included in appendix D. To make
the interpretation of the results of the rating scale uniform, a score of 5 was always assigned to the most favourable category and a score of 1 to the least favourable category.

An example of one of the rating scale items follows:

Objectives

1. The objectives of the package were not clear.  

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.87</td>
<td>.33</td>
</tr>
<tr>
<td>2</td>
<td>4.95</td>
<td>.20</td>
</tr>
<tr>
<td>3</td>
<td>4.85</td>
<td>.41</td>
</tr>
<tr>
<td>4</td>
<td>4.75</td>
<td>.52</td>
</tr>
<tr>
<td>5</td>
<td>4.75</td>
<td>.48</td>
</tr>
<tr>
<td>6</td>
<td>4.95</td>
<td>.20</td>
</tr>
<tr>
<td>7</td>
<td>4.73</td>
<td>.49</td>
</tr>
<tr>
<td>8</td>
<td>4.83</td>
<td>.43</td>
</tr>
<tr>
<td>9</td>
<td>4.60</td>
<td>.61</td>
</tr>
<tr>
<td>10</td>
<td>4.85</td>
<td>.35</td>
</tr>
</tbody>
</table>

Note: Each of the above items were evaluated on a 5-point scale where 1 was least positive and 5 was most positive.
The students responded very positively with average ratings close to 5 in every case. This indicates that they felt extremely positive about the objectives, content, organization, presentation, motivation, instructions, vocabulary, exercises, supplementary materials and overall value of the package.

The results of items 11, 12 and 13 are presented individually for each item.

11. Which part did you find most valuable? Why?

The 48 students who studied the package answered this question as follows:

21 responded that they found the **First Section** most valuable.

They gave the following reasons:

The first section was:

<table>
<thead>
<tr>
<th>Reason</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>better explained</td>
<td>4</td>
</tr>
<tr>
<td>more interesting</td>
<td>6</td>
</tr>
<tr>
<td>clearer</td>
<td>9</td>
</tr>
<tr>
<td>the basis for 2nd section</td>
<td>2</td>
</tr>
</tbody>
</table>

12 responded that they found the **Second Section** the most valuable.

They gave the following reasons:

The second section was:

<table>
<thead>
<tr>
<th>Reason</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>more interesting</td>
<td>4</td>
</tr>
<tr>
<td>clearly explained</td>
<td>3</td>
</tr>
<tr>
<td>more motivating</td>
<td>2</td>
</tr>
<tr>
<td>something new</td>
<td>3</td>
</tr>
</tbody>
</table>

14 students said that the **entire package** was valuable.

The reasons they gave are:

<table>
<thead>
<tr>
<th>Reason</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both sections were clear and precise</td>
<td>2</td>
</tr>
<tr>
<td>Everything was clearly explained</td>
<td>5</td>
</tr>
<tr>
<td>It was very interesting</td>
<td>2</td>
</tr>
<tr>
<td>It facilitated learning</td>
<td>2</td>
</tr>
<tr>
<td>Everything discussed was related to the subject matter</td>
<td>3</td>
</tr>
</tbody>
</table>
1 student said that the examples in general constituted the most valuable part because:

They made learning easier 1

12. Which part did you find least valuable? Why?

5 students thought that the least valuable part was the Second Section because:

It was more complicated 5

1 student said that the least valuable part was the First Section because:

It was less interesting than the Second Section 1

3 students replied that the least valuable part was the supplementary materials for the following reasons:

They were repetitive 1
They were too long 1
The vocabulary used was difficult 1

2 students said that the least valuable part was the specific topic, the data because:

It was not discussed clearly 1
It required more explanation 1

37 students said that no part was less valuable because:

The entire package was interesting 16
Everything was related 4
The entire package was clear 5
The package facilitated learning 3
Everything was well explained 2
The entire package was valuable 37
13. Would you like to study again using a self-instructional package? Why?

- 1 student - undecided
- 47 students - yes

<table>
<thead>
<tr>
<th>Reasons</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Makes me responsible</td>
<td>5</td>
</tr>
<tr>
<td>Facilitates learning</td>
<td>13</td>
</tr>
<tr>
<td>It is interesting</td>
<td>6</td>
</tr>
<tr>
<td>It is motivating</td>
<td>2</td>
</tr>
<tr>
<td>Less pressure to study</td>
<td>6</td>
</tr>
<tr>
<td>It can be used anytime and anywhere</td>
<td>11</td>
</tr>
<tr>
<td>I can work at my own pace with teacher's help</td>
<td>4</td>
</tr>
</tbody>
</table>

**Evaluation of the test**

Test - retest reliability for the posttest -- calculated by taking the correlation between the immediate posttest and the delayed posttest -- was found to be .88 for the classroom group and .86 for the individualized group.

Coefficient alpha reliability -- calculated using the responses of the combined groups, namely the individualized and classroom groups, on the immediate posttest -- was found to be .63 for the 26 item test.

Item difficulty indices and item discrimination indices based on the responses of the individualized group in the immediate posttest are reported in Table 23.
### Table 23

Item discrimination and item difficulty indices according to the responses of the individualized group on the immediate posttest

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Item difficulty</th>
<th>Item discrimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.96</td>
<td>0.48</td>
</tr>
<tr>
<td>2</td>
<td>0.95</td>
<td>0.36</td>
</tr>
<tr>
<td>3</td>
<td>0.98</td>
<td>0.20</td>
</tr>
<tr>
<td>4</td>
<td>0.92</td>
<td>0.59</td>
</tr>
<tr>
<td>5</td>
<td>0.95</td>
<td>0.25</td>
</tr>
<tr>
<td>6</td>
<td>0.94</td>
<td>0.63</td>
</tr>
<tr>
<td>7</td>
<td>0.94</td>
<td>0.63</td>
</tr>
<tr>
<td>8</td>
<td>0.96</td>
<td>0.35</td>
</tr>
<tr>
<td>9</td>
<td>0.94</td>
<td>0.33</td>
</tr>
<tr>
<td>10</td>
<td>0.98</td>
<td>0.05</td>
</tr>
<tr>
<td>11</td>
<td>0.89</td>
<td>0.02</td>
</tr>
<tr>
<td>12</td>
<td>0.83</td>
<td>0.33</td>
</tr>
<tr>
<td>13</td>
<td>0.92</td>
<td>0.41</td>
</tr>
<tr>
<td>14</td>
<td>0.89</td>
<td>0.25</td>
</tr>
<tr>
<td>15</td>
<td>0.94</td>
<td>0.44</td>
</tr>
<tr>
<td>16</td>
<td>0.92</td>
<td>0.16</td>
</tr>
<tr>
<td>17</td>
<td>0.96</td>
<td>0.20</td>
</tr>
<tr>
<td>18</td>
<td>0.94</td>
<td>0.19</td>
</tr>
<tr>
<td>19</td>
<td>0.92</td>
<td>0.22</td>
</tr>
<tr>
<td>20</td>
<td>0.98</td>
<td>0.05</td>
</tr>
<tr>
<td>21</td>
<td>0.96</td>
<td>0.07</td>
</tr>
<tr>
<td>22</td>
<td>0.96</td>
<td>0.07</td>
</tr>
<tr>
<td>23</td>
<td>0.92</td>
<td>0.28</td>
</tr>
<tr>
<td>24</td>
<td>0.89</td>
<td>0.62</td>
</tr>
<tr>
<td>25</td>
<td>0.96</td>
<td>0.02</td>
</tr>
<tr>
<td>26</td>
<td>0.96</td>
<td>0.20</td>
</tr>
</tbody>
</table>
The item difficulty indices ranged from .83 to .98, indicating that all the items were fairly easy (appropriate for a mastery learning situation).

Item discrimination indices ranged from .02 to .63. None of them were negatively discriminating.
CHAPTER V

Discussion

This chapter endeavors to discuss the results of the present study, which were reported in the previous chapter, by pointing out certain features that are relevant.

From the four hypotheses proposed in this study, two were confirmed with statistical support. These hypotheses were hypothesis one -- the group receiving self-instructional package would perform better on the immediate posttest than the group receiving classroom instruction -- which was found to be statistically significant (p = .004), and hypothesis four -- time spent working on the package would be positively related to posttest scores -- (t = .55, p = .005). Hypothesis three -- that age, sex and learning style preference would affect performance -- was confirmed in part because learning style preference was found to interact with the treatments significantly. More detailed comments are presented.

Hypothesis One -- It was hypothesized that students receiving information from an individualized package would perform better in the immediate posttest than students receiving traditional classroom instruction. This hypothesis was supported with a significance level of .004. However, if the pretest scores were not taken into account as a covariate, the results on the immediate posttest could have been significant at the .001 level.

Difference in the means revealed that students who studied with the package obtained significantly better results ($\overline{X}_p = 34.77$), than
students receiving the traditional classroom instruction ($X = 31.75$).
The differences between the adjusted means when the pretest was used as a covariate were also significant ($X_p$ adjusted = 34.50) for the individualized group and ($X_c$ adjusted = 32.29) for the classroom group.

These results show that students under individualized instruction acquired more knowledge than students under the traditional lecture method.

The mastery level achieved by students in the two treatment groups is another way to demonstrate the difference in acquired knowledge between one group and the other.

In the individualized group made up of 48 students:

- 0% of the students achieved 60% mastery
- 4% of the students achieved 70% mastery
- 10% of the students achieved 80% mastery
- 40% of the students achieved 90% mastery
- 46% of the students achieved 100% mastery

While in the classroom group made up of 24 students:

- 4% of the students achieved 60% mastery
- 21% of the students achieved 70% mastery
- 42% of the students achieved 80% mastery
- 21% of the students achieved 90% mastery
- 12% of the students achieved 100% mastery

These results seem to indicate that the lecture method of instruction is not the best mode to transmit information if the results are to be effective. These results strengthen the findings of McLeish (1968), that the lecture method is not always the most effective technique for all the students. One of the reasons that the self-instructional package may have been so effective is because students using the package, were allowed to study according to their individual preferences (Cooley & Glaser, 1971).
Students working with a package can work at their own pace and
take the package anywhere they want to study. These facets reflect the
theme of freedom to study, without any pressure imposed by a schedule.
This helps students learn more effectively (Manwaring, 1976; Moore et.
al., 1977-78).

Most of the students who participated as subjects in this study
reported that this was their first experience working with an individu-
ialized package. At the beginning of the study, students in the package
group felt a bit lost. However, the presence of a tutor motivating and
guiding them whenever the need arose, helped to make them feel more
comfortable and secure during their learning activity.

The results seem to indicate that the presence of a tutor --
encouraging and guiding the students while they study the self-instruc-
tional materials -- helps make the students feel more confident that
they can perform the task. This result supports the findings of Wilkinson
(1979) who also emphasized the importance of a tutor's role in a self-
instructional activity.

Even though the students did not frequently ask for assistance
from the tutor, they said that they felt "all the time" that they could
always approach the tutor for additional explanation, in the event of a
problem.

Another aspect that may have contributed to the good performance
using the package was the students' knowledge of the fact that the score
they obtained on the test, was going to make up one-third of their final
mark in the course (scientific method). Consequently, the students really
concentrated and tried their best to obtain a good mark which would
improve their final mark in the course. This strongly motivated students
to study the package seriously and deeply.
For the classroom group, the results obtained from the three-week session of classroom instruction -- for purposes of this study -- were also taken into account as one-third of the final mark. The difference was that for these students the classroom instruction was not a new and different experience. The only new element was the presence of a different teacher (the researcher) for the three-week session.

Hypothesis Two - that students using the package would score higher in the delayed posttest than students receiving information in the classroom - was not confirmed. However, if the pretest scores were not taken into account as a covariate, the results on the delayed posttest would have been statistically significant \( p = .006 \).

The results obtained in the delayed posttest show a significant decrease, as compared to the immediate posttest scores, in the group with the package. In the classroom group the decrease detected from the immediate to the delayed posttest scores was not significant.

These results seem to indicate that if students learn better using a self-instructional package than students in the traditional classroom situation, probably the students in the classroom retained the information (measured by the immediate posttest) with less of a loss than students studying the package. This results do not agree with the findings of Pask (1976) and Dunn & Dunn (1978) who said that students tend to retain information longer if their learning style preference is matched with the teaching method used.

However, it is also important to remember that the package group did perform significantly better on the delayed posttest than the classroom group \( p = .006 \) when the pretest scores were not used as a covariate. Thus retention as measured by the delayed posttest was generally better for the package group, but retention was only significantly better if
the groups were not adjusted by their initial knowledge of the material.

A possible reason why students in the package group suffered a significant decrease from the immediate posttest to the delayed posttest while the classroom group had only a non-significant decrease, could be the fact that students in the individualized group were surprised when they were asked to repeat the test once more. The reason for this negative reaction was that they did not want to answer the test again for fear of losing the mark they had already received earlier. Once assured by the professor -- who disclosed all these findings to this researcher -- that the mark would stay unchanged, they proceeded to write the test. (The professor who administered only the delayed posttest was the professor teaching the scientific method course during the term the study was undertaken. This researcher asked him to do so since this researcher was already in Canada during the delayed posttest.)

The classroom group took the test as a matter of course, although the students were not very enthusiastic about it. They did not react with as much surprise as the individualized group.

Hypothesis Three - that variables such as learning style, age and sex of the students would affect the outcomes of this study was confirmed in part, applying only to the first variable (i.e., learning style).

The significant two-way interaction (p = .001) between learning style preference as measured by a learning style questionnaire and treatment indicates that students can indeed identify ways to learn which are most successful for them. In effect, if the information is not presented in the way they prefer, the results might not turn out as well as if this situation is taken into account. These results are consistent with the findings of Pask (1976) and Dunn & Dunn (1978).
Students who showed a high inclination toward studying using a self-instructional package, obtained the highest scores in the individualized group and the lowest scores in the classroom group, while students who showed a low inclination toward studying using self-instructional packages performed best in the classroom group and worst in the individual group.

These results indicate that certain students possess the capacity to study using a package similar to the one used in this study, and they can identify this capacity before using a package by completing the learning style questionnaire and calculating their score. These students like to study by themselves, they like to receive written information, and they prefer to have an interaction with a tutor. However, other students do not like to study following this structure and they can identify their preference for other methods of instruction again through completing the learning style questionnaire. These individuals prefer to attend a regular class or to study using different kinds of materials other than packages such as the one used in this study.

If the students' preference for a certain method of instruction were taken into account, so that they were assigned to one group or another (i.e., individualized group or classroom group) according to their choice, students would tend to maximize their success.

According to the results obtained from this study, age does not appear to be a factor which affects the students' performance in a linear manner. The correlation between age and posttest scores was not significant either in the individualized group (r = .07) or in the classroom
group \((r = .07)\).

Although no significant effects were found to support this variable as a factor which affects the outcomes, however, slight performance differences according to age were found:

Older students performed better in the individualized group than their younger classmates. But younger students performed better in the classroom group, than the older counterparts.

One of the possible reasons for these results could be that older students are more responsible and have learned how to study on their own. And, since some of them are working students, a self-instructional situation helps them to accommodate their study schedule to their needs and eliminates the necessity of them having to attend a regular class if they choose not to.

Younger students generally are not working students; consequently, they do not feel the need to adjust their study schedule and perhaps prefer to study in a classroom situation because they do not have to do everything by themselves.

Sex

Sex, like age, is a factor that appears to have no significant effect on the outcomes of this study. The correlation between posttest scores and the sex of students was not significant for either the immediate or for the delayed posttests (see Table 19). Nor was there a significant two-way interaction between sex and treatment.

But once again (as with age) results showed a slight difference in each treatment group. In the individualized group female students performed better than males, and in the classroom group male students
performed better than females.

Perhaps, in this study, more female students preferred to study using a self-instructional package, and more male students preferred to attend a regular class.

In order to check out this hypothesis a two-way contingency table of sex by learning style group was created.

Table 24

Two-way contingency table of sex and learning style

<table>
<thead>
<tr>
<th>Learning style group</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>7</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>Female</td>
<td>24</td>
<td>14</td>
<td>6</td>
</tr>
</tbody>
</table>

From the table, it is obvious that a higher proportion of females were found to prefer self-instructional packages or the traditional classroom instruction.

The relationship between the learning style preference and sex was found to be significant at the .05 level when tested using the Chi-square distribution ($X^2$ with 2 d.f. = 6.148 > 5.99).

Hypothesis Four -- that those students who spend more time working with the package would score higher than students who spend less time with the package -- was confirmed.

The correlation obtained ($r = .55$) between the time spent working with the package and the scores, indicates a strong relationship between the two factors.
One of the advantages of individualized instruction is that students can spend the time they need to work with the materials, and they can stop the activity when they feel like it (Mitchell, 1980). This means they can work at their own pace (Manwaring, 1976; Moore et al., 1977–78).

It is logical to think that students who spend more time working with the package, can perform better than students who devote less time to the package.

In a learning event where a self-instructional package is used, students can spend only the time they really need to master the subject matter. On the other hand, in the classroom situation, students attend the class according to a fixed schedule and generally are not directed adequately toward outside work. Consequently, they lack interest in continuing to work with the information acquired in class.

The average time spent by students while working with the package was 25.58 hours, which is a little bit more than the previously calculated time of 20 hours.

According to the results of this study, time is an important factor to consider while using individualized instruction if the results are to be effective. Students must have enough time to master the knowledge they are acquiring.

The results of this study suggest that students who spent between 26 and 30 hours working with the package (see Figure 9), performed better than the students who spent less time, and slightly better than students who spent more than 31 hours.

The reason for this results could be that the optimum time to study this package is from 26 to 30 hours, so that if students spend
more time, they are just overlearning the material. But if students spend less time than necessary, the results might show negative effects.

**Evaluation of the self - instructional package**

The package used in this study was evaluated by the students who used it.

Evaluation results indicate that students in general liked the package. They responded very positively to the evaluation form administered for this purpose (see appendix D). The results of the evaluation form were very positive (see Table 22) and indicated that students felt comfortable while working with the package.

The students commented on some weaknesses of the package. For example, they said that some parts were too long, while some were too short. They felt that some parts required additional information (see page 68). However, the results of this evaluation seem to show that students really liked working with the package. From 48 students, only one was undecided whether or not to work with a similar package again. The rest of the students reported that they would like to study again with a package similar to the one used in this study. They gave different reasons why they felt comfortable while working with the package. One reason that most of the students gave is that the package facilitated learning and gave them the "freedom" to study anytime and anywhere they wanted to (see page 69).
Evaluation of the test

The test used as a pretest and posttest in this study was also evaluated to determine its reliability.

The results in the test - retest reliability were strong for both individualized group (.86) and classroom group (.88). These results indicated that the test was stable over time.

Coefficient alpha reliability was also calculated using both treatment groups on the immediate posttest. It was .63 which is a bit low, indicating that not all of the items were homogenous.

Item discrimination indices ranged from .02 to .63. None of the items were negatively discriminating. However, for six of the items in the test, the discrimination indices were very close to 0 (see table 23). Those questions should be revised for future applications of the test. This would probably improve the internal consistency of the test and thus raise the coefficient alpha reliability estimate.

Item difficulty indices ranged from .83 to .98, indicating that all the items in the test were fairly easy (which is appropriate when a mastery learning situation is expected).
CHAPTER VI

Conclusions

Based on the results of the statistical analysis and the discussion of the results obtained in the present study, the following conclusions can be drawn:

1. Print self-instructional packages with tutorial assistance offer many advantages within the particular context of the University of Aguascalientes. Some of these advantages are:
   a) Students who study with a package can obtain more effective learning than those who receive traditional classroom instruction.
   b) A greater number of students can take the course at the same time. This helps to solve the problem of an overpopulation of students and a shortage of teachers.
   c) Teachers using packages would have the opportunity to participate in more varied and productive academic activities in the university instead of working in the classroom explaining the subject matter over and over. Teachers would have the opportunity to: i) prepare their own packages; ii) improve their packages; iii) engage in the implementation of research projects; and iv) engage in team teaching.
   d) Students studying with self-instructional packages generally consider this learning situation to be positive and interesting.
   e) Students report that they tend to feel freer because they can work with the materials without time pressure.
f) Students seem to appreciate having a tutor available while working with the package.

g) If motivated properly, these students can find this mode of instruction helpful in enabling them to assume more responsibility for their learning.

On the other hand, there are some disadvantages that may be associated with print instructional materials. Some possible disadvantages may be the following:

a) If students are not properly motivated, they may not perform as well as expected.

b) If the package is not correctly designed (according to learner characteristics), the results may not be as good as expected.

c) If the package is too long, chances are that students' interest in working with the materials may decrease considerably.

d) If a questionnaire to detect students' learning style preference is not administered before distributing the package, it is possible that certain students would not like to study using a self-instructional package, which could negatively affect learning.

2. Learning style preference appears to be a vital aspect to consider prior to the selection of any medium of instruction. If the package is given to students who prefer working individually, the results obtained will probably be considerably better.

3. Sex and age of students are factors which do not appear to exercise important influences on the results of learning situations in which students work with print self-instructional
packages. However, the relationship detected between sex and learning style preference, where female subjects strongly preferred to study using self-instructional packages as opposed to the male subjects, suggests that more females will select this medium of instruction.

4. The length of time it takes the students to complete the self-instructional package appears to be an important factor to consider if this instructional medium is to be employed. Students can set their study pace according to their capabilities and needs. Hence, teachers who use self-instructional packages should allow enough time to complete the package so that even slow students do not feel any time pressure. Between 26 to 30 hours appears to be an optimum allocation of time for the package used in this study.

Contributions for further research and development

1. Packages like the one used in this study in the context of the University of Aguascalientes. They can be used as an alternative to the classroom teacher. This way information can be presented more effectively than the traditional lecture method. The aspects mentioned earlier, however, must not be ignored if the benefits from this medium of instruction are to be obtained.

2. Learning style preference appears to be an important indicator of performance on self-instructional materials as measured by the learning style questionnaire developed by this author. These findings open up the area for further research.
Limitations of this study

1. The results of this study may not be generalizable to other instructional materials. The results apply only to this particular print self-instructional package in the university where it was tested.

2. This study applies only to print self-instructional packages. Its use in combination with other media (television, slides, etc.) could produce different results.

3. The consideration of other variables like 'reading ability' could provide important findings that could serve to explore more thoroughly other aspects of this study that were not touched in this undertaking.

4. The random assignment of subjects to treatment groups would have improved the generalizability of the results.

Recommendations

In light of the specific results of this study, some aspects must be considered if self-instructional packages are to be used:

1. Students must be properly motivated to work with this type of materials by presenting them with the advantages which are offered.

2. Tutorial assistance should be available to motivate, encourage and guide the students during the time they are studying the package.

3. Students' learning style preference should also be considered as an important factor before recommending this medium of
instruction. A learning style questionnaire should be administered to determine the students' preferences for a particular mode of instruction.

4. Students should have a long enough time depending on their individual needs, within which to study the package without time pressure.

5. Students may not want to study very long packages. It is recommended then, that a package be used -- especially if this will be the students' first encounter with individual work -- for certain segments of the complete course.

References


Clark, R.E. Adapting aptitude-treatment interaction methodology to instructional media research. A.V. Communication Review, 1975, 23, 133-137.


Moore, M.G. Cognitive style and Telemathic (Distance teaching). ICCE Newsletter, 5, 4, pp. 3-10, 1975.


APPENDICES
APPENDIX A

Instructions to students on the use of the package

This lesson was prepared for you to help you learn by yourself, without having to attend a class regularly. All you have to do is to follow the instructions carefully. The lesson is about scientific method.

Please read the instructions carefully and if you have any questions about them -- or about the package when you read it -- your adviser will be around to help you, in order that you may obtain the best results.

The purpose of the lesson and the instructions for its use follow:

Purpose and objectives

The purpose of this package on Scientific Method is to present a general view of the importance of rigorously following a research method to achieve one of the main objectives of science: its growth and development.

Another purpose of this package is to motivate you to study more about the scientific method.

More specifically, this package will enable you to obtain the following objectives. After studying the package and doing the exercises you will be able to:

1. Define science as a body of rational, exact and verifiable knowledge and also as a valuable tool for dominating nature and changing society.
2. Make a distinction between scientific knowledge and common sense knowledge by giving concrete examples of each.
3. Differentiate between formal sciences and factual sciences, considering that the factual sciences have to be observed and/or experimented
on, to confirm their conjectures or suppositions. The formal sciences, meanwhile, require no experimentation.

4. Give two concrete examples of factual ideas and two examples of formal ideas. Explain why they are formal or factual.

5. Distinguish between science and technology (taking into consideration the aspects of theory and practice) by giving concrete examples of each.

6. Distinguish between social sciences and natural sciences by selecting them from a given list.

7. Identify the scientific method as a rigorous tool which helps scientists with their work by showing them the steps to be followed in research in order to obtain more valid results.

8. Identify the steps to be followed — according to the scientific method of research — explaining their role in the entire process.

9. Point out the activities to be done while formulating the problem research statement. This includes problem definition and problem distillation and explaining the importance of observing each step.

10. Explain the role of the hypotheses in the scientific research process.

**Study Guide**

The structure of this package will be described in detail a little later. The structure is also summarized in the flow chart presented after the description.

Approximately 20 hours of your time will be needed, to work with the package and to do the exercises. However you can work at your own pace so that you can finish the entire task in less than or more than 20 hours.
The package begins with a general introduction which gives you a general view of the topic discussed in the package.

The package is divided into two sections, both of which explain different concepts related to the scientific method. These concepts were established earlier in the section describing the objectives of the package.

Each section has two sets of exercises. Each set consists of several questions. Some of the questions are constructed with the purpose of summarizing the recently acquired knowledge in that particular part of the package. Other questions, meanwhile, will require your active participation (i.e., reading or consulting supplementary materials) to enable you to acquire the knowledge needed to appreciate the next section in the package.

At the end of the package, some articles and supplementary materials will be added to help you answer some questions in the exercises. Refer to them whenever necessary. Also included is a reference section, consisting of some books that could be useful in case you want to know more about the subject matter.

After each question, you will find a blank space right after a line (XXXXXXXXXX). This space is for your answer; if the space is not enough for your answer, please write your answer on a sheet of paper and staple it right on the blank space. The answer for each question is provided after a series of Xs; this way you can check if your answer is correct. In case of a wrong response, the answer provided can help explain why you did not get the right answer. It will be convenient to use a sheet of paper or a piece of cardboard to cover the answers while studying. This will keep you from looking at the answers at once. This would also give you the chance to analyze the question, resulting in more productive
learning. Look at the answer only when you finish writing your own answer. When you see the X's, cover the answer with the sheet of paper. Then, formulate your own answer, write it down, and if necessary -- consult the supplementary materials related to that particular question. Once you have written the answer, you can withdraw the sheet of paper and compare your answer with the answer in the package.

The examples are always boxed to help you locate them easily.

A sectional summary as well as a general summary follows after each section and at the end of the package respectively. The purpose of this section is to help you remember the basic points discussed in each section in particular and in the package, in general. A flow chart follows containing graphic suggestions about the steps to follow while studying the package. If you do not understand something, remember that your adviser is always around to help.

After studying the package, you will be asked to return the package together with the responses.

Good Luck!
FLOW CHART

General Introduction

Introduction to Section I

References

Section I

Supplementary Materials

Exercises, Section I

Correct?

Yes

Summary, Section I

Introduction to Section II

References

Section II

Supplementary Materials

Exercises, Section II

Correct?

Yes

Summary, Section II

Conclusions

--- Compulsory

--- Optional
APPENDIX B

Test

Scientific Method

Name ___________________________ Age __________

Sex _______ Program ______________________________

The purpose of this test is to determine how much knowledge you have about the Scientific Method. Try your best to answer the questions.

GOOD LUCK

1. Mention 3 methods to obtain knowledge. (3 points)
   1)
   2)
   3)

2. Give 2 examples of common sense knowledge. (2 points)
   1)
   2)

3. Write down 2 differences between common sense knowledge and scientific knowledge. (2 points)
   1)
   2)

4. Which are the 2 main sub-activities involved in a research activity's statement of the problem? (2 points)
   1)
   2)
5. Write down 2 basic differences between formal sciences and factual sciences. (2 points)
   1) 
   2) 

6. Identify the research steps involved in the Scientific Method. (4 points)
   

7. What is the relationship between Scientific Method and scientific research? How is the scientific method different from scientific research? (2 points)

8. From the following list, identify the formal sciences and the factual sciences by writing the word formal or factual on the line opposite the word. (2 points)

   Chemistry  
   Mathematics  
   Psychology  
   Biology  
   Sociology  
   Logics
After carefully reading the following statements, write T if you think the sentence is true or F if you think it is false. If you think it is false, please replace the underlined word with the correct answer. Write the correct answer on the line below.

1. Technology tries to obtain new knowledge
   just for the sake of knowing.

2. Factual sciences need experimentation to
   determine whether or not their hypotheses are
   acceptable.

3. Variables are predictions the researcher makes
   about the research results.

4. In descriptive research, the researcher
   manipulates a particular factor to determine
   if this manipulation generates any change.

5. Psychology is a nomotetic social science.

6. The dependent variable is the factor under
   study which the researcher manipulates to
   find out how it affects a phenomenon.
Try to relate the two columns by writing the corresponding number in the right column on the line close to the left column.

(10 points)

Process employed to solve a group of problems. (1) Variable

Body of knowledge gained through systematic study, based on facts and principles. (2) Knowledge

Systematic activity directed to the discovery and development of an organized body of knowledge. (3) Method

Researcher's prediction about the results which will be obtained from the research. (4) Deduction

Reasoning used in science which employs logic that moves from specific to general. (5) Technology

It is a kind of science that gives us information about something real and works with facts, since it has to be observed and/or experimented on to confirm their conjectures. (6) Research

Application of science to practical ends. (7) Hypothesis

Reasoning used in science which employs logic that moves from general to specific. (8) Factual science

It is the intuitive process by which the experimenter derives a descriptive statement from the data; it is the explanation of the results. (9) Induction

(10) Science

(11) Inference
Mark the correct option with an X.

1. These are the conditions or characteristics that the researcher manipulates, observes or controls to determine their effect on a certain phenomenon.
   a) hypotheses
   b) problems
   c) variables
   d) data

2. According to Piaget, which among the social sciences are those that require quantitative relationship and the tendency to use experimental research methods?
   a) historic sciences
   b) nomotetic sciences
   c) legal sciences
   d) philosophic sciences
Test Método Científico

Nombre ___________________________ : Edad _______
Sexo ________ Carrera _______________________

Este examen tiene por objeto determinar tus conocimientos sobre el Método Científico, trata de contestarlo lo mejor que puedas.

BUENA SUERTE

1. Menciona 3 métodos para obtener conocimientos. (3 puntos)
   1) _______
   2) _______
   3) _______

2. Escribe 2 ejemplos de conocimiento de sentido común. (2 puntos)
   1) _______
   2) _______

3. Escribe 2 diferencias entre conocimiento de sentido común y conocimiento científico. (2 puntos)
   1) _______
   2) _______

4. ¿Cuáles son las 2 sub-actividades principales en el establecimiento del problema de la investigación? (2 puntos)
   1) _______
   2) _______

5. Escribe 2 diferencias básicas entre ciencias formales y ciencias fácticas. (2 puntos)
   1) _______
   2) _______
6. Enumera los pasos o etapas del Método Científico. (4 puntos)

7. ¿Qué diferencia existe entre Método Científico e Investigación Científica? (2 puntos)

8. Identifica las ciencias formales y las fácticas de la siguiente lista, escribiendo la palabra formal o fáctica en la línea de la derecha. (2 puntos)

   Química
   Matemáticas
   Psicología
   Biología
   Sociología
   Lógica
Después de leer cuidadosamente las siguientes afirmaciones; escribe en la línea de la derecha una V si crees que es verdadera y una F si crees que es falsa. En el caso de que creas que es falsa, cambia la palabra que esté subrayada por la correcta.

(6 puntos)

1. La **Tecnología** se ocupa de obtener conocimientos por el hecho de conocer más.

2. Las ciencias **fácticas** necesitan de la experimentación para comprobar sus conjeturas.

3. Las **variables** son predicciones del investigador sobre los resultados de la investigación.

4. En la investigación **descriptiva** el investigador ma-
   nipula un factor particular para comprobar si la manipulación genera algún cambio.

5. La **Psicología** es una ciencia social **nómótéticamente**.

6. La **variable dependiente** es el fenómeno que se está estudiando y que el investigador manipula para ver cuál es su efecto.
Trata de relacionar las dos columnas escribiendo el número correspondiente de la columna de la derecha en la línea de la columna izquierda.

(10 puntos)

| Procedimiento para tratar un conjunto de problemas. | (1) Variable |
| Cuerpo de conocimientos basado en hechos y principios, obtenido a través de estudio sistemático. | (2) Conocimiento |
| Actividad sistemática dirigida al descubrimiento y desarrollo de un cuerpo de conocimientos organizado. | (3) Método |
| Predicción del investigador sobre los resultados que se obtendrán de la investigación. | (4) Deducción |
| Razonamiento usado en la ciencia que va de lo particular a lo general. | (5) Tecnología |
| Nos da información sobre algo real, se ocupa de los hechos y necesita de la experimentación para confirmar sus conjeturas. | (6) Investigación |
| Aplicación de la ciencia para fines prácticos. | (7) Hipótesis |
| Razonamiento usado en la ciencia que va de lo general a lo particular. | (8) Ciencia Fáctica |
| Proceso intuitivo por el cual el experimentador deriva una explicación de los resultados de la investigación. | (9) Inducción |
| | (10) Ciencia |
| | (11) Inferencia |
Señala con una X la opción correcta. (1 punto cada una)

1. Son las condiciones o características que el investigador manipula, observa o controla.
   a) hipótesis
   b) problemas
   c) variables
   d) datos

2. De acuerdo con Piaget, cuáles son entre las ciencias sociales las que se distinguen por el uso de relaciones cuantitativas y la tendencia a usar métodos de investigación experimental?
   a) ciencias históricas
   b) ciencias nomotéticas
   c) ciencias legales
   d) ciencias filosóficas
APPENDIX C

Learning Style Questionnaire

Name ________________________ Program _________________

Instructions – Please answer the following questions by placing the letter of the appropriate alternative in the blank to the left of the question number.

1. Which best describes your main objective of this course?
   a) to learn more about Scientific Method
   b) to get a good mark that could improve my average
   c) to follow a necessary step in my program
   d) other (please specify) ______________________________

2. Why do you work on your assignments for your course?
   a) to learn more
   b) to obtain extra points
   c) because it is compulsory
   d) other (please specify) ______________________________

3. How could your teacher help you best to achieve your objectives?
   a) by allowing you to work at your own pace and advising you
   b) by organizing team work in the classroom
   c) by lecturing in the classroom
   d) other (please specify) ______________________________
4. How important is it to you to consult the teacher while studying?
   a) I like to consult the teacher frequently
   b) I like to consult the teacher once in a while
   c) I prefer not to consult the teacher

5. Under which of the following circumstances do you learn best?
   a) when I study by myself
   b) when I study with a classmate
   c) when I study with a team

6. What motivates you to study?
   a) I motivate myself
   b) seeing others studying
   c) the pressure of deadline

7. Which one of the following best describes your manner of studying?
   a) I study regularly during the semester
   b) I study infrequently for long intervals
   c) I study when I feel the pressure of deadline

8. How often do you finish the projects that you start?
   a) I always finish what I start
   b) I usually finish what I start
   c) it is hard for me to finish what I start
9. Which of the following ways of perceiving information helps you retain it better?
   a) I can remember information better if I see it
   b) I can remember information better if I hear it
   c) I can remember information better if I apply it

10. How do you prefer to obtain the news?
    a) by reading the newspaper
    b) through the television
    c) by listening to the radio

11. How do you prefer to receive instructions related to something that you have to do?
    a) I prefer written instructions
    b) I prefer oral instructions
    c) I prefer a combination of both

12. How can you better recall a telephone number?
    a) I need to write it down once I hear it
    b) I can remember it once I hear it
    c) I need to dial the number many times to learn it

13. What kind of structure do you need to study most effectively?
    a) I need a clearly structured program that includes well defined activities and references
    b) I need a general guide
    c) I prefer to organize the structure by myself
14. How do you organize your schedule for studying?
   a) I prefer to study for short periods, and then to rest before continuing
   b) I prefer to study long hours without stopping
   c) I do not have any preference as regards my study schedule

15. Assuming you had control over your study schedule, at what time of the day do you prefer to study?
   a) I prefer to study in the morning
   b) I prefer to study in the afternoon
   c) I prefer to study at night
   c) I have no definite preference for a particular time of day

16. What kind of background sounds enable you to concentrate while you are studying?
   a) absolute quiet
   b) soft music (records, tapes, radio, etc.)
   c) television
   d) it really doesn't matter

17. To what extent does the temperature of the room affect your concentration?
   a) I can study better when it is cool
   b) I can study better in a warm environment
   c) the temperature doesn't really affect me
18. How much do you need to move around while studying?
   a) I like to change position (stand up, walk and come back, etc.) very often while studying
   b) I like to sit for a long time while studying
   c) the position is not really important while I am studying

19. How important is lighting when you are studying?
   a) I need a specific kind of light that gives a certain brightness
   b) it is not an important factor for me while I am studying

20. What kind of location do you prefer to study?
   a) in an informal place (at home, the park, etc.)
   b) in a formal place (library, classroom, etc.)
   c) I do not have any preference for a location

21. Do you eat or drink something while studying?
   a) yes, I always do
   b) sometimes I do
   c) I never do
Scoring Procedure for the Learning Style Questionnaire

Essential Characteristics

Motivation

1. a) 4 points  
   b) 2 points  
   c) 1 point  
   d) 1 point

2. a) 4 points  
   b) 2 points  
   c) 1 point  
   d) 1 point

Need to work at their own and tutorial assistance

3. a) 4 points  
   b) 2 points  
   c) 1 point  
   d) 1 point

4. a) 4 points  
   b) 3 points  
   c) 1 point

Need to work alone

5. a) 4 points  
   b) 2 points  
   c) 1 point

Responsibility

6. a) 4 points  
   b) 2 points  
   c) 1 point

7. a) 4 points  
   b) 2 points  
   c) 1 point

Persistence

8. a) 4 points  
   b) 3 points  
   c) 1 point

Visual Orientation and Preference for Reading

9. a) 4 points  
   b) 2 points  
   c) 1 point

10. a) 4 points  
    b) 2 points  
    c) 1 point

11. a) 4 points  
    b) 2 points  
    c) 1 point

12. a) 4 points  
    b) 2 points  
    c) 1 point
Need for structure

13. a) 4 points  
b) 2 points  
c) 1 point  

14. a) 4 points  
b) 4 points  
c) 1 point  

Secondary Characteristics

Need for Specific time of the day

15. a) 3 points  
b) 3 points  
c) 3 points  
d) 1 point  

Sound

16. a) 3 points  
b) 1 point  
c) 1 point  
d) 1 point  

Temperature  

17. a) 3 points  
b) 3 points  
c) 1 point  

Mobility  

18. a) 3 points  
b) 2 points  
c) 1 point  

Light

19. a) 3 points  
b) 1 point  

Design

20. a) 3 points  
b) 3 points  
c) 1 point  

21. a) 3 points  
b) 1 point  
c) 1 point
Intake

21. a) 3 points
    b) 2 points
    c) 1 point

77 - 67 points = First group - Students who would strongly prefer studying using a print self-instructional package.

66 - 56 points = Second group - Students who can study using a print self-instructional package, but who would also prefer to receive the information through another teaching method.

55 points or less = Third group - Students who would strongly dislike using a self-instructional package, preferring instead to receive the information from other kinds of teaching instruments.
APPENDIX C

CUESTIONARIO PARA EL "ESTILO DE APRENDIZAJE"

Nombre ___________________________  Carrera ___________________________

INSTRUCCIONES: Por favor contesta las siguientes preguntas con sinceridad. Lee con cuidado cada una de las preguntas y elige la alternativa que vaya más de acuerdo con tu estilo para aprender. Selecciona la letra correspondiente y escríbela sobre la línea situada a la izquierda del número correspondiente a cada pregunta.

1. ¿Cuál es la principal razón que tienes para tomar este curso?
   a) Aprender más acerca del método científico
   b) Obtener una buena calificación que me ayude en mi promedio.
   c) Cumplir un paso necesario en mi carrera.
   d) Otra (específica) ___________________________

2. ¿Por qué haces, en general los trabajos para tus cursos?
   a) Para aprender más.
   b) Para obtener puntos extra.
   c) Porque son obligatorios.
   d) Otra (específica) ___________________________
3. ¿De qué manera podría ayudarte mejor tu maestro?
   a) Permitiéndote trabajar a tu propio ritmo y asesorándote.
   b) Organizando trabajo en equipos en el salón de clases.
   c) Dando clase tradicionalmente.
   d) Otra (específica) ______________________________

4. ¿Qué tan importante es para ti consultar al maestro cuando estudias?
   a) Me gusta consultar al maestro frecuentemente.
   b) Me gusta consultar al maestro de vez en cuando.
   c) Prefiero no consultar al maestro.

5. ¿En qué circunstancias aprendes mejor?
   a) Cuando estudio solo.
   b) Cuando estudio con un compañero.
   c) Cuando estudio en equipo.

6. ¿Qué te motiva para estudiar?
   a) Yo mismo me motibo.
   b) Cuando veo a otros que comienzan a estudiar.
   c) La presión de un examen.

7. ¿Cómo organizas tus estudios generalmente?
   a) Estudio regularmente durante el semestre.
   b) Estudio irregularmente por largos períodos.
   c) Estudio cuando voy a tener un examen.
8. ¿Qué tan seguido terminas los proyectos que comienzas?
   a) Siempre termino lo que empiezo.
   b) Casi siempre termino lo que empiezo.
   c) Me cuesta mucho terminar lo que empiezo.

9. ¿Cuál de las siguientes maneras de recibir información te ayuda a retenerla mejor?
   a) Puedo recordar mejor la información si la veo.
   b) Puedo recordar mejor la información si la oigo.
   c) Puedo recordar mejor la información si la aplico.

10. ¿Cómo prefieres enterarte de las noticias?
    a) Leyendo el periódico.
    b) Por medio de la televisión.
    c) Escuchando el radio.

11. ¿Cómo prefieres recibir las instrucciones sobre algo que tienes que hacer?
    a) Prefiero instrucciones por escrito.
    b) Prefiero instrucciones habladas.
    c) Prefiero una combinación de ambas.

12. ¿Cómo aprendes mejor un número de teléfono?
    a) Necesito escribir el número en el momento en que lo escucho.
    b) Puedo recordar el número una vez que lo escucho.
    c) Necesito marcar el número varias veces para aprenderlo.
13. ¿Qué clase de estructura necesitas para estudiar más efectivamente?
   a) Necesito un programa claramente estructurado, incluyendo actividades muy bien definidas y referencias.
   b) Necesito solamente una guía general.
   c) Prefiero organizar yo mismo la estructura.

14. ¿Cómo organizas tu horario para estudiar?
   a) Prefiero estudiar por períodos cortos y descansar entre uno y otro período.
   b) Prefiero estudiar por horas sin descansar.
   c) No tengo ninguna preferencia relacionada con mi horario de estudio.

15. Si pudieras tener control en tu horario de estudio ¿qué hora del día preferirías?
   a) Prefiero estudiar en las mañanas.
   b) Prefiero estudiar en las tardes.
   c) Prefiero estudiar en las noches.
   d) No tengo preferencia definida.

16. ¿Cómo prefieres el ambiente en cuanto a ruido cuando estudias?
   a) Completamente silencio.
   b) Con música suave (discos, cassettes, radio, etc.)
   c) Televisión
   d) No me afecta ningún tipo de ruido.
17. ¿Qué tanto te afecta la temperatura en tu concentración?
   a) Puedo estudiar mejor en un ambiente fresco.
   b) Prefiero un ambiente tibio.
   c) La temperatura no afecta mi concentración.

18. ¿Qué tan seguido te gusta cambiar de postura cuando estudias?
   a) Me gusta cambiar de postura (levantarme, caminar, volverme a sentar, etc.) muy seguido.
   b) Me gusta quedarme sentado durante horas.
   c) La posición no es un factor muy importante para mí cuando estudio.

19. ¿Qué tan importante es para ti la luz cuando estudias?
   a) Necesito determinado tipo e intensidad de luz.
   b) No es un factor importante para mí cuando estudio.

20. ¿Dónde prefieres estudiar?
   a) En un lugar informal (casa, parque, etc.)
   b) En un lugar formal (biblioteca, salón de clases, etc.)
   c) No tengo preferencia por un lugar para estudiar.

21. ¿Es importante para ti comer o beber algo mientras estudias?
   a) Sí, siempre lo hago.
   b) Algunas veces lo hago.
   c) No, nunca lo hago.
APPENDIX D

Evaluation form to evaluate the self-instructional package in scientific method

Name: ____________________ Program: ____________________

Instructions: Please indicate your response by circling the appropriate alternative.

Objectives

1. The objectives of the package were not clear. 1 2 3 4 5 . The objectives of the package were very clearly defined.

Content

2. The content of the package was poorly related to the objectives. 1 2 4 5 There was a very close relationship between content and objectives.

Organization

3. The organization of the package was very clear. 1 2 3 4 5 The organization of the package was confusing.

Presentation

4. The presentation of the package was interesting. 1 2 3 4 5 The presentation of the package was boring.

Motivation

5. The package was not motivating. 1 2 3 4 5 The package was extremely motivating.

Instructions

6. The instructions explaining how to work with the package were clear. 1 2 3 4 5 The instructions explaining how to work with the package were confusing.
Vocabulary

7. The vocabulary used in the package was confusing. 1 2 3 4 5

Exercises

8. The exercises were very helpful. 1 2 3 4 5

Supplementary Materials

9. The supplementary materials were not at all helpful. 1 2 3 4 5

Overall value of the package

10. Very good 1 2 3 4 5

11. Which part did you find most valuable?

Why?

12. Which part did you find least valuable?

Why?

13. Would you like to study again using a self-instructional package?

Yes

No

Why?
APPENDIX D

EVALUACION DEL PAQUETE AUTO - INSTRUCTIVO EN
METODO CIENTIFICO

Nombre ___________________________ Carrera ________________

INSTRUCCIONES: Después de haber estudiado el paquete auto-instructivo, por favor expresa tus opiniones encerrando en un círculo el número que creas conveniente.

Objetivos
1. Los objetivos de la lección no son nada claros. 1 2 3 4 5 Los objetivos son claramente establecidos.

Contenido
2. El contenido del paquete no está relacionado con los objetivos. 1 2 3 4 5 El contenido está estrechamente relacionado con los objetivos.

Organización
3. El contenido del paquete está muy bien organizado y claro. 1 2 3 4 5 El contenido del paquete es confuso y desordenado.

Presentación
4. La presentación del paquete es interesante. 1 2 3 4 5 La presentación del paquete es aburrida.

Motivación
5. La lección es muy motivante. 1 2 3 4 5 La lección no es nada motivante.
Instrucciones

6. Las instrucciones sobre cómo estudiar el paquete son muy claras.
1 2 3 4 5
Las instrucciones sobre cómo estudiar el paquete son confusas.

Vocabulario

7. El vocabulario usado en el paquete es confuso.
1 2 3 4 5
El vocabulario usado en el paquete es muy claro.

Ejercicios

8. Los ejercicios del paquete son muy útiles para aprender.
1 2 3 4 5
Los ejercicios del paquete no son útiles.

Material Complementario

9. El material complementario no resulta útil para el paquete.
1 2 3 4 5
El material complementario es muy útil para el paquete.

Valor de la lección en general

10. Muy buena.
1 2 3 4 5
Muy mala

11. ¿Cuál te parece la mejor parte del paquete?

¿Por qué?

12. ¿Cuál te parece la parte de menos valor?

¿Por qué?

13. ¿Te gustaría volver a estudiar usando un paquete de auto-instrucción?

Si

No

¿Por qué?