PROGRAMMED INSTRUCTION FOR GROUPS OF TEACHERS IN REMOTE LOCATIONS: PROTOTYPE DEVELOPMENT

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This is to certify that the

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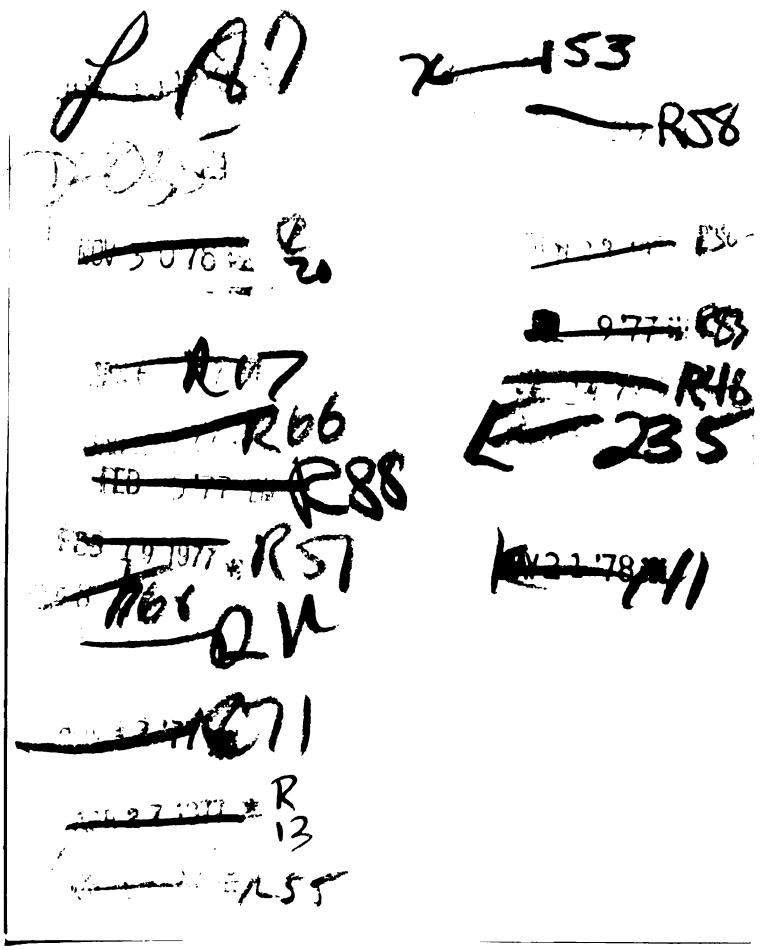
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ABSTRACT

PROGRAMMED INSTRUCTION FOR GROUPS OF TEACHERS IN REMOTE LOCATIONS: PROTOTYPE DEVELOPMENT

By

Harry A. Pearson

The problem of providing adequate education for all children is acute throughout the world. With rapid increases in knowledge and populations this situation is likely to become more acute.

One solution to the problem may be to use programmed materials by which new information can be presented to students or to teachers. Through these materials the number of students working independently under one teacher may be increased or the in-service training of teachers may be more effective.

Towards this goal, there is a need for a "package" of short training sessions for training teachers as potential users or writers of programmed materials for all grade levels and all subject areas.

As a result of these sessions, an international cadre of programmers could be developed whose members would prepare instructional materials for use in their own country and, at the same time, make adaptations of

programmed materials from other countries. In this way some repetition of programming tasks could be avoided.

Procedure

A prototype training experience, called an InGrouP session, was developed to train science-oriented secondary-level teachers as potential users and writers of programs.

The session was divided into two sections, each requiring approximately three hours. The first section, the program section, contained programmed materials on the techniques and rationales used in programs and the characteristics of programs. Consideration was also given to the evaluation of frames and programs. In the second, the simulation section, participants were given the opportunity to write three series of frames. Each series was evaluated in the training session. Three methods of evaluation were simulated.

The instructional techniques used included varieties of programmed instruction, workshop and simulation procedures, and the instructional method could be described as variable group interactive self-instruction in programmed instruction. The term InGrouP was adopted for this method from Instruction for Groups: Programmed.

Two instruments were developed. A twenty item Likert-type attitude scale was developed and used to measure changes in reported attitudes towards programmed instruction.

A test booklet of three subtests was developed and used to measure changes in knowledge and skills. It measured changes in knowledge of the techniques used in programs and the characteristics of programs, in the ability to evaluate single frames and program sequences, and in the ability to recognize an acceptable program-writing sequence and the ability to write a short series of frames.

An independent pretest and posttest groups design was used in which participants were randomly assigned to treatment groups.

Three training sessions were held to detect patterns of change. In the third session an attempt was made to measure the independent effects of the program section and the simulation section.

Findings

At $p<0.05$, a significant improvement was found in knowledge of techniques and the rationales underlying their use, and of the characteristics of programs as a result of completing the training session. Also, at the same significance level, improvement occurred in the ability to recognize an acceptable program-writing sequence and to write a series of frames. The training session produced no significant change at $p<0.05$ in the ability to evaluate frames and program sequences nor was there a significant change in attitude towards programmed instruction.

In one session the program section produced significant improvement at $p<0.05$ in the ability to evaluate frames and programs.

Conclusions

Although no long-term study of the effects of the InGrouP sessions was made, there is evidence that within the six-hour period the knowledge that a participant has about the basis of programmed instruction, and his ability to write a series of frames can be improved. This method of instruction shows promise for the training of teachers in programmed instruction. As such, it may help to overcome the problem of providing adequate education for all children.

PROGRAMMED INSTRUCTION FOR GROUPS OF TEACHERS IN REMOTE LOCATIONS: PROTOTYPE DEVELOPMENT

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

CHAPTER I

THE PROBLEM

In a world in which the increase in population and the increase in knowledge have been described as explosions, the problem of providing adequate educational opportunities becomes more and more acute. Especially in the "developing nations" education is seen as probably the greatest single factor essential for progress towards full development. But in these countries, the provision of education for all is not possible at the present time using existing methods.

In all nations, the logistic difficulty of updating teachers on new techniques and information in their fields of competences is a growing problem. More pronounced in developing nations, is a shortage of trained teachers or personnel suitable for training as teachers. Any expansion of teacher training programs requires a pool from which new teachers may be drawn. In developing countries, an adequate pool rarely exists.

Economic factors are also serious. Even when a large number of potential teachers is available, the expense of training them and providing them with the environment in which they would operate as trained teachers may be beyond the financial capacity of the nation or district at the time.

In Australia, the problem of providing adequate education for all has a geographical component. With a population density of a large part of the continent averaging less than two persons per square mile, conventional classroom teaching for all is not feasible. At the present time, lessons are mailed to and from students in remote areas, constituting a correspondence course program operated from certain central offices. Some interaction occurs between teacher and student by two-way radio. Augmenting these procedures, an itinerant teacher visits each student at least once during the school year. In 1968, about ten thousand children were receiving their formal schooling in this way.[1] However based on data from Western Australia, the total number of people receiving instruction by correspondence is probably about one hundred thousand. Most of these people are adults.[2]

Possible Solutions to the Problem

The problem can probably be attacked from two directions although there is interaction and overlap between the two approaches.

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[1]From correspondence with the education departments in Queensland, New South Wales, Victoria, South Australia, Tasmania, and Western Australia, February - April, 1969.

[2]H. W. Dettman, Director General of Education, Education Department, Perth, Western Australia, February 21, 1969 (letter).

There is a need for a concerted effort to update a range of courses in education, strengthening the academic preparation of teachers, and sharpening their professional skills.[3] Vaizey[4] considers that the need is urgent in underdeveloped countries. To be effective, massive in-service programs would be required to update the large number of teachers involved. In the United States, the National Science Foundation attempts to do this through summer institutes and academic year institutes, but the proportion of the total number of teachers these courses reach is small. Any in-service program within the existing framework of the school year must also be limited. To produce effective teachers, these in-service programs must contribute to the teachers' knowledge of subject matter and their expertise with new equipment and instructional materials.

In India, some emphasis is being placed on programmed instruction as a method of reaching large numbers of students when an adequate number of teachers is not

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[3]R. Freeman Butts, "Teacher Education: A Focal Point," in Education and the Development of Nations, ed. by John W. Hanson and Cole S. Brembeck (New York: Holt, Rinehart and Winston, 1966), p.375.

[4]John Vaizey, "Priorities within Education," in Education and the Development of Nations, ed. by John W. Hanson and Cole S. Brembeck (New York: Holt, Rinehart and Winston, 1966), p.370.

available.[5] For India, Arthur Clarke[6] considers that the presentation of televised lessons using communications satellites may be a feasible solution in the future.

In Australia, the use of programmed materials should produce more effective instruction for those students in the remote areas, and the same materials could be used to supplement conventional teaching methods to improve instruction in the conventional classroom learning situation.

It seems that programmed materials have a wide range of uses from updating teachers to providing educational experiences for children who cannot be taught in the conventional way whether the presentation be by book, machine or by television. In addition, programmed materials can provide more effective and efficient learning because of the features of the materials which allow for individual progression, active responding, and immediate knowledge of results.

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[5]From correspondence with Dr. S. S. Kulkarni, National Institute of Education, New Delhi, India, April 1969.

[6]Arthur Clarke on "The Epic Journey of Apollo 11," C.B.S. Telecast, July 20, 1969.

However the preparation of programmed materials is expensive and time consuming. Meacham[7] reports that it requires about one hundred hours to prepare a program for one hour of instruction. For this reason, most of the writers of programs are attached to large commercial organizations. This distribution of writers may have serious consequences as the organizations would tend to control the curriculum and Cox,[8] writing of this corporate monopoly, considers that if total control passed into the hands of these organizations it would be tragic for education.

Training experiences are needed to help teachers themselves learn to evaluate programs and to write programmed materials to meet the needs of their own students. There is a need for teacher-programmers in all grades and in all subjects. However this need is not restricted to one country but is seen as a world-wide need. With the availability of proper training experiences, a country could develop a group of programmers who could prepare materials for their own country and translate and modify programs from other countries to meet their own

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[7]Joe D. Meacham, "Programmed Instruction and Teaching Machine Technology," National Society for Programmed Instruction, 3(9), November 1964, p.14.

[8]Helen H. Cox, Education U.S.A.: A Special Report, 1967 (Washington, D.C.: National School Public Relations Association, 1967), p.17.

needs. In this way, duplication of effort would be reduced in the production of materials which have already been developed elsewhere.

These groups together might constitute an international cadre of programmers for the exchange of programmed materials and research findings.

The Purpose of the Study

This study was directed at the development and evaluation of one prototype training experience as a model--a training session or InGrouP session[a]--for science-oriented teachers at the secondary level.

Science and mathematics were selected as the areas from which examples used in the training session would be taken because the rapid expansion of knowledge and the shortage of teachers trained in a number of fields of science were probably greater than in other subject areas. Also, the majority of commerical programs available are in these areas.

The purpose of the training session is to acquaint teachers with the techniques and rationales inherent in instructional program design and use, and the general characteristics of the standard programs that are available commercially. Also the session is to provide training in

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[a]From Instruction for Groups: Programmed.

the evaluation of programmed materials from the structure of the frames, the sequencing of frames, and from test results obtained when the programs have been used. In addition, the session is to provide an opportunity to write series of frames and to have these evaluated.

The Structure of the InGrouP Session

The training session uses a number of the instructional techniques drawn from a variety of types of in-service programs. It uses programmed instruction, some of the features of workshops, and instructional simulation. In Chapter II these features are outlined.

To the overall design of the InGrouP session, five constraints were applied so that the applications of the prototype could be as diverse as possible. These constraints follow.

(1) The training session should be restricted to one working day, or two half-days. This constraint was considered desirable so that the session could be used within the existing framework of in-service training through "professional development days." Longer training sessions would be less likely to be used as they would require a greater disruption of school organization, and the motivation of the participants would likely be less intense.

(2) The training session should be as independent of expert supervision as possible. It was felt that if expert supervision were required, broad-scale utility would be greatly reduced. While it was realized that supervisors could be trained, this additional requirement would restrict its use and its impact. Further, uncontrolled biases would be introduced.

(3) The equipment for the training session should be as simple as possible. This contraint was considered important so that no school district, school, informal group, or individual would be prevented from using the experience because of shortages of equipment such as projectors, teaching machines, or computers.

(4) The materials and procedures should be such that they could be used equally well with small groups and large groups.

(5) At the completion of the training session, participants should be able to take away the materials they have used.

Although this prototype training session was developed for teachers in the United States, it was felt that these constraints were even more appropriate for countries such as Australia and India where expert supervision and equipment may be more difficult to provide.

The training session, or InGrouP session, is divided into two sections. For the first section, the program section, the training materials are self-instructional: the participant is presented with the techniques, rationales, and characteristics of programs, and a guide to evaluating frames and programs. The second section, the simulation section, provides the participant with the opportunity to write a series of frames and to have it evaluated for weaknesses.

The overall procedure is a combination of self-instruction and interaction among members of small groups structured within the larger group of the participants. The generic name, InGrouP, has been adopted for this method of training.

Definition of Terms

Some of the terms used have a variety of meanings in the literature of education; others are peculiar to the procedures of the study. The following explanations of terms give the meaning applied to each term as it has been used in this dissertation. The terms have been arranged alphabetically.

Attitude Scale

A specific attitude scale developed for this study, and used to measure the changes in stated attitudes of the participants towards programmed instruction.

Booklet 1

One of the training materials used in the first section of the training session. It is self-instructional, and contains information about the characteristics of programs, techniques used in programs, and some of the features of good frames and programs. It is used in conjunction with booklet 2.

Booklet 2

A training material used in the first section of the training session. It is a confirmation booklet for booklet 1, and it contains tables which are to be filled in by the participant. These tables act as a summary of the major ideas presented in booklet 1.

Booklet 3

One of the training materials used in the second section of the training session. Essentially it contains directions for writing series of frames and specific instructions for the participant so that the series of frames will be evaluated and returned to the writer.

Booklet 4

A training material for the second section. It is a workbook in which the series of frames are written by the participant.

Characteristics of programs

These are the features common to programs of a particular type. They are the result of the techniques used in the program. For example, error rates, frame lengths, and advantages and disadvantages of constructed response, or multiple choice programs.

InGrouP

A generic name adopted for a method of training teachers as users and writers of programmed materials. The method used variable group interactive self-instruction, and the name was taken from Instruction for Groups: Programmed.

InGrouP materials

The materials used in this particular InGrouP session on programmed instruction for science-oriented secondary-level teachers. These materials were printed and required active responses from the participants.

InGrouP session

A training session which uses variable group interactive self-instruction as the medium of instruction to teach teachers about programs and programming. This is a group of sessions for all subjects and for all grades. The trial InGrouP session in this study is one particular research session belonging to the whole group of InGrouP sessions.

Programmed Instruction

A presentation of instructional materials in a logical sequence of steps. The participant is required to respond actively to the materials, and he receives immediate feedback to confirm his responses.

Program Section

The first of two sections which make up the training session, or InGrouP session. The materials are presented in booklets 1 and 2 as programmed materials.

Simulation Section

The second section in the InGrouP session. The instructional materials are in booklets 3 and 4.

Standard Programs

Conventional programs such as are available commercially. The two main types are the constructed response program made up of short frames through which all students work in the same sequence, and the multiple choice program with longer frames, providing opportunity for branching so that different students may progress through different sequences depending on their needs.

Subtest 1

The first eleven items in the test booklet. These items relate to the techniques used in programs and the rationales underlying their use, and the characteristics of programs.

Subtest 2

Items 12 through 20 in the test booklet. These nine items relate to the evaluation of frames, and programs from their structure and test findings.

Subtest 3

Items 21 and 22 in the test booklet. These test the ability to recognize an acceptable program-writing sequence, and the ability to write a series of frames.

Supervisor

An arrangements manager responsible for distributing the training materials, introducing the various parts of the training session, assisting individuals, and leading the discussions.

Techniques Used in Programs

Those devices used by the programmer to ensure effective and efficient learning. They include cues, prompts, response styles, branching, and lines under or around frames.

Test Booklet

An instrument containing three subtests which were used to measure the effectiveness of the training session.

Trial InGrouP Session

An InGrouP session used to evaluate the effectiveness of the materials. In addition to InGrouP materials, the attitude scale and the test booklet were used during the session.

Statement of Aims

The aim of the study was to conceptualize, develop instrumentation, field test, and evaluate procedures suitable for in-service teacher training utilizing the InGrouP model.

Trial InGrouP sessions were used to investigate the following general statements. The testable hypotheses are given in Chapter IV.

1. Teachers who participate in an InGrouP session will be more able to identify the techniques used in programs and the rationales underlying their use, and the characteristics of standard programs, than those teachers who have not participated.

2. Teachers who participate will be more competent to evaluate frames and programs, than those who have not participated.

3. Teachers who participate will be more able to recognize an acceptable program-writing sequence, and to write a series of frames, than those who have not participated.

4. Teachers who participate in an InGrouP session will have an attitude more favorable to programmed instruction than those who have not participated.

Limitations of the Study

By imposing the constraints on supervision and equipment, the limits of the applications of the training session for the training of teachers in programmed instruction have been reduced.

However the limitations due to the research nature of the study still exist. Initially it was hoped that all aspects of the InGrouP session could be tested on one group of teachers at one time. With the random assignment of teachers to treatment groups, many of the factors affecting internal validity would have been well controlled, with differences between pretest groups and posttest groups being attributable to the treatments.

By repeating the InGrouP session on a number of occasions, comparisons between them cannot be drawn without risking invalidation due to factors characteristic of a particular session. Within each InGrouP session, the number of participants available restricted the research design so that factors such as history, maturation, and mortality must be considered as rival hypotheses.[9] These possible sources of invalidity are considered in relation to the study in Chapter IV.

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[9]Donald T. Campbell and Julian C. Stanley, Experimental and Quas-Experimental Designs for Research (Chicago: Rand McNally, 1963), p.5.

Some limitations which appear to be of importance are related to the measuring devices used. In this study, the participants' attitudes to programmed instruction are considered to be of particular importance; these were measured using a Likert-type attitude scale. However there is always some doubt as to what such a scale actually measures. At best, it can only measure the expressed reaction of the participant to written statements. The relationship between this expressed reaction and the true attitude is not known.

Another limitation of measurement is that, while the knowledge of the participants about programmed instruction can be measured quantitatively, their skill at writing a series of frames can only be measured qualitatively.

All measurements of attitudes, knowledge and skills are related to the context of the trial InGrouP session in which they were made. No investigation or estimates were made of residual attitudes, the degree to which programmed materials were subsequently employed or the number of programs written by participants after the InGrouP session. Therefore no statement can be made about the effect of an InGrouP session on attitudes or behavior over a long time interval.

Summary

This InGrouP session to train science-oriented secondary-level teachers as users and writers of programs is seen as a prototype for a group of training experiences which use variable group interactive self-instruction. Such sessions on all subjects at all grade-levels are seen as essential for rapidly updating teachers so that programmed materials may be used more widely, and flexibility in curricula will be maintained.

Programmed instruction may lead to the solution of the problem of providing adequate education for all in both developed and developing countries as it provides logical presentation of subject matter, opportunity for active responding, and immediate knowledge of results with minimum teacher participation.

With widespread application of training experiences similar to the InGrouP sessions in a number of countries, the development of an international cadre of programmers is a possible consequence. A cadre of this sort, if properly organized and trained, could lead to more effective and efficient education by reducing the time spent repeating programming activities already performed in other countries.

Overview

In Chapter I, the problem has been outlined and the importance of this study in relation to the problem has been stated. The development of the attitude scale

and the test booklet for use in the trial InGrouP sessions is described in Chapter III. In Chapter IV, the design of the study and the hypotheses tested are given, while Chapter V contains a discussion of the analyses of the data obtained from the trial InGrouP sessions. Conclusions and implications of this study are given in Chapter VI. In the next chapter, some relevant comments and research findings about the components of InGrouP are outlined.

CHAPTER II

REVIEW OF THE LITERATURE

InGrouP, or the method developed for this training experience, uses components from three modes of instruction; programmed instruction, workshops, and simulation. In this chapter, relevant literature relating to these three methods is cited. Since the effect of the InGrouP session on the attitudes of the participants is important, a discussion of the literature on attitudes and the changing of attitudes is included.

Finally, these four aspects of learning are related specifically to the prototype InGrouP session developed in this study.

On Programmed Instruction

Although good teachers have used the principles of programmed instruction for centuries, the modern concept of programmed instruction probably originated from the time that the first patent for a teaching machine was taken out in the United States in 1866.[1] Some impetus was given to the movement in World War I, when the military

[1]William A. Deterline, An Introduction to Programmed Instruction (Englewood Cliffs, New Jersey: Prentice Hall, 1962), p.9.

used programmed instruction techniques to train soldiers.[2] In the second decade of this century, Pressey developed and used programmed materials and considered that this method of instruction could revolutionize teaching, but this method of instruction did not gain popular support.[3] Kimmel, while recognizing the importance of Skinner's work in this field in the 1950's, attributes the rise of the programmed instruction movement to the flight of Sputnik.[4] The impact of this technological display caused serious concern about the effectiveness of the existing educational methods, and money was made available by the government and by private organizations for improving instruction.

The development of programmed instruction seems to have followed the pattern shown by many new technologies. It is characterized by an initial rapid rate of development, or "oversell" phase, followed by a gradual decline which has been termed the "disillusionment" phase.

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[2]Peter Kimmel, "Der Programmierte Unterricht in den U.S.A.," Erziehung und Unterricht, 3 (March, 1968), p.289.

[3]Robert M. W. Travers, An Introduction to Educational Research (New York: Macmillan, 1964), p.69.

[4]Kimmel, "Programmierte Unterricht," p.290.

Corey[5] cites evidence indicating that both these phases have existed for programmed instruction. He used the number of entries in the Education Index 1959-65, and the entries in Psychological Abstracts 1961-65 relating to programmed learning and teaching machines as indicators. His results are given in Tables 2.1 and 2.2 respectively. Using the number of commercial programs available for purchase, De Cecco[6] is able to support this analysis.

TABLE 2.1.--Entries in the Education Index Relating to Programmed Instruction[a]

	1959-61	1961-63	1963-65
Programmed Learning	51	321	313
Teaching Machines	79	119	29

[a]Stephen M. Corey, "The Nature of Instruction," Programed Instruction, Sixty-sixth Yearbook of the National Society for the Study of Education, Part II (Chicago: The Society, 1967), p.25.

[5]Stephen M. Corey, "The Nature of Instruction," Programed Instruction, Sixty-sixth Yearbook of the National Society for the Study of Education, Part II (Chicago: The Society, 1967), pp.25-6.

[6]John P. De Cecco, Psychology of Learning and and Instruction: Educational Psychology (New Jersey: Prentice Hall, 1968), p.525.

TABLE 2.2.--Entries in Psychological Abstracts Relating to Programmed Instruction[a]

	1961	1962	1963	1964	1965
Programmed Learning	-	5	43	63	26
Teaching Machines	15	22	24	22	14

[a]Stephen M. Corey, "The Nature of Instruction," Programed Instruction, Sixty-sixth Yearbook of the National Society for the Study of Education, Part II (Chicago: The Society, 1967), p.26.

TABLE 2.3.--Programs Available for Purchase[a]

	1962	1963	1965
Number Available	122	352	291

[a]John P. De Cecco, Psychology of Learning and Instruction: Educational Psychology (New Jersey: Prentice Hall, 1968), p.525.

Criticism could be leveled against using these as indicators of trends as there is no evidence of the significance of the studies reported to the advancement of programmed instruction as an accepted technology. Similarly, the availability of a program is no indication of its worth, or to the extent to which it is used.

Each set of data indicates an increase followed by a decline. The agreement in patterns from these researchers probably indicates that the phases of oversell and disillusionment have existed.

Evidence of the present position of the movement is not known. However, Mager[7] concludes that the development of programmed instruction is moving quietly towards becoming a mature technology and that its phases of oversell and disillusionment have concluded. If it follows the pattern of other technologies, its development will increase again, and it might be expected to rise rapidly because Gleason[8] considers that:

> Programmed instruction has been accepted by educators more rapidly than any other innovation in history.

However the rate of increase depends on the acceptance of programmed instruction by the teachers, and the number of persons available to write programs relevant to the school situation. Lindvall and Bolvin[9] consider that the slow acceptance up to the present time may be due to a misunderstanding of the purposes of programmed instruction so that many teachers may be biased against it.

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[7]Robert F. Mager, "President's Page," Journal of the National Society for Programmed Instruction, V(January, 1966), p.3.

[8]Gerald Gleason, "Will Programmed Instruction Serve People?" Educational Leadership, XXIII(March,1966), p.471.

[9]C. M. Lindvall and John O. Bolvin, "Programed Instruction in the Schools: An Application of Programing Principles in Individually Prescribed Instruction," Programed Instruction, Sixty-sixth Yearbook of the National Society for the Study of Education, Part II (Chicago: The Society, 1967), p.220.

Perhaps its ultimate acceptance will reflect the characteristics of programmed instruction in general rather than as a medium for instruction. Whalley[10] states that it is based on the same principles as good classroom teaching; thus emphasis on programmed instruction may, in turn, improve conventional teaching. Programmed instruction takes advantage of the basic human drive for success,[11] and students are found to learn as much and score as well using programmed materials as using conventional methods; but in terms of time expended the former can save as much as fifty percent.[12]

Numerous studies have been made comparing programmed methods with conventional methods, and between the various forms of programmed materials. For example, Lackner[13] reports on current research in programmed instruction.

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[10]Noel Whalley, A Guide to the Preparation of Teaching Programmes (Bristol, Eng.: Teaching Programmes Ltd., 1966), p.1.

[11]James E. Espich and Bill Williams, Developing Programmed Instructional Materials (Palo Alto, Calif.: Fearon, 1967), p.7.

[12]Francis Mechner, "Behavioral Analysis and Instructional Sequences," Programed Instruction, Sixty-sixth Yearbook of the National Society for the Study of Education, Part II (Chicago: The Society, 1967), p.7.

[13]Lois M. Lackner, "Current Research in Programmed Texts and Self-Instructional Learning in Mathematics and Related Areas," AV Communications Review, 15(Summer 1967), pp.181-98.

He cites the work of Brown, and Dobyns, and Kellems that found programmed instruction to be superior to conventional methods and the combination of programmed materials with the direct teacher contact to be even more superior. Most of the studies have used college students of mathematics as the population.

Anderson[14] sums up the position by stating:

> The results have generally tended to favor programmed instruction when compared with conventional instruction. Although the differences are not great, it is generally concluded that programmed instruction is at least as good as conventional instruction when testing conventional outcomes of information and understanding, and perhaps more significant for the curriculum worker, that it takes less time and that it is better than no instruction at all.

This has special implications for societies which endeavor to provide a wide range of subjects for their students, and where the advance of knowledge can not be paralleled by an equivalent advance in teacher preparation, and in countries in which, because of geographical problems or teacher shortages, trained teachers are not available to give direct teaching to children.

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[14]Vernon E. Anderson, Principles and Procedures of Curriculum Improvement (New York: Ronald Press, 1966), p.373.

Studies comparing presentation methods indicate the same general pattern. Eigen and collaborators[15] find that teaching machines require more time than programmed texts but both produce equal learning. Anderson[16] states that there is no significant difference between teaching machines and programmed texts when the amount of learning is measured.

At the present time, there seems to be a trend away from teaching machines in favor of programmed texts, and De Cecco[17] states that the programmed text will probably survive the teaching machine.

Research has given inconclusive results as to the effectiveness of the techniques used in programs. Goldstein[18] states that there are no clear-cut results as to the effects of variations in step size, knowledge of results, and response modes.

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[15]L. D. Eigen and others, "A Comparison of Modes of Presenting a Programmed Instruction Sequence," Programed Instruction, 1(4), February 1962, p.2.

[16]Anderson, Principles and Procedures of Curriculum Improvement, p.373.

[17]John P. De Cecco, Readings in Programmed Instruction (New York: Holt, Rinehart and Winston, 1964), p.433.

[18]Leo S. Goldstein, "Research in Programmed Instruction," in Trends in Programmed Instruction, ed. by G. D. Ofiesh and W. C. Meierhenry (Washington, D.C.: Department of Audiovisual Instruction, National Education Association and the National Society for Programmed Instruction, 1964), pp.220-3.

Different writers have summarized the usefulness of programmed instruction in a number of ways. Stolurow[19] states that in spite of "no significant difference" studies, research indicates that, in general, students learn. Blyth,[20] Fry,[21] Schramm,[22,23] Deterline,[24] and Lindvall and Bolvin[25] write more enthusiastically about the efficiency and effectiveness of programmed instruction.

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[19]Lawrence Stolurow, "Implications of Current Research and Future Trends in Educational Technology," in Readings in Programmed Instruction, ed. by John P. De Cecco (New York: Holt, Rinehart and Winston, 1964), p.436.

[20]John W. Blyth, "Teaching Machines and Human Beings," in Teaching Machines and Programmed Learning: A Source Book, ed. by A. A. Lumsdaine and Robert Glaser (Washington, D.C.: Department of Audiovisual Instruction and the National Education Association, 1960), p.404.

[21]Edward B. Fry, Teaching Machines and Programmed Instruction: An Introduction (New York: McGraw Hill, 1963), p.2.

[22]Wilbur L. Schramm, Programed Instruction: Today and Tomorrow (Fund for the Advancement of Education, 1962), p.12.

[23]Wilbur L. Schramm, The Research on Programmed Instruction, U. S. Department of Health, Education and Welfare, Office of Education Bulletin 35 (Washington, D.C.: U. S. Government Printing Office, 1964).

[24]Deterline, An Introduction to Programmed Instruction, p.vii.

[25]Lindvall and Bolvin, "Programed Instruction in the Schools," pp.217-236.

Cartier[26] and Lange[27] consider that perhaps some of the impact of programmed instruction may be its effect on other instructional elements resulting from the production concepts which are characteristic of programming.

On Workshops

The term "workshop" has been used in a number of ways by different writers. Kelley[28] lists nine purposes of workshop experiences. These center on participation, growth, and co-operation to develop learning methods and techniques which can be used in a classroom. He considers that a workshop must be for a minimum of two days as planning and evaluation will take one day.[29] O'Rourke and Burton[30] doubt whether a workshop on any significant problem can be organized and run in less than three or four days.

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[26]Francis A. Cartier, "After the Programming Fad Fades, Then What?" AV Communications Review 11(2),1963, p.7.

[27]Phil C. Lange, "Future Developments," Programed Instruction, Sixty-sixth Yearbook of the National Society for the Study of Education, Part II (Chicago: The Society, 1967), p.291.

[28]Earl C. Kelley, The Workshop Way of Learning (New York: Harper and Row, 1951), pp.7-11.

[29]Ibid, p.137.

[30]Mary A. O'Rourke and William H. Burton, Workshops for Teachers (New York: Appleton-Century-Crofts, 1957), p.2.

On in-service training, Flanders[31] considers that it can provide conceptual and procedural tools necessary for teachers to experiment with their own teaching methods, and that the methods used in a training experience should be consistent with the principles of teaching that are learned.

Workshops on programming have been conducted, but most of these have been oriented towards business and industry. The Resources Development Corporation course in 1966 was of five days duration.[32] Although Brethower's "Practicum" is not intended to be used in a workshop, it uses programmed instruction to teach programming. The working time for this book is reported to be up to twenty-four hours excluding the time required to write the actual programs.[33] In both the Resources Development Corporation workshop and Brethower's book there is no indication given that the attitudes of the participants were considered.

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[31]Ned A. Flanders, Helping Teachers Change Their Behavior (Washington D.C.: U. S. Office of Education, 1963), p.2.

[32]Resources Development Corporation, R. D. C. Seminar: Theory and Practice of Programed Learning (East Lansing: The Corporation, 1966, pamphlet).

[33]Dale M. Brethower and others, Programmed Learning - A Practicum (Ann Arbor, Michigan: Ann Arbor Publishers, 1965), p.iv.

On Attitudes

Allport[34] has defined an attitude in the following way:

> . . . a neural state of readiness organized through experience, asserting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related.

Katz and Stotland[35] consider that attitudes have three major components. The information component forms the foundation on which the attitude is built. The affective component involves feelings, and it is this component which attitude scales attempt to measure. The third component, the action component, represents the extent to which the attitude has habits of action associated with it.

To bring about a change in behavior, that is the action component, Espich and Williams[36] consider that a change in attitude is necessary. This implies that the affective component must be altered. In other words, the feelings that a person has about a particular object must be altered.

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[34]W. Gordon Allport, "Attitudes," in A Handbook of Social Psychology, ed. by Carl Murchison (Worchester, Massachusetts: Clark University Press, 1935), p.810.

[35]Daniel Katz and Ezra Stotland, "A Preliminary Statement to a Theory of Attitudinal Structure and Change," in Psychology: A Study of a Science, ed. by S. Koch (New York: McGraw Hill, 1959), p.399.

[36]Espich and Williams, Developing Programmed Instructional Materials, p.4.

On attitudes to programmed instruction, O'Toole[37] states that there is some evidence that attitudes will be a strong factor in the adoption and successful implementation in the school setting.

As in other aspects of programmed instruction, there are conflicting views as to the polarity of the attitudes of teachers. Lackner,[38] Stolurow,[39] and Tobias[40] indicate that teachers tend to have negative attitudes to programmed instruction. This is probably due to misconceptions of the role of programmed instruction in the teaching situation. On the other hand, O'Toole[41] and Lange[42] report favorable attitudes among teachers.

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[37]John F. O'Toole, Jr., "Teachers' and Principals' Attitudes," AV Communications Review, 12(Winter 1964), p.431.

[38]Lackner, "Current Research on Programmed Texts," p.181.

[39]Stolurow, "Implications of Current Research," p.434.

[40]Sigmund Tobias, "Lack of Knowledge and Fear of Automation as Factors in Teachers' Attitudes towards Programmed Instruction and Other Media," in AV Communications Review, 14(Spring 1966), p.99.

[41]O'Toole, "Teachers' and Principals' Attitudes," p.436.

[42]Lange, "Future Developments," p.311.

However there is some evidence to suggest that attitudes to programmed instruction can be changed. Eichholz and Rogers[43] indicate that teachers familiar with the developments in the field would have more favorable attitudes. Flanders[44] indicates that learning new ideas about teaching evokes emotional reactions and shifts in attitudes. Nagay,[45] reporting on experiments in Norway in which programmed materials were used, states that promising results were obtained on the degree of teacher and student acceptance of the materials as a result of the experiments.

The importance of the teacher's attitude towards instructional programs is stressed by Susan Markle:[46]

> There is little doubt that the teacher's attitude towards the materials is a significant factor in both student attitudes and student performance.

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[43]Gerhard Eichholz and Everett M. Rogers, "Resistance to the Adoption of Audiovisual Aids by Elementary School Teachers," in Innovations in Education, ed. by Matthew B. Miles (New York: Bureau of Publications, Columbia University, 1964), pp.299-316.

[44]Flanders, Helping Teachers Change Their Behavior, p.2.

[45]John A. Nagay, Programmed Instruction in Norway, Sweden, and Denmark, Office of Naval Research, Technical Report ONRL-6-66(London, Eng: 3 March 1966), p.2.

[46]Susan Markle, "Empirical Testing of Programs," Programed Instruction, Sixty-sixth Yearbook of the National Society for the Study of Education, Part II (Chicago: The Society, 1967), p.136.

This statement stresses the importance of the teacher as a user of programs. Argyris,[47] although not referring specifically to program writing, says that values rarely follow skills, but rather that skills follow values. So it would seem appropriate that a training experience on program-writing should try to change attitudes if it is to be an effective instrument in producing program writers.

On the measurement of attitudes, Allport[48] considers that each person may possess many conflicting attitudes so that his mental set at the moment of responding to an attitude scale may tell only part of the story. Rationalization and deception on the part of the respondent may occur. He states that attitude scales should be regarded as the roughest approximation of the way in which the attitude really exists. Eichholz and Rogers[49] consider that deception may play an important role in the way a person responds to an attitude scale. They consider that teachers would be unlikely to express an attitude reflecting the belief that audiovisual aids might replace

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[47]Chris Argyris, Personality and Organization (New York: Harper and Row, 1957), p.135.

[48]Allport, "Attitudes," p.832.

[49]Eichholz and Rogers, "Resistance to the Adoption of Audiovisual Aids," pp.299-316.

teachers as this overt expression would be in conflict with their professional goals.

Probably the two most commonly used attitude scales are the Likert and the Thurstone scales. The Likert scale has some advantages over the Thurstone scale in that it is easier to construct and score. Although comparison studies of these two types are difficult to carry out, one study indicates that both scales have similar reliabilities.[50] Goode and Hatt[51] give guidelines which may be used for constructing and validating a Likert-type scale. They suggest that from fifteen to eighteen items should be used and that half of these items should reflect an attitude favorable towards the attitude being measured. They suggest that the validity of the scale may be assessed by using the responses from pro- and anti-groups, and that the validity may be increased by weighting the items. The selection of the items may be based on the discriminating power of each item.

On Simulation

With recent emphasis on simulation of space explorations, simulation methods have received wide publicity. Although less well known, their use in education has also increased.

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[50] Allen L. Edwards, Techniques of Attitude Scale Construction (New York: Appleton-Century-Crofts, 1957), pp.167-8.

[51] William J. Goode and Paul K. Hatt, Methods in Social Research (New York: McGraw Hill, 1952),pp.275-6.

Morgenthaler[52] defines simulation as a means by which the essential features of a system or activity may be duplicated without actually attaining reality itself. Simulation is used to create facsimiles of the features of the system in an artificial situation.[53] In this way a wider array of types of interaction feedback cues can be provided. By simulation the richness of an experience can be enhanced by increasing the representational value of the experience with a decrease in dependence on verbal or symbolic representations.

The uses of simulation are varied: it may be used to save expense, or time, or to reduce danger, or to create enthusiasm.[54,55] It may be used to analyze ongoing systems, or to develop and evaluate new designs, or to train humans.[56]

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[52]G. W. Morgenthaler, "The Theory and Application of Simulation in Operations Research," in Progress in Operations Research, ed. by R. L. Ackoff (New York: John Wiley, 1961), p.367.

[53]Ibid., pp. 373-5.

[54]Phi Delta Kappa, Phi Delta Kappa Symposium on Educational Research: Simulation Models for Education (Indianapolis: Phi Delta Kappa, November 1962), p.17.

[55]Cleo H. Cherryholmes, "Some Current Research on the Effectiveness of Educational Simulation: Implications for Alternative Strategies," American Behavioral Scientist, 10 (2), 1966, p.5.

[56]Donald D. Bushnell, "Computer Based Simulation: New Technology for Education," AV Communications Review, 11, 1963, p.45.

Possibly the greatest advantage of simulated experiences is that the learner can obtain immediate knowledge of the effects of his actions.[57,58]

Summary

There is evidence to show that programmed materials can produce learning, and that they tend to save time, when compared with conventional methods. There are no clear-cut findings indicating that one method of presentation is superior to another. However the present trend seems to favor programmed texts as a medium of presentation. It is considered by some that the real value of programmed instruction may be in its effect on other aspects of teaching.

Workshops stress participation, growth and co-operation. Generally it seems that at least two days are required for an effective workshop. In any workshop, the instructional techniques used should be parallel or at least compatible with the techniques being taught.

Attitudes are complex phenomena which are difficult to measure because of conflicting attitudes. In responding to attitude scales, subjects often rationalize and carry out deceptions. Attitudes can be changed although there is some evidence that information, though basic to the

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[57] Ibid., p.48.

[58] Paul A. Twelker, "Classroom Simulation and Teacher Preparation," The School Review, 75 (2), 1967, p.201.

formation of an attitude, may not be very effective in bringing about a change. Favorable attitudes are seen as being vital to writers and users of programs. A favorable attitude on the part of the teacher is seen as essential if programmed instruction is to be successful with the students.

For reasons of time, expense, or danger, simulation techniques may be the only way to provide experiences. Simulations can duplicate the essential features of a situation, and as a result stimulate interest. They are useful as a means of giving immediate knowledge of the effects of decisions.

About InGrouP

Literature relating to three of the components of the prototype training session and the importance of attitudes has been reviewed. The next section contains references to the method used in this study.

The Need for InGrouP

If schools are to make use of programming techniques, specific steps will have to be taken to acquaint teachers with the characteristics of the method.[59] Cox[60] indicates

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[59]Lawrence M. Stolurow, "Implications of Current Research and Future Trends," Journal of Educational Research, 55 (9), June-July 1962, p.519.

[60]Cox, Education U. S. A., p.9.

that with the rapid advances made in knowledge and instructional materials, the schools have a shortage of personnel capable of translating these new materials into something that can be handled in the classroom. Moreover Margolis[61] quotes Schramm as saying that there is no widespread movement to eliminate this shortage. Any change which is to occur will require a retraining of the teachers.[62]

Stolurow[63] predicts that special institutes and regular courses will have to be organized to meet the need for trained teachers to use and write programs. It is through these training sessions that more teachers will become familiar with programs and write more programs. As an outcome of an increased awareness, the development of programmed instruction will be stimulated so that the part of the development curve representing the "maturity" phase will rise more sharply.

As acceptance of new techniques is closely related to teacher involvement,[64] acceptance

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[61]Richard Margolis, "Programed Instruction: Miracle or Menace?" in Revolution in Teaching: New Theory, Technology, and Curricula, ed. by Alfred de Grazia and David A. Sohn (New York: Bantam Books, 1964), p.119.

[62]Phil C. Lange, "Administrative and Curricula Considerations," Programed Instruction, Sixty-sixth Yearbook of the National Society for the Study of Education, Part II (Chicago: The Society, 1967), p.156.

[63]Stolurow, "Implications of Current Research and Future Trends in Educational Technology," p.435.

[64]O'Toole, "Teachers' and Principals' Attitudes," p.438.

and involvement seem imperative if the control of educational policy is to remain with the educators and not pass into the control of the large corporate producers.

Also, there is reason to believe conventional teaching methods will also be improved if teachers study programmed instruction; the basic principles underlying programmed instruction are extensions of the principles of learning.[65,66,67]

The Nature of InGrouP

The underlying principle was that the methods used in the InGrouP session should be similar to the skills being taught. Therefore, where possible, the materials were programmed, and the teachers were given experience in writing and evaluating programs. Welch[68] considers that, up to a point, training for program writing and

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[65]Carlton B. Downing, "Programmed Instruction in Perspective," in Trends in Programmed Instruction, ed. by G. D. Ofiesh and W. C. Meierhenry (Washington, D.C.: Department of Audiovisual Instruction, National Education Association and the National Society for Programmed Instruction, 1964),p.32.

[66]Norman Wallen and Robert M. W. Travers, "Analysis and Investigation of Teaching Methods," in Handbook of Research on Teaching, ed. by N. L. Gage (Chicago: Rand McNally, 1963), pp.464-5.

[67]William A. Deterline, "Problems in Program Production," Programed Instruction, Sixty-sixth Yearbook of the National Society for the Study of Education, Part II (Chicago: The Society, 1967), p.201.

[68]Don Welch, "Teaching Machines and Programmed Instruction: What is in Store for Us?" Programmed Instruction, 1 (6), June 1962, p.5.

training for using programs run parallel. The writing of frames gives a teacher a deeper understanding of the subject matter and how children learn.

Because of the constraint imposed by the present policy on professional development days, some selection of materials was required for inclusion in the InGrouP session so that the total experience could be offered in a period of about six hours. The materials were limited to those aspects of programmed instruction which were considered necessary for developing an understanding of the rationales and the features which are commonly found in programs at the present time or may become more common in the future. Espich and Williams[69] state that:

> A basic understanding of the principles on which programming techniques are based will make it easier for the programmer to grasp the concepts of programming and to vary the techniques where required.

The frame-writing section was limited to the preparation of several short series of frames, each of about eight frames on a specific aspect of a topic area. By this method the participants would not get experience in writing long programs but Downing[70] and Deterline[71]

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[69]Espich and Williams, Developing Programmed Instructional Materials, p.3.

[70]Downing, "Programmed Instruction in Perspective," p.31.

[71]Deterline, "Problems in Program Production," p.185.

consider that modular programming is preferred to long programs, and that teachers prefer to write short programs. Green[72] states that perhaps the most pressing need of the neophyte programmer is for specific directions on how to write frames.

The Method of Presentation

The materials were presented in book form. This mode of presentation would provide for maximum flexibility with the minimum amount of equipment and so would reduce restrictions on the use of the training session caused by the absence of trained personnel to supervise, or the absence of equipment. Espich and Williams[73] consider that all programs begin on paper, and this is supported by statements by Lindvall and Bolvin.[74] Espich and Williams[75] also consider that the majority of programs available are of the pencil-and-paper type.

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[72]Edward J. Green, "Process of Instructional Programing," Programed Instruction, Sixty-sixth Yearbook of the National Society for the Study of Education, Part II (Chicago: The Society, 1967), p.63.

[73]Espich and Williams, Developing Programmed Instructional Materials, p.16.

[74]Lindvall and Bolvin, "Programed Instruction in the Schools," p.219.

[75]Espich and Williams, Developing Programmed Instructional Materials, p.16.

As about eighty percent of the programs currently available are of the constructed-response type, the main part of the programmed section was written in this form,[76] However both horizontal and vertical formats were used to illustrate that constructed-response programs can be written in several ways. Some emphasis was given to branching sequences as there is some experimental evidence to support both types of sequencing.

A number of books contain sections on the characteristics of good frames. Those by Espich and Williams,[77] and Susan Markle[78] were used as guides for the preparation of the programmed materials used in this InGrouP session. The use of a separate booklet (booklet 2) for the confirmation of frames requiring longer responses or comments, and for review tables used by the participants to test their progress and to provide summaries follows from the examples given by Markle,[79] and Bell and Hunt.[80]

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[76] Ibid., p.49.

[77] Ibid., p.131-136.

[78] Susan Markle, Good Frames and Bad (New York: John Wiley, 1964), pp.227-8.

[79] Ibid., p.237.

[80] Norman T. Bell and James C. Hunt, Self-Instructional Program in Psychology (Glenview, Ill.: Scott Foresman and Co., 1967), pp.256-64.

In the program-writing and evaluation of programs parts of the training materials, the principle of mathetics, or "backward fading" was used as there is strong experimental and theoretical evidence to support its use.[81] For example, by this technique, as the participant works through frames illustrating a particular sequence of programming, the frames become progressively less complete. By responding to each frame, the participant always sees the complete sequence to the point at which he is able to write out the complete sequence by himself.

The pattern used for the analysis of the topic area to be programmed was adapted from those used by Brethower and others,[82] and by Mager.[83] The sequences for writing frames and their evaluation were modified from those suggested by Brethower,[84] and from those suggested within the Learning Systems Institute at Michigan State University.

In the next chapter, the components of the InGrouP materials and the test instruments and procedures followed to develop these are described.

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[81]Mechner, "Behavioral Analysis and Instructional Sequences," p.91.

[82]Brethower and others, Programmed Learning - A Practicum, pp.53-84.

[83]Robert F. Mager and Kenneth Beach, Jr., Developing Vocational Instruction (Palo Alto, Calif.: Fearon, 1967), pp.7,10,25 and 28.

[84]Brethower and others, Programmed Learning - A Practicum, p.167-99.

CHAPTER III

DEVELOPMENT OF INSTRUMENTS

The materials used in the trial InGrouP sessions were developed to present the characteristics of programs, the techniques used in programs, and to provide a guide to the selection of good frames and programs. Also, they provided an opportunity to write series of frames and to have these evaluated.

These components were written so that the InGrouP sessions would be as independent as possible of the need for expert supervision and supplementary equipment.

Copies of all instruments are included in Appendix A.

Booklets for the Program Section

The program section concentrated on the features of programs and on how to select good frames and good programs. The materials were programmed but additional material was included to explain some of the rationales operating. The materials were presented in two booklets, booklets 1 and 2, which were used simultaneously by the participants. The second book was used to illustrate that programmed material does not necessarily have to be restricted to one book but that the student may be

directed out of the main programmed sequence to other activities.

Booklet 1

This booklet contained the program through which the participants worked. It contained series of frames illustrating the principles of programmed instruction, most of the confirmations of responses, and related comments. A bibliography was included to be used by the participants outside the training experience.

Booklet 2

This booklet was divided into two parts. In the first, confirmations were given to some of the frames in booklet 1 which required longer responses. The second part contained review tables which were to be completed by the participants at several stages in the program sequence. These tables also served as a summary and integrating agent for the participants.

Booklets for the Simulation Section

The materials for the simulation section were written in two booklets. These provided instructions for writing three series of frames and instructions for having them evaluated within the InGrouP session. The material included in them built on the knowledge and skills developed in the program section.

Booklet 3

This booklet contained the instructions for writing three series of frames. The first series was to be written to teach a specific topic area which was defined for the writer. The writer was given a partly completed analysis of the problem. After completing it, he was requested to write a series of about eight frames to teach to the weakness indicated by the analysis of the problem.

The second and third frame-writing experiences were in a topic area of the participant's choice. Some twenty suggested areas were given but the participant could program outside those suggested. The third series of frames was written after an evaluation of the second series had been made. This evaluation was used to improve the series for the third writing experience.

In all, three evaluation procedures were used.

(1) a "face-to-face interview" situation was simulated to represent the type of evaluation which would result from conducting an actual field testing interview with a typical student for whom the frames were designed. The participants worked in pairs with one member assuming the role of a "typical student," the other acted as the programmer and conducted the interview. The programmer evaluated his own program, and then the pair reversed

roles so that the program written by the other member of the pair was evaluated. This method of evaluation was used for the first experience in writing frames.

(2) a "no feedback mail" technique was used in which mailing out a program to respondents who have no personal contact with the programmer was simulated. The completed programs were identified by number only. Then they were placed in a pile and each member of the training session took one to work through. He added responses and comments about the program which he considered appropriate. Then each program was returned to the writer.

(3) a "feedback mail" technique was also used. The procedure used was similar to that used for the "no feedback mail" method except that the frames contained the correct responses.

Participants could select which of the second and third methods they would use first to evaluate their program on the topic of their choice. However they were instructed to use the alternative method for the final rewrite of their program. In this way all participants used all three evaluation methods.

Booklet 4

This was essentially a workbook in which the programs were written. Pages were provided for each writing experience. For the first experience, the first page

contained some of the information which the programmer could assume was available to the typical student. The pages for the second and third writing experiences were blank except for the cover page which provided space for the identification number and the method of evaluation being used.

This format provided an example of "backward fading," and also meant that a "package" of the four booklets would provide all the materials required with the exception of a pencil or pen.

Development of the Booklets

For purposes of refinement before the trial sessions, the booklets were given to four teachers of junior high school science who were asked to work through the materials by responding to each frame and adding comments on sequencing, terminology, and the time taken. To test the wording of the frames and the development of the concepts, three of the teachers were given booklets which did not contain confirmations of the responses. This was done in an attempt to control any tendency to look ahead to the correct answer before writing in the response. From their responses some changes were made in terminology and sequencing.

The revised forms of the booklets were administered to a new group of six teachers of junior high school science under the conditions to be used in the InGroup sessions. All participants used booklets containing confirmations.

From the results and comments, the materials were revised to give the final forms. Two major changes were made in the procedures to be used. Firstly, because of differences in the times required to write the series of frames, it was apparent that time limits would have to be imposed in the writing parts of the training session or else the exercises would not be completed in the time available. To make this possible, the participants had to be instructed to program only one specific aspect of the topic they selected. The other change eliminated excessive movement between booklet 3 and booklet 4. Originally, instructions for writing the frames were given in both booklets. As a result of this trial, all instructions were placed in booklet 3, and booklet 4 became a workbook in which the series of frames were written. There were no major changes in overall content.

Attitude Scale

Fifty statements about programmed instruction were selected from research papers and articles. Where necessary, these were shortened to contain no more than

about twenty words. The polarities of some were changed so that half the statements reflected an attitude in favor of programmed instruction.

Item Validity

The scale was given to a group of graduating students in education. The group consisted of twenty-eight students who had expressed an attitude favorable to programmed instruction, and twenty-eight who indicated an attitude against.

Each item response was weighted from 0 through 4 for responses of "strongly disagree" through "strongly agree." From these results a discriminative index was calculated for each item. The computation was made using a modification of the method suggested by Goode and Hatt.[1] The formula used was:

$$D.I. = \frac{W_f - W_a}{4n_a}$$

where: D.I. is the discriminative index.
W_f is the sum of the weighted responses on an item made by those in favor of programmed instruction.
W_a is the sum of the weighted responses on an item made by those against programmed instruction.
n_a is the number of respondents in one polar group ($n_a = n_f = 28$)

[1]Goode and Hatt, Methods in Social Research, p.275.

The modification gave a maximum discriminative index of 1.00 and a minimum of 0.00. The discriminative index for each item is given in Table B.1 in the appendix.

Twenty items with discriminative indices at least four time that suggested as minimal by Goode and Hatt[2] were selected and used in the final form of the attitude scale. Ten of these reflected a negative attitude to programmed instruction and ten reflected an attitude favorable to it.

The face validity of each item and the whole scale was estimated by asking three persons with experience in programmed instruction to rate the face validity of each item and the whole scale on a five-point scale from 0 for "no apparent validity" through 4 for "very high face validity." An index for each part was calculated by adding all ratings for the part and dividing by twelve. Thus the maximum face validity index possible was 1.00 and the minimum was 0.00. These indices are given in Table B.3 of the appendix.

The overall face validity index was 0.750.

Attitude Scale Reliability

The scale was given to 119 junior high school science teachers, secondary science method students and practicing teachers, and the results were analyzed by the RAVE method

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[2] Ibid., p.276.

of reciprocal averages given by Wright and Porter.[3] This procedure gave an optimum weighting scale for each item from 0 through 5. The assigned weights are given in Table B.2. Using these weights, the reliability coefficient was 0.8759 and the standard error was 3.8056.

Table 3.1 contains the statistics of the attitude scale obtained from the sample.

TABLE 3.1.--Attitude Scale Statistics[a] (n = 119)

Mean	63.6134
Standard deviation	11.0393
Reliability coefficient	0.8759
Standard error	3.8056

[a]Calculated using the RAVE program.

Test Booklet

One booklet was developed to test three aspects of the trial InGrouP sessions. Therefore, in effect, the test booklet contained three subtests although the items were numbered sequentially. All items except the last were multiple choice items to which the participants were asked to select the best answer.

[3]David J. Wright and Andrew C. Porter, An Adaptation of Frank B. Baker's Test Analysis Package, Occasional Paper No. 1 (East Lansing: Office of Research Consultation, Michigan State University, 1968), p.13.

Subtest 1 (Items 1 through 11)

This contained statements about the characteristics of programs, techniques used in programs and the rationales underlying their use. Each item was scored 1 for a correct response so that the maximum score possible was 11.

Subtest 2 (Items 12 through 20)

This subtest contained questions about frames, program sequences, and statements taken from test findings of programs. Participants could score a maximum of 9.

Subtest 3 (Items 21 and 22)

Item 21 contained four program-writing sequences from which the participants were asked to select the best. In Item 22, participants were asked to write a short series of frames to teach the topic given in the item. The maximum scores were 1 for Item 21 and 10 for Item 22.

The test booklet was given to each person in the groups used in the development of booklets 1-4. Some minor changes in terminology were made as a result of their comments.

Subtest and Item Validities

A panel of three persons involved with programmed instruction were asked to rate each item and each subtest on a five-point scale from 0 for "very low or zero face validity" through 4 for "very high face validity." From these ratings, a validity index for each item and each

subtest was calculated. An index of 1.00 indicated that all three judges considered that the item had very high face validity, whereas an index of 0.00 indicated that all members of the panel agreed that the item had very low or zero face validity.

The indices for the items are given in Table C.2 of the appendix. Those for the subtests have been included in Table 3.2 below.

Subtest Reliabilities

Two reliability coefficients for subtests 1 and 2 were calculated. One, of Hoyt's reliability coefficient equivalent to a Kuder Richardson #20 split half reliability was found using the GITAP program, the other used these coefficients to calculate a reliability coefficient for the whole subtest by the Spearman-Brown Prophecy Formula. These coefficients are given in Table 3.2.

Summary

Two instruments were developed to measure the effectiveness of the trial InGrouP sessions. The twenty item Likert-type attitude scale was developed from a pool of fifty items about programmed instruction. The final selection of items for inclusion in the actual attitude scale was based on the discriminative index of each item calculated from responses from biased groups. Half of those selected expressed an attitude in favor of programmed

TABLE 3.2.--Subtest Statistics

	Subtest 1	Subtest 2	Subtest 3
Face Validity (n=3)[a]	0.667	0.667	0.833
Overall Reliability (n=53)[b]	0.792	0.426	-
Hoyt Reliability (n=53)[c]	0.650	0.271	-
Standard Error	1.335	1.244	-

[a]Computed from ratings made by a three-member panel using a five-point scale with 0 for very low or zero face validity and 4 for very high face validity. The formula used was:

$$\text{Validity} = \frac{\Sigma r}{12}$$

where: Σr is the sum of the three ratings.

[b]Computed from the Hoyt Reliabilities using the Spearman-Brown Prophecy Formula [Source: Allen L. Edwards, Statistical Methods for the Behavioral Sciences, (New York: Holt, Rinehart and Winston, 1961), p.177.]

[c]Computed by analysis of variance with the GITAP program.

instruction. The possible responses to the items were weighted to increase the reliability. These weightings were used in the research design. A panel of three judges was used to estimate face validity.

The second instrument, the test booklet, consisted of twenty-two items to form three subtests. Subtest 1 was developed to measure knowledge of techniques used in programs and the characteristics of programs. Subtest 2

was developed to measure the ability of the subject to evaluate frames and programs, and subtest 3 to measure the ability to write a series of frames. The reliabilities of subtests were found using the participants of the trial InGrouP sessions. The validity of each subtest was found using the same panel of judges as for the attitude scale.

In Chapter IV, aspects of the research design, the sample, and the testable hypotheses are presented. These are followed by an analysis of the data obtained from the three trial InGrouP sessions.

CHAPTER IV

DESIGN OF THE STUDY

To test the effects of the prototype InGrouP materials in an InGrouP session, it was necessary to develop a research design to measure the changes in attitudes, knowledge of programmed instruction, the ability to evaluate frames and program sequences, and the ability to write a series of frames.

In this chapter, the sample used in the trial InGrouP session is defined as representative of a larger population of science-oriented secondary-level teachers with similar characteristics. The measures used and the actual research design are outlined and the objectives of the trial InGrouP session are stated as testable hypotheses. Finally the methods used to analyze the data are discussed.

In all, three trial InGrouP sessions were held so that patterns of changes could be detected. It was felt that reoccurring patterns would add more certainty to any conclusions drawn from any one training session.

The Sample

In all three trial InGrouP sessions the participants were volunteers. They were not required to pay a fee for

the session nor were they paid in any way for attending. Therefore it seems reasonable to assume that all participants were interested (at least curious) to some degree in programmed instruction before the commencement of the training sessions.

The first trial InGrouP session was held on Saturday, May 24, 1969. The teachers of secondary-level science in the public and parochial schools within a radius of about seventy miles of the Michigan State University campus were invited to attend. Letters and telephone calls to the school principals constituted the invitations.

The second session was held on Saturday, June 21, 1969. The teachers of secondary-level science and mathematics who were attending National Science Foundation Summer Institutes at Michigan State University and also those attending curriculum courses in the College of Education were invited to attend.

Participants for the third session on the evenings of Thursday, June 19, and Tuesday, June 24, 1969 were drawn from the same population as that for the second session. In this case the materials were presented in two three-hour periods. In the first, the program section was given, while the simulation section was given on the second evening.

Table D.7 in the appendix summarizes the demographic data on the participants. It gives geographical locations, teaching experiences, and sex differences of the participants in all three trial InGrouP sessions.

The Measures

Because of the short time required for the training session, and the problem of developing two parallel forms of the attitude scale and the test booklet, all participants were given the same two measuring instruments. Some participants were pretested, the others posttested. The demographic data about the participants were obtained from a checklist on the registration card given to each participant as he entered the room prior to the commencement of the training session.

The Design

The basic design used independent pretest and posttest groups. It could be represented as:

R AT PS
R PS AT

where: R indicates random assignment of participants to treatments.
A indicates administration of the attitude scale.
T indicates administration of the test booklet.
P indicates the program section (booklets 1 and 2).
S indicates the simulation section (booklets 3 and 4).

With a larger number of participants in the third session, this design was expanded in an attempt to measure the effects of the program and simulation sections separately. The design for trial InGrouP session 3 was:

R	AT	PS		
R		PS	AT	
R		P	AT	S

Campbell and Stanley[1] consider that the basic design used here controls for all factors likely to reduce internal validity except mortality, history, and maturation. In this application of the design, differences in the previous histories of the participants were accounted for by the random assignment to treatment groups. The time lapse between pretesting and posttesting was probably not sufficient to permit significant differences to occur between groups. The effect of maturation would also be slight because of the short time lapse, but any effect would probably be one of fatigue which would tend to lower the scores for the posttest group.

The same instructional materials and measures were used in all trial InGrouP sessions.

After a brief introduction by the supervisor to explain the components of the session, participants used booklets 1 and 2 for the program section. As the partici-

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[1]Campbell and Stanley, Experimental and Quasi-Experimental Designs for Research, p.40.

pants worked through the materials at their own rates, they finished at different times.

The simulation section takes about three hours to complete and the participants worked through this part of the training session after completing the program section. This section was introduced by the supervisor who presented a brief overview of the evaluation procedures. More specifically, the task required of the participants was explained in some detail, and the places in the room to which completed programs should be taken for evaluation were indicated. Placing the programs in piles simulated mailing the programs. Some control of the time available for each part of this section was exercised by the supervisor. He allocated time and gave participants warnings five minutes before the expiration of time.

At the conclusion of the simulation section a discussion was held to consider some of the major controversies on programmed instruction. The basis of the discussion was the four questions given in booklet 3. However questions and answers were elicited from members of the group before opinions were put forward by the supervisor.

As a result of the experience with the first trial InGrouP session, the supervisor included a short discussion session after the first writing and evaluation exercise. In this, some of the common errors made by the participants were mentioned and discussed, and the steps required for

the next two writing and evaluation exercises were outlined. These points are given in the supervisor's manual in Appendix A. This additional discussion session was used in the second and third sessions. Otherwise the formats were the same in all trial InGrouP sessions.

A variety of commercial programs were available so that the participants could see how some of the techniques illustrated in the InGrouP materials were incorporated into larger programs. Participants were not required to look at these, but they were told that they were available.

Testable Hypotheses

The following null hypotheses were tested for all three trial InGrouP sessions.

$_1H_0$: There is no difference between mean scores for subtest 1 for volunteers who complete the trial InGrouP session and for those prior to the session.

$_2H_0$: There is no difference between mean scores for subtest 2 for volunteers who complete the trial InGrouP session and for those prior to the session.

$_3H_0$: There is no difference between mean scores for subtest 3 for volunteers who complete the trial InGrouP session and for those prior to the session.

$_4H_0$: There is no difference between mean scores for the attitude scale for volunteers who complete the trial InGrouP session and for those prior to the session.

In symbolic form, all null hypotheses that apply to all InGrouP sessions could be represented by the general equation:

$$M_{x_{posttest}} = M_{x_{pretest}}$$

where: $M_{x_{posttest}}$ is the mean score for the posttest treatment group in any trial InGrouP session for the aspect (x) being considered.

$M_{x_{pretest}}$ is the mean score for the pretest treatment group in the same trial InGrouP session for the same aspect (x).

The alternate hypotheses were:

$_1H_1$: Volunteers who have completed the trial InGrouP session have a higher mean score for subtest 1 than volunteers prior to the session.

$_2H_1$: Volunteers who have completed the trial InGrouP session have a higher mean score for subtest 2 than volunteers prior to the session.

$_3H_1$: Volunteers who have completed the trial InGrouP session have a higher mean score for subtest 3 than volunteers prior to the session.

$_4H_1$: Volunteers who have completed the trial InGrouP session have a higher mean score for the attitude scale than volunteers prior to the session.

These alternate hypotheses could be represented by the general equation:

$$M_{x_{posttest}} > M_{x_{pretest}}$$

In addition, the following null hypotheses were tested in the third trial InGrouP session only.

$_5H_0$: There is no difference between mean scores for subtest 1 for volunteers who complete the trial InGrouP session and for volunteers who complete the program section only.

$_6H_0$: There is no difference between mean scores for subtest 2 for volunteers who complete the trial InGrouP session and for volunteers who complete the program section only.

$_7H_0$: There is no difference between mean scores for subtest 3 for volunteers who complete the trial InGrouP session and for volunteers who complete the program section only.

$_8H_0$: There is no difference between mean scores for the attitude scale for volunteers who complete the trial InGrouP session and for volunteers who complete the program section only.

In symbolic form, these could be presented by:

$$M_{x_{posttest}} = M_{x_{midtest}}$$

The alternate hypotheses were:

$_5H_1$: Volunteers who have completed the trial InGrouP session have a higher mean score for subtest 1 than volunteers who have completed the program section only.

$_6H_1$: Volunteers who have completed the trial InGrouP session have a higher mean score for subtest 2 than volunteers who have completed the program section only.

$_7H_1$: Volunteers who have completed the trial InGrouP session have a higher mean score for subtest 3 than volunteers who have completed the program section only.

$_8H_1$: Volunteers who have completed the trial InGrouP session have a higher mean score for the attitude scale than volunteers who have completed the program section only.

These alternate hypotheses could be expressed as:

$$M_{x_{posttest}} > M_{x_{midtest}}$$

To determine the effect of the program section, the following null hypotheses were tested in the third trial InGrouP session.

$_{9}H_{0}$: There is no difference between mean scores for subtest 1 for volunteers who complete the program section only and for those prior to the trial InGrouP session.

$_{10}H_{0}$: There is no difference between mean scores for subtest 2 for volunteers who complete the program section only and for those prior to the trial InGrouP session.

$_{11}H_{0}$: There is no difference between mean scores for subtest 3 for volunteers who complete the program section only and for those prior to the trial InGrouP session.

$_{12}H_{0}$: There is no difference between mean scores for the attitude scale for volunteers who complete the program section only and for those prior to the trial InGrouP session.

Expressed as an equation:

$$M_{x_{midtest}} = M_{x_{pretest}}$$

The alternate hypotheses were:

$_{9}H_{1}$: Volunteers who complete the program section only have a higher mean score for subtest 1 than volunteers prior to the trial InGrouP session.

$_{10}H_{1}$: Volunteers who complete the program section only have a higher mean score for subtest 2 than volunteers prior to the trial InGrouP session.

$_{11}H_{1}$: Volunteers who complete the program section only have a higher mean score for subtest 3 than volunteers prior to the trial InGrouP session.

$_{12}H_1$: Volunteers who complete the program section only have a higher mean score for the attitude scale than volunteers prior to the trial InGrouP session.

These could be represented as:

$$M_{x_{midtest}} > M_{x_{pretest}}$$

The Analysis

As the attrition rate between the beginning and the end of each training session was high, it was considered desirable to test differences in performance between those who completed the session and those who left early, as some common confounding effect might have been operating. If significant differences were found, then only the results from those who completed the trial InGrouP session could be used. This would seriously reduce the number of cases for whom data would be available.

The following null hypothesis was formulated and tested:

> There is no difference between mean scores for those in the pretest groups who completed the trial InGrouP sessions and those in the pretest groups who left before the session was completed.

As accepting this null hypothesis when in fact it was false could seriously affect the validities of the analyses of data using all test scores, the level of significance was set at 0.10 to reduce the chance of making a Type II error.

The hypothesis was tested with a *t* test for each set of data, and a summary of the results is given in Table 4.1.

TABLE 4.1.--Differences between Means for Pretest Leavers and Pretest Non-leavers

	Attitude Scale	Subtest 1	Subtest 2	Subtest 3
$Mean_{non\text{-}leavers\ (n=15)}$	70.67	5.33	4.80	2.33
$Mean_{leavers\ (l=12)}$	70.83	4.93	4.25	2.42
$Mean_{(n)}-Mean_{(l)}$	- 0.16	0.40	0.55	- 0.09
Standard error	3.752	0.271	0.499	1.357
$\underline{t}$ ratio	0.044	0.768	1.101	0.061
$Significance_{(0.10)}$[a]	-	-	-	-

[a]A $\underline{t}$ ratio of 1.708 is required for significance at p = 0.10 with 25 degrees of freedom.

Therefore for all pretest scores, the null hypothesis must be accepted that there are no differences between mean scores for those who completed the training session and those who left early. As a result of this finding, the analyses of the data from the trial InGrouP sessions used all available test scores, irrespective of whether the participant completed the session or not.

As three training sessions were conducted at different times and randomization of the participants to treatment groups across all sessions was not possible, the data from each trial InGrouP session were analyzed separately.

In the first and second trial InGrouP sessions, the comparisons between means were made using *t* tests for means of independent samples. As the alternate hypotheses were directional, one-tailed tests were applied.

As three comparisons between means were required in the third session, the data were analyzed by one-way analysis of variance techniques.[2] For significant *F* ratios, the actual locations of the differences within the analysis of variance table were found using the Scheffé method.[3]

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[2]William L. Ruble, Donald F. Kiel and Mary E. Rafter, One-way Analysis of Variance with Unequal Number of Replications Permitted, STAT Series Description No. 13 (East Lansing: Agricultural Experiment Station, Michigan State University, November 1968).

[3]William L. Hays, Statistics for Psychologists (New York: Appleton-Century-Crofts, 1963), p.484.

All differences between means were tested at the 0.05 level of significance. This level was considered appropriate because the consequences of making a Type I error were considered to be less important than the consequences of making a Type II error. The reasons behind this decision were that the InGrouP session required a relatively small commitment of time on the part of the participants, and the materials were relatively inexpensive, but at the same time the contribution of the training session to the use and preparation of programmed materials in the school, and the effect on conventional teaching might be considerable.

Summary

Four aspects of using and writing programmed materials were considered for those teachers of secondary-level science and mathematics who volunteered to attend. The aspects considered were:

(1) in subtest 1, knowledge of the techniques used in programs and the rationales underlying their use, and the characteristics of programs;

(2) in subtest 2, the ability to evaluate single frames, program sequences, and programs from test findings;

(3) in subtest 3, the ability to recognize an acceptable program-writing sequence, and the ability to write a series of frames; and

(4) in the attitude scale, the expressed attitudes of the participants towards programmed instruction.

The design required the random assignment of the participants to treatment groups. The control groups were pretested with the attitude scale and the test booklet. The experimental groups were posttested with the same instruments.

Three separate trial InGrouP sessions were run, and the data from these were analyzed separately using t tests and one-way analysis of variance methods where applicable. The level of significance was set at 0.05. There was found to be no difference at $p<0.10$ for mean scores for the pretest participants who completed the session and the mean scores for participants who left before completing the session.

In Chapter V, the results of the analysis of the data are presented.

CHAPTER V

ANALYSIS OF RESULTS

The actual scores obtained by the participants in the control and experimental groups are listed separately for each trial InGrouP session in Appendix D.

The following results were obtained when the null hypotheses given in the preceeding chapter were tested for all three trial InGrouP sessions at a significance level of 0.05.

Techniques and Characteristics of Programs

$_1H_0$: There is no difference between mean scores for subtest 1 for volunteers who complete the trial InGrouP session and for those prior to the session.

The results for testing this hypothesis with either a *t* test or an *F* test are summarized in Table 5.1.

TABLE 5.1.--Effects of the Trial InGrouP Sessions on Mean Scores for Knowledge of Techniques and Characteristics

	Session 1[a]	Session 2	Session 3
Posttest Mean	8.60	9.00	10.00
Pretest Mean	4.46	5.71	5.22
$Mean_{post}$-$Mean_{pre}$	3.98	3.29	4.78
$Significance_{(0.05)}$	sign.	sign.	sign.

[a]Session = trial InGrouP session.

Therefore, at $p<0.05$, the null hypothesis of no difference between means for subtest 1 must be rejected and the alternate hypothesis, $_1H_1$, accepted.

The effect of the simulation section in changing knowledge of techniques and characterisitics was tested by comparing the mean of the midtest group with the mean of the posttest group in the third session.

The null hypothesis tested was:

$_5H_0$: There is no difference between mean scores for subtest 1 for volunteers who complete the trial InGrouP session and for volunteers who complete the program section only.

The effect of the program section of the trial InGrouP session was tested by comparing the mean score of the pretest group with the mean score of the midtest group in the third training session.

The null hypothesis was:

$_9H_0$: There is no difference between mean scores for subtest 1 for volunteers who complete the program section only and for those prior to the trial InGrouP session.

The results of testing Hypothesis $_5H_0$ and Hypothesis $_9H_0$ by one-way analysis and the Scheffé method of comparison are given in Table 5.2. Both results have been combined in the one table. Therefore $_5H_0$ could not be rejected at $p<0.05$ and the conclusion drawn that the simulation section did not alter the test performances for the knowledge of techniques and characteristics. However $_9H_0$ could be rejected at that level of significance and the alternate hypothesis, $_9H_1$, accepted.

TABLE 5.2.--Effects of the Simulation Section and the Program Section on Mean Scores for Knowledge of Techniques and Characteristics

	Simulation Section	Program Section
Posttest Mean	10.00	-
Midtest Mean	8.30	8.30
Pretest Mean	-	5.22
Difference of Means	1.70	3.08
$Significance_{(0.05)}$	-	sign.

Evaluation of Frames and Programs

The following null hypothesis was tested using the results from three training sessions:

$_2H_0$: There is no difference between mean scores for subtest 2 for volunteers who completed the trial InGrouP session and for those prior to the session.

The results of the analysis are summarized in Table 5.3 in which the term "session" refers to the trial InGrouP session.

TABLE 5.3.--Effects of the Trial InGrouP Sessions on Mean Scores for Evaluating Frames and Programs

	Session 1	Session 2	Session 3
Posttest Mean	5.60	5.71	5.50
Pretest Mean	4.82	4.57	4.22
$Mean_{post}-Mean_{pre}$	0.78	1.14	1.28
$Significance_{(0.05)}$	-	-	-

Therefore the null hypothesis, $_2H_0$, could not be rejected at $p<0.05$.

The separate effects of the simulation section and the program section on the ability to evaluate single frames and programs were tested using the results obtained from the participants in the third trial InGrouP session.

The null hypotheses were:

$_6H_0$: There is no difference between mean scores for subtest 2 for volunteers who complete the trial InGrouP session and for volunteers who complete the program section only.

$_{10}H_0$: There is no difference between mean sccres for subtest 2 for volunteers who complete the program section only and for those prior to the trial InGrouP session.

The results are summarized in Table 5.4.

TABLE 5.4.--Effects of the Simulation Section and the Program Section on Mean Scores for Evaluating Frames and Programs

	Simulation Section	Program Section
Posttest Mean	5.50	-
Midtest Mean	6.00	6.00
Pretest Mean	-	4.22
Difference of Means	- 0.50	1.78
Significance$_{(0.05)}$	-	sign.

Therefore Hypothesis $_6H_0$ could not be rejected at $p<0.05$. Hypothesis $_{10}H_0$ can be rejected at that level and the alternate hypothesis accepted.

Writing a Series of Frames

The null hypothesis tested was:

$_3H_0$: There is no difference between mean scores for subtest 3 for volunteers who complete the trial InGrouP session and for those prior to the session.

This was tested in three training sessions and the results are given in Table 5.5.

TABLE 5.5.--Effects of the Trial InGrouP Sessions on Mean Scores for Writing a Series of Frames

	Session 1	Session 2	Session 3
Posttest Mean	3.80	8.00	7.75
Pretest Mean	2.45	3.14	1.33
$Mean_{post}-Mean_{pre}$	1.35	4.86	6.42
$Significance_{(0.05)}$	-	sign.	sign.

The results obtained from the three sessions were not consistent. In the first trial InGrouP session, there was no significant difference between pretest and posttest means for the ability to write a series of frames. However, in both the second and third sessions, the differences were significant at $p<0.05$.

The effects of the simulation section and the program section on the mean scores for writing a series of frames were tested by the following null hypotheses:

$_7H_0$: There is no difference between mean scores for subtest 3 for volunteers who complete the trial InGrouP session and for volunteers who complete the program section only.

$_{11}H_0$: There is no difference between mean scores for subtest 3 for volunteers who complete the program section only and for those prior to the trial InGrouP session.

The results are summarized in Table 5.6.

TABLE 5.6.--Effects of the Simulation section and the Program Section on Mean Scores for Writing a Series of Frames

	Simulation Section	Program Section
Posttest Mean	7.75	-
Midtest Mean	5.00	5.00
Pretest Mean	-	1.33
Difference of Means	2.75	3.67
Significance$_{(0.05)}$	-	-

Therefore neither $_7H_0$ nor $_{11}H_0$ could be rejected at $p<0.05$.

Attitude to Programmed Instruction

To assess the effectiveness of the trial InGrouP session in changing attitudes to programmed instruction, the following hypothesis was tested:

$_4H_0$: There is no difference between mean scores for the attitude scale for volunteers who complete the trial InGrouP session and for those prior to the session.

The results are given in Table 5.7.

TABLE 5.7.--Effects of the Trial InGrouP Sessions on Mean Scores for the Attitude Scale

	Session 1	Session 2	Session 3
Posttest Mean	75.80	69.28	72.00
Pretest Mean	72.82	72.28	67.00
$Mean_{post}-Mean_{pre}$	2.98	- 3.00	5.00
$Significance_{(0.05)}$	-	-	-

The null hypothesis that there is no difference between mean scores on the attitude scale for the pretest and the posttest groups could not be rejected at $p<0.05$.

The midtest scores obtained in the third trial InGrouP session were used to test the effects of the simulation section and the program section. The null hypotheses were:

$_{8}H_{0}$: There is no difference between mean scores for the attitude scale for volunteers who complete the trial InGrouP session and for volunteers who complete the program section only.

$_{12}H_{0}$: There is no difference between mean scores for the attitude scale for volunteers who complete the program section only and those prior to the trial InGrouP session.

The results are given in Table 5.8.

Therefore neither $_{8}H_{0}$ nor $_{12}H_{0}$ could be rejected at $p<0.05$.

TABLE 5.8.--Effects of the Simulation Section and the Program Section on Mean Scores for the Attitude Scale

	Simulation Section	Program Section
Posttest Mean	72.00	-
Midtest Mean	66.30	66.30
Pretest Mean	-	67.00
Difference of Means	5.70	- 0.70
Significance$_{(0.05)}$	-	-

Summary

The data from the attitude scale and the test booklet were analyzed using t tests for the first and second trial InGrouP sessions, but F tests had to be used for the analysis for the third session because of multiple means.

Four null hypotheses were tested in each of the three sessions to measure the effects of the total trial InGrouP session on the development of knowledge of techniques used in programs and the rationales underlying their use, and the characteristics of programs; on the ability to evaluate frames and programs; and on the ability to write a series of frames. Changes in attitudes to programmed instruction were also measured as indicated by changes in attitude scale scores.

Another four hypotheses were tested to evaluate the effects of the program section only, and four more were tested to evaluate the effects of the simulation section. These eight hypotheses were tested using the data from the third trial InGrouP session.

All hypotheses were tested at the 0.05 level of significance. This was considered to be an appropriate level for the type of equipment required and the possible consequences of the InGrouP session on the subsequent behavior of the participants.

The findings are summarized in Table 5.9 in which the symbols for the hypotheses correspond to the symbols used on Pages 62 to 66.

Therefore it is concluded that the following statements are supportable:

1. the combination of the program section and the simulation section causes significant gains in mean scores for knowledge of the techniques used in programs and the characteristics of programs, $({}_1H_1)$;

2. the combination of the program section and the simulation section causes significant gains in mean scores for the ability to write a series of frames if a short discussion is held after the first writing and evaluation exercise, $({}_3H_1)$;

3. the program section alone causes significant gains in mean scores for knowledge of the techniques and characteristics of programs, $({}_9H_1)$; and for the ability to evaluate frames and programs, $({}_{10}H_1)$.

TABLE 5.9.--Summary of the Rejections of Hypotheses for the Components of the Trial InGrouP session. (p=0.05)

	Session 1[a] P + S[b]	Session 2 P + S	Session 3 P + S	Session 3 P only	Session 3 S only
Knowledge of Techniques and Characteristics	reject $_1H_0$	reject $_1H_0$	reject $_1H_0$	reject $_9H_0$	-
Ability to Evaluate Frames and Programs	-	-	-	reject $_{10}H_0$	-
Ability to Write a Series of Frames	-	reject $_3H_0$	reject $_3H_0$	-	-
Changes in Attitude to Programmed Instruction	-	-	-	-	-

[a] "Session" means trial InGrouP session.

[b] P + S refers to the total trial InGrouP session.
P refers to the program section only.
S refers to the simulation section.

In Chapter VI, a summary of the development of this study is presented and the previous statements are discussed in more detail. Conclusions are then drawn and some implications of this study for further research are outlined.

CHAPTER VI

SUMMARY, CONCLUSIONS AND IMPLICATIONS

Summary

The Problem

The problem underlying this study was the need to develop training sessions by which teachers may become more actively involved in using and writing programmed materials. Although programmed instruction has been generally accepted as a method of instruction, there are indications that it has not been used as extensively as it might. At the same time, the present trend seems to be towards large corporate organizations controlling the production of programmed materials. In that it could tend towards less flexibility (attention to individual and localized needs), corporate monopoly of the development of instructional programs constitutes a potential hazard.

The need for writers of programs and knowledgable adaptive users becomes more acute as the accumulation of knowledge expands and the population of the world increases.

A Training Session

The prototype session developed in this study represents an attempt to provide training for potential users and writers of programs in a situation in which five constraints were operating. These constraints required minimizing the participation of the supervisor and the quantity and elaborateness of the equipment needed. Also, the procedure provided flexibility so that the training could be used with groups of varying sizes and the session could be completed in one day or two half-days. The materials were contained in booklets which could be retained by the participants for reference purposes.

Such a training session, or InGrouP session, could form part of a battery of sessions by which the involvement of teachers with programmed instruction could be increased. The battery is visualized as providing training for teachers of all subject areas in all grades. The battery could be expanded to provide training for teachers in other countries. In this way, an international cadre of programmers could be formed to share programs and research findings. The members of the cadre could write programs for their own country and modify other programs from other countries to meet the objectives and characteristics of their own culture. This would lead to a wider acceptance and efficient use of programmed instruction as a medium for presenting materials in a logical sequence,

for providing individual instruction with active responding and for immediate knowledge of results. Some of the burden of preparing programs could thus be reduced through sharing effort and costs.

The Study

The prototype InGrouP session was prepared for science-oriented secondary-level teachers. The examples used in the materials were taken from science and mathematics at approximately the junior high school level.

The materials were used in two sections. The first, or program section, used self-instructional materials to present the techniques used in programs and the rationales underlying their use, and the characteristics of programs. In addition, the features of good frames and good programs were outlined. The second section, or simulation section, gave participants the opportunity to apply the principles considered in the previous section when writing three series of frames. These series of frames were evaluated by simulating three evaluation procedures.

The method of instruction incorporated features from programmed instruction, workshops and simulation. Participants worked individually, in small groups and in large groups at various times throughout the session.

For research purposes, the basic structure of the InGrouP session was modified to include the administration of two instruments to measure the effects of the procedure.

These instruments were developed to measure changes in four factors:

1. knowledge of techniques, rationales and characteristics of programs;
2. ability to evaluate frames, programs and program sequences;
3. ability to identify an acceptable program-writing sequence, and to write a series of frames; and
4. expressed attitude to programmed instruction.

The two instruments, a twenty item Likert-type attitude scale and a test booklet containing three subtests, were used with all participants. Each instrument was developed using respondents and procedures similar to those to be used in the research sessions.

In addition, qualitative information was sought to indicate the appropriateness of the method and the materials for teachers of the type who participated.

Three trial InGrouP sessions were conducted to which secondary-level science and mathematics teachers were invited to attend. The first session was attended by science teachers from an area of Michigan within a radius of about seventy miles of the university. At the second and third sessions, the majority of the science and mathematics teachers were from outside Michigan. In all sessions, the participants were volunteers and they received no payment for attending. The medians for the

categories of length of experience in science teaching and total teaching experience differed slightly between sessions. However the medians for the number of periods per week in which programmed materials were used in the 68/69 school year were identical.

A total of sixty-seven teachers attended the sessions although only slightly less than half completed both sections. As some of those who did not complete the session were pretested, some data were available from more than three-fourths of the total.

Two trial InGrouP sessions were each completed in a day, whereas the third session was presented in two three-hour periods on separate evenings.

In each session, the participants were randomly assigned to control and experimental groups. All control groups were pretested with the attitude scale and the test booklet. In the first two sessions, the experimental group was posttested using these instruments. In the third session, one experimental group was tested after completing the program section while the other experimental group was posttested after completing both program and simulation sections of the training session.

Findings

Comparisons between pretest and posttest means indicate that, for teachers who participated in the trial InGrouP sessions, the following conclusions are supported

by analyses significant at $p<0.05$:

1. a gain in mean scores for the knowledge of techniques used in programs and the rationales underlying their use, and the characteristics of programs ($_1H_1$);

2. no gain in mean scores for the ability to evaluate single frames, programs and program sequences ($_2H_0$);

3. a gain in mean scores for the ability to recognize an acceptable program-writing sequence, and to write a series of frames when a discussion session was included in the training session at the completion of the first writing and evaluation exercise ($_3H_1$); and

4. no gain in mean scores for the attitude scale on programmed instruction ($_4H_0$).

Analyses of data from the program section of the third session indicate the following conclusions supported by analyses significant at $p<0.05$:

5. a gain in mean scores for the knowledge of techniques used in programs and the rationales underlying their use, and the characteristics of programs ($_9H_1$);

6. a gain in mean scores for the ability to evaluate single frames, programs and program sequences ($_{10}H_1$);

7. no gain in mean scores for the ability to recognize an acceptable program-writing sequence, and to write a series of frames ($_{11}H_0$); and

8. no gain in mean scores for the attitude scale ($_{12}H_0$).

Also, data from the simulation section at the third session indicated the following:

9. no gain in mean scores for any of the four areas considered ($_5H_0$-$_8H_0$).

Some participants had difficulty in assuming the role of a typical student and with the subject matter in the first frame writing exercise. One suggestion put forward was that the supervisor should evaluate a series of frames presented to the group by overhead projector. While this method of instruction appears to have obvious merit, to incorporate it would require the removal of one of the constraints. A supervisor with some expertise in programmed instruction would be required to make the evaluation.

Conclusions

Although the findings were based on data obtained from fifty-three participants who attended one of the three trial InGrouP sessions, the patterns of findings indicate that, in general, the effects were the same in all three sessions.

The only difference between the trial InGrouP session and the general application of the materials in InGrouP sessions is the administration of the attitude scale and the test booklet. From comments made by some participants, elimination of these instruments is more

likely to improve performance than to decrease it. Without these instruments the attrition rate would probably be lower. There is no reason to assume that the materials would produce results differing from those found in the research sessions.

Therefore it may be concluded that for secondary-level science and mathematics teachers similar to those who attended the trial InGrouP sessions, the complete training session produces significant gains in mean scores for knowledge of program techniques and for the ability to write a series of frames.

The program section produces significant gains in the mean scores for knowledge of techniques used in programs and for the evaluation of programs but does not produce significant gains in mean scores for the ability to write programs.

No part of the InGrouP session, nor the whole session produces significant gains in attitude within the brief time frame required by this prototype.

No statement about the long-term effects of the InGrouP session can be made.

Implications for Future Research

There are a number of areas related to this study into which research could be extended.

Probably the most important next step is to seek some evaluation of the effects of the InGrouP session

over an extended period of time. Such evaluation could focus on both the theoretical involvement in programmed instruction of the teachers as measured by paper-and-pencil type instruments such as the attitude scale and the test booklet used in this study and the practical involvement of the teachers with programmed materials in their schools.

As the examples from science and mathematics used in the materials in this study are secondary to learning about programs and programming, research could be done to investigate the effectiveness of the existing materials with teachers from other subject areas and from other grades. An alternative would be to develop parallel forms of the materials for teachers in other subject areas, other grades and other cultures.

Finally, there is some indication from comments made by participants in this study that the program section which is self-instructional may be better worked outside the group situation. Such a change would reduce the time required for the training session to about three hours. However it is not certain whether participants left to work through the materials on their own would enter the simulation part of the training session adequately prepared. Research in this area may prove fruitful.

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APPENDICES

APPENDIX A

INGROUP MATERIALS

Registration No. _____ P

Name _____

BOOKLET 1

CHARACTERISTICS OF PROGRAMS AND TECHNIQUES USED IN PROGRAMMING

This booklet is part of a workshop experience developed to give you a basis for understanding and assessing programs, and to give you experience with some of the techniques used in programs.

You will be asked to make responses to a number of questions throughout the program. These responses should be written in the space provided after the question. Generally, confirmation of your answer is given immediately below the line under your response. Some confirmations are given in Booklet 2.

All responses will be treated as confidential.

SECTION 1 - TECHNIQUES USED IN PROGRAMS

After selecting the topic area for which a teacher wishes to use a program, specific behavioral objectives should be prepared. These are the goals which the student should reach after working through the program, and these should be the same as the goals of the program to be used.

FRAME 1 Which of the following sets of behavioral objectives better describes the objectives of this Workshop?

Set A	Set B
At the conclusion of the workshop, you will :	At the conclusion of the workshop, you will :
1. have seen a number of programming techniques,	1. be able to name programming techniques,
2. have been presented with the characteristics of programs,	2. be able to state the characteristics of programs,
3. be able to read research findings meaningfully.	3. be able to assess a program from research findings.

(Name the set)_____

Confirm your answer with the one given in Booklet 2.

FRAME 2 All programs have three characteristics.

The first characteristic is that the material is presented in a series of logical steps. By working through these steps, the student is led from simple known facts into the information to be learned. In an attempt to assess the quality of a program, a teacher should examine the logical sequence of _____ presented.

---

steps

FRAME 3 The second characteristic of a program is that the student is required to respond, just as you have done in the previous frames of this program.

Because of this, programmed instruction has advantages over many other methods of teaching because a student is required to make r _____ at frequent intervals.

---

responses

FRAME 4 When a response is written it is called an overt response. When the response is selected but not written, it is called a(n) _____ response.

---

covert

This means that the response is made internally, or in other words, the student actually works out the answer but is not required to write it down. Covert is the opposite to overt.

FRAME 5 Research shows that covert responding saves time when it is used in a program but that _____ responding probably leads to better learning.

---

overt

FRAME 6 However, some research results indicate no difference between _____ and _____ responding when the effectiveness of instruction is measured.

(Either order) overt, covert

FRAME 7 In this program you have been making _____ responses.

---

overt

So far you have worked through seven frames. A frame is a step in a program. The length of frames or steps can vary greatly from only a few words to one which may take a page in a book.

FRAME 8 The third characteristic of a program is that the student receives immediate information as to the correctness of his response.

This immediate knowledge of results is called f_ _ _ b _ _ _.

---

feedback

This is a term borrowed from electronics. There it is used for the effect of one action altering subsequent actions.

FRAME 9 Feedback is considered essential for effective learning because it gives information on _____

_____

(Your words) correctness of responses, or progress.

In most of this booklet, the correct answers have been placed below the frame. Many programs have them to the right of the frame or to the right of the following frame.

In the next frame, the correct response has been placed to the right of the frame.

FRAME 10 The three characteristics of all programs are :

1. _____

_____

2. _____

_____

3. _____

_____

(Your words, any order)
1. logical sequence of steps.
2. active responding (but not necessarily overt).
3. immediate feedback.

No matter where the programmer thinks that the correct answers should be placed, he should be consistent throughout the entire program. In this booklet, the answers have been placed in various positions to show you some of the possibilities commonly used. It's not good programming to change in the middle of a program!

By the way, let's pause for a moment. Have you found that you have tended to glance down at the answer before you made your response? (No response necessary, but be honest!)

Most people tend to do so.

Research has given mixed results on the importance of peeking. Some say that it saves time. Others say that peeking reduces correct recall later on. Its effect on learning probably depends on when the peeking occurs. If the student thinks out his own response first, then confirms his covert response before writing, then probably nothing is lost. However, if he just copies down the correct response, then he probably does not learn too much.

There are several ways to reduce peeking One way is to "conceal" the answers haphazardly throughout the text. But this is time-consuming and annoying. Another way is to use a cover or slide which is moved down the page to uncover the answer only after the response has been made. This requires willpower! If the answers are given to the side of the frame then the cover is used to conceal the answer strip down the side of the page.

In Booklet 2, the last page has been left blank so that you may detach it and use it as a cover for the remainder of the program.

Work through the next sequence of frames and notice how peeking is reduced. The answers are given in the margin to the left of the frame which follows.

FRAME 11 To find the mean of a set of scores, first find the sum of the scores by adding all the scores together.

For this set of scores (2, 3, 5, 6, 9) the sum is _____.

(The next frame is at the top of the next page, TURN TO PAGE 5 AND CONTINUE.)

Answer to Frame 12

ΣX

FRAME 13 Now the next step in finding the mean is to count up the number of scores in the set. How many scores are there in this set?

_____

(TURN TO PAGE 6.)

Answer to Frame 15

$\frac{\Sigma X}{N}$.

FRAME 16 Now apply this formula to the data.

The mean of the scores (2, 3, 5, 6, 9) is found by dividing the number ____ by the number _____.

(TURN TO PAGE 6.)

10

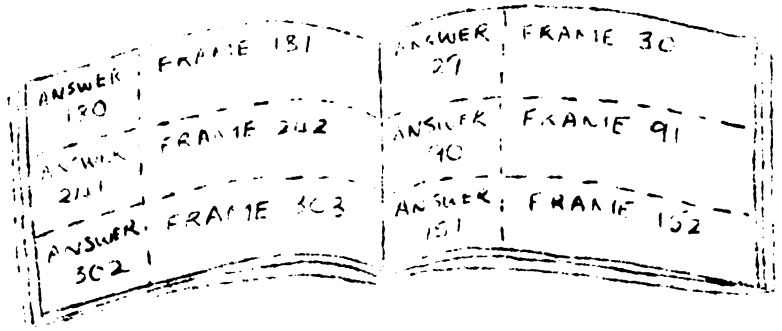
FRAME 20 Would you call the arrangement of the last nine frames (Frames 11-19) a horizontal or a vertical format?

_____

---

horizontal format (because you worked through pages horizontally rather than working vertically down each page).

When this horizontal format is used, it is used through the entire book so that a double page from a book may look like this:



Now continue through the program with Frame 21 which is just below the double line on the next page.

Answer to Frame 11 25	FRAME 12 To generalize, a statistical shorthand may be used to represent the computation you have just carried out. If the Greek letter, sigma (Σ) is used to represent "the sum of", and X is used to stand for each score, then the computation may be written in statistical shorthand as _____ (TURN BACK TO PAGE 4)
Answer to Frame 14 $5 = \Sigma$	FRAME 15 To find the mean, divide the sum of the scores by the number of scores. In statistical shorthand, this operation could be written as _____ (TURN BACK TO PAGE 4)
Answer to Frame 17 5	FRAME 18 In statistical shorthand, the mean is written as $\bar{X}$. So the equation for finding the mean is ____ = _____. (TURN TO PAGE 6)

FRAME 21 What advantage does this horizontal format have over a vertical format?

_____

(your words) more difficult to peek.

It is harder to peek but if you really wanted to do so it can still be done. In book form, the horizontal format is not quite as messy as it was here because the student works through the book reading the top frame on all the right-hand pages, then the middle frame on the right-hand pages and so on until all the pages on the right have been worked. Then he starts again at the front of the book and works through all the left-hand pages.

FRAME 22 What disadvantages does the horizontal format have?

1. _____

2. _____

Confirm your responses.

Frame 23 is just below the double line on the next page.

Answer to Frame 13 5	FRAME 14 A shorthand way of writing the number of scores in a set is to use N as the number of scores. Therefore, in your example : 5 = ___ (TURN BACK TO PAGE 5)
Answer to Frame 16 25 by 5	FRAME 17 The mean of the scores (2, 3, 5, 6, 9) is _____. (TURN BACK TO PAGE 5)
Answer to Frame 18 $\bar{X} = \frac{\Sigma X}{N}$	FRAME 19 What is the mean of the following set of scores? Scores 6,7,8,11,13,15. Mean _____. (TURN BACK TO PAGE 4 AND CONTINUE WITH FRAME 20)

FRAME 23 The format used for the first part of this program (Frames 1-10) was _____

vertical (format)

Just a thought in passing! How does the use of the Confirmation section in Booklet 2 affect peeking?

No overt response necessary but it might be worth a thought as a technique to reduce peeking. However one essential feature of programmed instruction is that feedback must be immediate to provide reinforcement. The effect of reinforcement is probably more important than any undesirable effects caused by peeking. So if a programmer eliminates peeking at the expense of immediate feedback then the efficiency of the program has suffered.

Should all answers be given in a confirmation section? Probably not as this would make it very easy to peek. Which answers should go there?

As review, turn to Page 7 of Booklet 2 and complete Tables 1 - 3.

This is probably an appropriate point to take a short break if you feel you need one.

SECTION 2 - SOME MORE TECHNIQUES AND PROGRAM TYPES

Many programmers favor putting the frames in boxes. In this way the student's attention is focussed on the contents of the box and the contents are separated from the correct answer.

The frames on this page have been written in boxes.

FRAME 24

The oboso is unusual because it does not _____.

No confirmation yet, although this is contrary to good programming.

My guess would be that, from the information in Frame 24 (and the sketch may be considered relevant from a certain angle), few of you have given the correct answer because you are not sure what an oboso is. In fact, I'm not sure either.

Try the next frame.

Frame 25

The oboso is an unusual bird because, although it has wings, it cannot _____.

I would hazard a guess that even without the sketch of the mythical oboso, most people would be able to give the correct response - fly. The sentence context "leads" you to only one logical answer, although the answer did not occur anywhere in the frames.

Programmers say you were "prompted" to make the correct response. If a prompt is to be successful, the student must have the correct answer in his vocabulary. Programmers also use another technique which maximizes the chances of students making the correct response.

Try the next four frames.

FRAME 26 Photosynthesis is the process by which green plants make carbohydrates from carbon dioxide and water in the the presence of chlorophyll and sunlight.

It is this process of _____ by which plants produce food.

photosynthesis

Easy wasn't it?

FRAME 27 One major difference between plants and animals is that plants are able to make carbohydrates (i.e. food) from raw materials by the process called photo _ _ _ _ _ _ _ _ _.

---

photo s y n t h e s i s.

FRAME 28 The reaction :

carbon dioxide + water $\xrightarrow{\text{light}}$ carbohydrate + oxygen

represents the chemical process of ph_____.

---

photosynthesis

FRAME 29 Plants produce oxygen and carbohydrates by _____.

---

photosynthesis

In the last four frames (Frames 26-29) you were "led" to make the correct response. You were not prompted because you did not arrive at the correct answer by the context of the sentence, but rather by the content. In other words, the sentence actually contained the word which was the correct response. After the first frame you were "led" by parts of the answer appearing in the frame.

Such leads are "cues".

The first frame (Frame 26) required direct copying. This technique should be avoided where possible as a correct response does not guarantee that any learning has occurred. However, in some cases such as spelling programs, or when introducing new terms in science, there may be no satisfactory alternative. You could, however, pre-test by giving the student the last frame (Frame 29) only, then modify the sequence of frames depending on whether he knew the word "photosynthesis" or not.

In the four frames on photosynthesis, the amount of cuing was progressively reduced. This is sometimes called "fading".

FRAME 30 Look back at the series of frames 2 through 8. In which were you cued by the contents of the frames themselves?

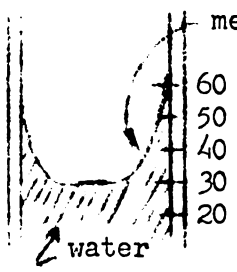
_____

Confirm.

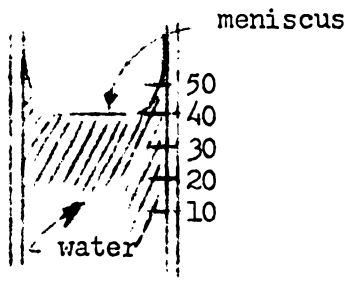
Let's look at some of the other features of programs

FRAME 31

A.



B.



These are magnified views of the surface of water in two tubes or containers.

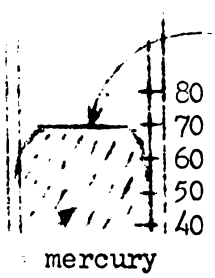
In Tube A, the reading of the level of water is 30.

What is the reading in Tube B? _____

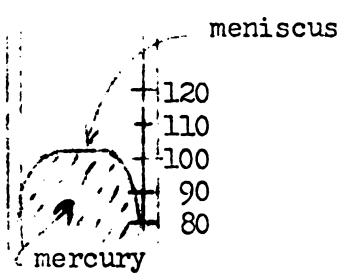
40

FRAME 32

C.



D.



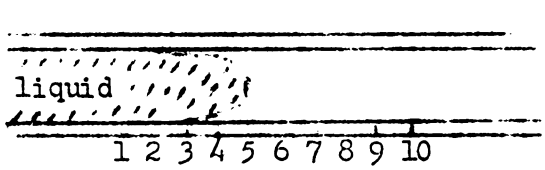
The reading of the level of mercury in Tube C is 70.

The level of mercury in Tube D is _____.

100

FRAME 33

E.



The reading of the level of liquid in Tube E is _____.

5

FRAME 34 Compare Frames 32 and 33.

1. Which one would you call a teaching frame? _____

2. Suggest a name for the other frame. _____

---

1. Frame 32.
   It may be considered to be a teaching frame because it contains sufficient information to enable the student to work out the correct response without reference to any other frame.

2. (Your words) testing, or criterion frame.
   To respond correctly the student would have to have prior knowledge of the subject matter.

Criterion frames are used to test the effectiveness of teaching. Often they are used in a program some distance from the teaching frames to which they are related. This then presents a better testing situation.

FRAME 35 How could the sequence of the series of frames on liquid levels (Frames 31-33) be improved?

_____

_____

(Your words) separate the criterion frame from the teaching frames.

FRAME 36 Suggest reasons why criterion frames are probably more effective if placed away from their teaching frames.

1. _____

2. _____

Confirm.

FRAME 37 The free surface of a liquid is called the _____.

---

meniscus

Notice that this term was not taught but there is a fair chance that the correct response will be made because it was cued by having the word "meniscus" in Frames 31 and 32.

FRAME 38 Give a rule for reading the level of any liquid in a tube or container.

(Your words) the reading is taken from the center of the meniscus.

FRAME 39 Look at this series of frames again (Frames 31 - 33 and 38).

A(n) _____ (example/rule) was presented first in the series.

---

example

FRAME 40 In the last frame of the series, you were asked to give a(n) _____ (example/rule).

---

rule

FRAME 41 This series would, therefore, be known as an EGRULE sequence.

This term was derived by programmers by combining EXAMPLE (EG) with _____.

RULE

EGRULE is one sequence used in programming a series of frames. It may be used to sequence information within a frame also. Look at the next frame.

FRAME 42 $X^2 \cdot X^3 = X^5$

$X^3 \cdot X^5 = X^8$

$X^a \cdot X^b =$ _____

X^{a+b}

This last frame may be considered to be an EGRULE frame because two examples are given first, then a rule was asked for. Perhaps mathematicians would argue that $X^a \cdot X^b$ is another example. It probably doesn't matter much. The point is that examples are used first in the frame. In other words, the student is required to generalize. In the last frame, instead of giving $X^a \cdot X^b =$ _____, the student could have been asked to express the rule in words.

Now work through the next series of frames.

FRAME 43 Changing the temperature of a substance tends to change its size (or volume). The volume tends to increase as the substance is heated but it will tend to _____ when the substance is cooled.

(Your words) decrease, or diminish, or get smaller.

FRAME 44 You probably made the correct response in Frame 43 because you were _____.

---

prompted

FRAME 45 You were prompted to make the correct response in Frame 43 by :

1. _____

2. _____

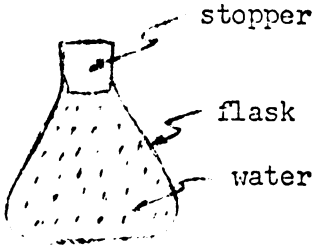
Confirm.

FRAME 46 If a balloon containing cool air, is placed in front of a source of heat, the size of the balloon will _____.

---

increase

FRAME 47



The flask was completely filled with water at room temperature.

On heating, the stoppered flask may break or the stopper may be forced out because _____ causes the water in the flask to _____.

(Your words) heating
expand

FRAME 48 Which of the following sequences best represents the order of presentation of the frames in the last series (Frames 43, 46, 47)?

1. rule then examples
2. examples then rule
3. only examples
4. only rules

---

1. (rule then examples)

FRAME 49 Suggest a name for this sequence of presenting frames in a program.

RULEG

FRAME 50 This is derived from RULE and EXAMPLE (EG). Both EGRULE and RULEG sequences have been used in this program on programmed instruction.

Which sequencing technique do you consider to be better?

---.

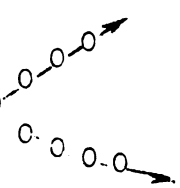
Confirm.

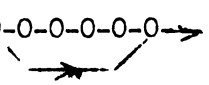
FRAME 51 So far you have all worked through all the frames in this program.

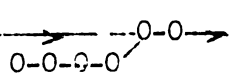
Below, a circle represents a frame (or a series of frames) and arrows represent the direction of movement from one frame (or series) to the next.

Which diagram best represents this program, so far?

A. -O-O-O-O-O→

B. 

C. 

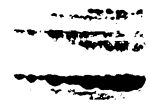
D. 

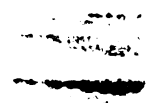
A.

FRAME 52 All the participants have worked through all the frames in the same order.

Which of the following terms best describes this type of program?

A. Branching
B. Forked
C. Complete
D. Linear





D. (linear)

All participants followed the same path or line from start to finish.

FRAME 53 A disadvantage of a linear program is that _____

_____

Confirm.

FRAME 54 Does a linear program allow for individual differences?

_____

---

yes.

Students can work at different rates so a linear program does allow for differences in reading rates and rates of learning.

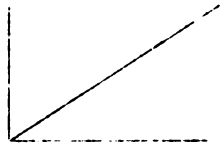
There are ways of allowing for other individual differences other than just rates.
For example, in a program to teach graphing scientific data, after a series of frames on how to actually make a graph, the following frame could be given.

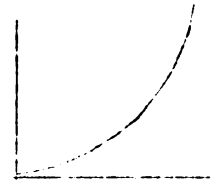
FRAME 55 (NO RESPONSE NECESSARY)

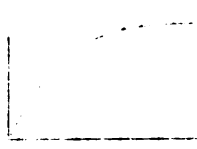
Graph the following laboratory results.

	Values			
X readings	1	2	3	4
Y readings	1	4	9	16

Which of the following graphs looks most like your graph?

A. 

C. 

B. 

D. 

E. None of the above.

_____

Turn to the page indicated for your particular response.

Response A. Turn to Page 2, Confirmation Booklet.
B. Page 2.
C. Page 3.
D. Page 3.
E. Page 3.

(Select one of the responses in Frame 55 and follow through how the programmer handles the problem. Then try another until you see the range of options available to the students who might make these responses.)

FRAME 56 What would be the effect of placing Frame 55 BEFORE the hypothetical series of frames on graphing?

_____

_____

Confirm.

FRAME 57 What would be a suitable name for a program implied by the teaching graphing sequence and Frame 55?

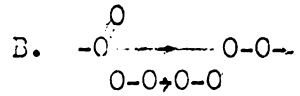
_____

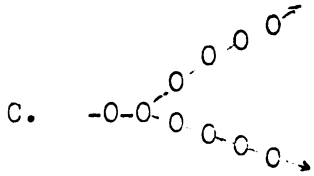
(Your word) branching

It is a branching program in which the individuals may proceed through different series of frames depending on their response to Frame 55.

FRAME 58 Which of the following diagrams best represents the implied graphing sequence?

A. -0-0-0-0-0-0→

B. 

C. 

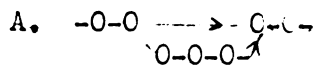
_____

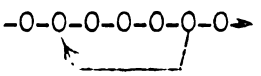
Confirm

Branching programs allow for individual differences other than just rate. However they are more difficult to write. As all students will not work through the same set of frames, care must be taken that all information considered essential to the development of all students is placed in the main stream, not in one of the branches.

FRAME 59 Remedial loops and accelerating loops can be built into a branching program to meet the needs of the students.

For remedial work, which of the following sequences do you consider to be more desirable?

A. 

B. 

(1) _____

Why? (2) _____

_____

Confirm.

FRAME 60 If you were giving a series of frames on measuring the levels of liquids (similar to Frames 31-33) suggest some improvements you would make.

_____

_____

_____

_____

(Your opinion) Here are some suggestions:
1. pretest and then provide branching.

2. separate the criterion frame. from the teaching frames.

3. use actual equipment for the criterion test.

Working through a program does not mean that you are restricted to the book, machine or computer which contains the program. Recent trends suggest that programs should be used in conjunction with texts, laboratory experiences, diagrams, charts, etc. These materials are "built into" the program only in as much as the student is referred to them for some part of the program. On completion of the "outside" assignment, the student will return to the program and continue.

Now turn to Page 8 in Booklet 2 and complete Tables 4-6.

If you need a break, this is a good time for one. You are over half way through the program.

SECTION 3 - CHARACTERISTICS OF PROGRAMS

Frames may vary greatly in length and content. For example, some are short, others long; some verbal, others may be essentially pictorial.

The programmer should aim to maximize brevity and clarity.

FRAME 61 Suggest two cases where short frames are probably superior to long frames.

1. _____

2. _____

(Your opinion) Here are some suggestions.
1. for students with low reading ability.
2. teaching factual material.
3. where a short frame is sufficient.

FRAME 62 Suggest two reasons why a programmer might prefer pictorial frames.

1. _____

2. _____

(Your opinion) Three possible reasons are:
1. save words.
2. clarity.
3. create interest by providing variety.

Generally, diagrams are placed to the left of the written material or above it unless the diagrams represent a number of possible alternatives from which the student may select a response. Then the diagrams are placed at the end of the frame. Some programmers consider that a diagram must be relevant to the subject matter in the frame.

In Frames 24 and 25, which were about the oboso bird, one could argue that the diagrams did not help in making the correct response. Should they have been included? (NO RESPONSE NECESSARY). However, in the series on reading the level of a liquid in a container, the diagrams were the key to the frame. It would be extremely difficult to write the frames without diagrams.

How does a programmer control the responses made by the student? There are two ways commonly used in programs. You have seen both of these already.

FRAME 63 Some frames were constructed so that, by cuing or prompting, you made the correct response. Which term do you think best describes that response pattern?

1. Tested response
2. Constructed response
3. Overt response
4. Objective response.

---

2. constructed response

Would it have been easier if Frame 63 had been cued by underlining "constructed"? (NO OVERT RESPONSE REQUIRED).

FRAME 64 When a number of possible alternatives were given, and you were asked to make a choice, the response pattern is called:

(Your words) multiple choice

Here, rather than cue the frame, I relied on your past experience (entering behavior) with multiple choice tests in your school.

There are two schools of thought on which type of program is the better. Skinner, who first developed constructed response type programs, and his followers believe that, by using the constructed response technique, errors are kept to a minimum so that the students only see correct answers.

Crowder and his followers believe that the multiple choice type program is superior because learning occurs even when errors are made, providing feedback is immediate. They argue that the ability to discriminate and generalize can only be learned using multiple choice type programs.

FRAME 65 Multiple choice type programs naturally include branching.

Can a constructed response type program use branching?

Confirm.

FRAME 66 The number of errors made in a constructed response type program will be _____(greater/less) than the number made in a multiple choice program.

---

less

If its a good constructed response program, the number of errors is kept low by cuing and prompting.

FRAME 67 What type of frame was Frame 66?

(Your words) multiple choice, or forced choice, or criterion.

FRAME 68 Imagine that you have tried three multiple choice and two constructed response programs with your class (or classes just like your class) and you have analysed the errors made in each program.

In the chart below, what conclusions can you make about the suitability of each program for your class?

Type	No. of errors	Conclusion(s)
multiple choice	none	
multiple choice	medium	
multiple choice	very many	
constructed response	very few	
constructed response	many	

Confirm.

FRAME 69 Now imagine that you have written several programs, tried them out with your classes, and analysed the results obtained in the program, and on a post-test after the program.

For the cases given in the chart at the top of the next page, what conclusions would you make about each program?

(MC = multiple choice

CR = constructed response)

Type	Errors in program	Post-test errors	Conclusions
MC	none	many	
MC	some	none	
CR	many	none	
CR	few	many	

Confirm.

Some writers use one type of frame only in a program. Others use both types to give a mixed program.

The trend at present is towards mixed programming when the learning situation warrants the use of a program. In this way, large pieces of subject matter may be presented in the traditional ways, but programs are used in areas where there is:

1. high factual content
2. a wide range in entering behavior
3. a chance that many errors will occur when taught by traditional methods
4. need for individual or home learning
5. need for a change in method.

This blend of the traditional teaching methods with short programs has been called adjunct autoinstruction by Pressey.

The choice of a program depends on the nature of the subject matter and the abilities and entering behaviors of the students.

FRAME 70 There are three distinct methods of presenting programmed material. These are:

1. textbook
2. mechanical machine
3. computer .

Which of these can effectively control peeking? _____

---

2 and 3

Both the computer and most mechanical machines do not reveal the correct answer until the student has made his response. Then the device makes it so that the answer can not be altered before the correct answer is uncovered.

A programmer can reduce **peeking** in a textbook program, but it is very difficult to control it completely.

FRAME 71 Complete the following chart.

Method of presentation	Advantage(s)	Disadvantage(s)
Textbook		
Machine		
Computer		

Confirm.

FRAME 72 One of the disadvantages of many programmed textbooks is that they can only be used once. In a school setting, this may be expensive. Suggest a way to make programmed texts reusable.

(Your words) prepare a "response booklet" so that responses are not made in the text.

Many programs use this device, or the classroom teacher can prepare his own.

FRAME 73 Suggest an advantage in using separate response booklets, other than making the texts reusable.

(Your opinion) completed pages can be removed from time to time to assess progress without interrupting the work of the student.

You are almost there now. Complete Tables 7 and 8 in Booklet 2.

FRAME 74 What are some of the advantages of having you complete the Tables in Booklet 2?

1. _____

2. _____

3. _____

(Your words, any order) Here are some possible gains.
1. Link together related aspects.
2. Makes a reference summary.
3. Consolidates learning by revision.

Now is a good time to have a short break if you feel like one.

SECTION 4 - ASSESSMENT OF PROGRAMS

Good programs and good teaching have the following common features:

1. specific behavioral objectives
2. logical sequence of presentation
3. student motivation
4. repetition
5. immediate feedback
6. provision for individual differences.

FRAME 75 Which two of these are most often missing in the traditional classroom situation?

1. _____

2. _____

(Your opinion) probably (5) immediate feedback and (6) provision for individual differences are the most difficult to provide.

Assessing the suitability of a program to meet specific needs requires a detailed analysis of the situation in which it is intended to use the program.

This analysis can then be compared with the characteristics of the situation for which the program was intended. If these two sets of characteristics agree then the program can be expected to be suitable.

The analysis requires three stages:

1. A definition of the specific topic to be treated by the program.

2. An analysis of the characteristics of the students who will take the program.

3. A clear statement of the goal(s) or behavioral objectives to be achieved by the program.

FRAME 76 Give two reasons why a teacher might consider it desirable to use a program for a particular topic.

1. _____

2. _____

Confirm.

FRAME 77 Which of the three stages in the "analysis" step gives the best indication of "entering behavior"?

2

There are a number of ways of completing the analysis. However, there are some advantages in having a systematic approach. One approach which has been used by program writers (and is suitable for a user's analysis) is given below.

This Analysis Report has been completed for you.

Analysis Report

Topic area Reading levels of liquids in wide containers.

Population Average 7th grade students taking a physical science block.

Behavioral analysis

Common errors:	Population should:
1. looking at an angle to the surface of the liquid.	1. look parallel to the surface of the liquid
2. reading at the point where the liquid touches the side	2. read from the middle of the free surface
3. not having the scale vertical	3. have the scale vertical
4. taking only one reading	4. take several readings, and average.

Behavioral objective

The students will be able to make accurate readings of the levels of liquids in wide containers.

Note that the behavioral objective would become the aim or objective of the program, but the comments under "Population should . ." indicate the points to which a program should be directed.

FRAME 78 Complete the following Analysis Report by selecting the best behavioral objective from the four alternatives given. The behavioral objective selected will depend on the statements made in the remainder of the report; read right through it before making your decision. Cross through the objectives you would not use.

Analysis Report

Topic area Multiplication of like terms in Algebra.

Population High school students of average ability who are taking "Introductory Algebra". They have learned how to express multiples using the index notation.

Behavioral analysis

Common errors:	Population should:
1. multiplying the indices together	1. add indices
2. adding indices of unlike terms	2. add indices of like terms only
3. $A \cdot A^5 = A^5$	3. add 1 to the indices when one term has no index given.

Behavioral objective

1. the students will be able to identify like terms.

2. 2. the students will be able to multiply $A.A^5$ correctly.

3. the students will not attempt to multiply unlike terms together.

4. the students will be able to multiply like terms with indices greater than zero.

Behavioral objective

1. is too restrictive; it represents only a small part of the total process.
2. is too specific; it is a specific case.
3. does not define what the student <u>is</u> expected to do.
4. is the best objective offered in this report.

FRAME 79 Here is another Analysis Report. This one is only partly completed. Read right through the report, then complete it by crossing through the alternatives you would not use in the Population and Common Errors sections. Write a Behavioral objective.

Analysis Report

Topic area Filling out forms to report research projects for a computer data bank.

Population a. Researchers who will fill out the forms.

researchers who will be responsible for the research project.

Behavioral analysis

Common errors:	Population should:
1. Forms are carelessly filled out	1. Complete the forms so that the information can be read easily.
Forms are illegible	
2. Not all available information is supplied	2. Complete every item for which there is information.
Spaces are left on the form	

Behavioral objective

_____

_____

_____

Confirm.

In the three Analysis Reports that have been given, after the student makes his response, he always sees a complete Report. A parallel in learning poetry would be to learn the last few lines first, then work back. There is evidence that this process, called mathetics, is effective.

Before going further, fill out the "Analysis" box in Table 9 on Page 10 of the Confirmation Booklet.

FRAME 80 What parts of an actual program would give you the best indication of the objectives of the program?

(Your words) criterion frames

Often this is the only guide that you have to the actual objectives of the program. You might be lucky enough to find a statement of the objectives of the program in supplementary information for teachers. Usually this report will include test results, etc.

Criterion frames follow directly from the behavioral objective(s), and they form the skeleton on which the programmer builds the program.

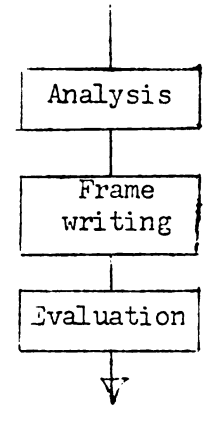
FRAME 81 Suggest a criterion frame for the objective you prepared for "researchers filling in research project reports for a computer data bank" (Frame 79).

(Your opinion) As the objective is stated in behavioral terms, the criterion frame should ask for some activity. Two suggestions are: Sort these project reports (provided for the student) into two categories; those correctly filled out, and those not. Better - Using this information (provided), fill out the report forms (provided).

The second criterion frame is preferred because it tests the capacity to actually do the task which has been taught.

There are a number of ways of preparing a program. Many writers suggest starting with the "Analysis Report" similar to the one that has been used here.

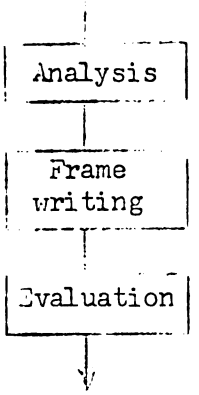
After completing the analysis, the programmer will write the frames.



FRAME 82 Which type of frame would be written first?

---

criterion frames



After writing the criterion frames, the writer completes the program by writing the teaching frames.

The completed program is usually tested extensively. These tests provide information about difficulty and sequencing. This information is then used to improve the program through a series of revisions.

The research data obtained from tests of the final form of the program should be included in the supplementary literature which should be available to users.

FRAME 83 What information about the program do you consider should be included as a supplement to the program?

_____

_____

_____

_____

Confirm.

FRAME 84 At the top of this page and on the previous page, there has been an outline "model" of the sequence followed by many programmers. This technique could be extended to include more pages, or different models.

Suggest how this technique assists learning.

_____

_____

(Your opinion) reinforces learning, or, links related steps together.

In this Workshop, a number of the techniques used in programs and the characteristics of the more common types of programs have been given to you.

As revision, complete the final frame on the next page.

FRAME 85 Match each term with the phrase which best describes it. Place the letter of the phrase in front of the term's number.

___	1. branching program	A.	is one which is made but not recorded.
___	2. covert response	B.	guides the student to the correct response by the structure of the sentence.
___	3. cue	C.	provides for individual differences other than reading rate
___	4. diagram	D.	makes a correct response most likely by including part of the response in the frame itself.
___	5. linear program	E.	is used above or to the left of the text of the frame to explain it
___	6. prompt	F.	makes all students move through all frames

C - 1; A - 2; D - 3; E - 4; F - 5; B - 6.

Computers, teaching machines and programmed textbooks are just media for presenting a program. All three have their advantages and disadvantages. However, no matter which medium is used, the techniques used in the programs are essentially the same.

Also, the preparation of a program for presentation by any one of these media is basically the same. The programmer will go through the steps outlined here, or through some similar routine. The techniques used in the program itself will be similar to those presented and used in this program.

Generally the expected responses are clear-cut, but as in this program some responses depend on opinions. The fact that no clear--cut answer can be given does not mean that programming techniques cannot be used.

It has been said that there are probably no restrictions on what can be programmed other than the skill of the programmer.

Return this booklet and Booklet 2 to your supervisor, and ask him about the next stage.

(see over)

If you would like this reference list, please detach.

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Registration No. ____ P

Name _____

BOOKLET 2

CONFIRMATION OF RESPONSES AND REVIEW TABLES

This booklet is designed to supplement Booklet 1. It provides a summary and an opportunity to "leave" the booklet on programming.

The last page of this booklet has been left blank, and can be detached as indicated in Booklet 1.

All responses will be treated as confidential.

CONFIRMATION

FRAME 1 You were asked which set of statements better describes the behavioral objectives of this Workshop. To be behavioral, the objectives must state a definite performance to be attained. They lead to the direct measurement of achievement, whereas non-behavioral objectives, such as Set A, do not permit direct measurement.

Set B is a set of behavioral objectives based on the introductory paragraph.

(RETURN TO FRAME 2)

FRAME 22 (Your opinion) Here are a few thoughts:

1. Time consuming.
2. Frustrating because of the continual page turning.
3. A little more difficult to organize for printing.

(RETURN TO FRAME 23)

FRAME 30 By the actual content of each frame, you were cued in:

Frame 2. The word "step" was underlined.
Frame 3. The first letter of the correct response was underlined.
Frame 4. Underlining "overt" could probably be considered as a cue; "overt" itself is not a cue.
Frame 8 Giving the first and fifth letter, and the number of letters required is a form of cuing.

(You were prompted by the context or sentence structure in:

Frame 4. "But" implies an opposite.
Frame 5. "But" again.)

FRAME 36 (Your words, any order) Some possible responses are:

1. Better test of recall because of the intervening time lapse between the teaching frames and the testing situation.
2. A student is less likely to refer back to the teaching frames.

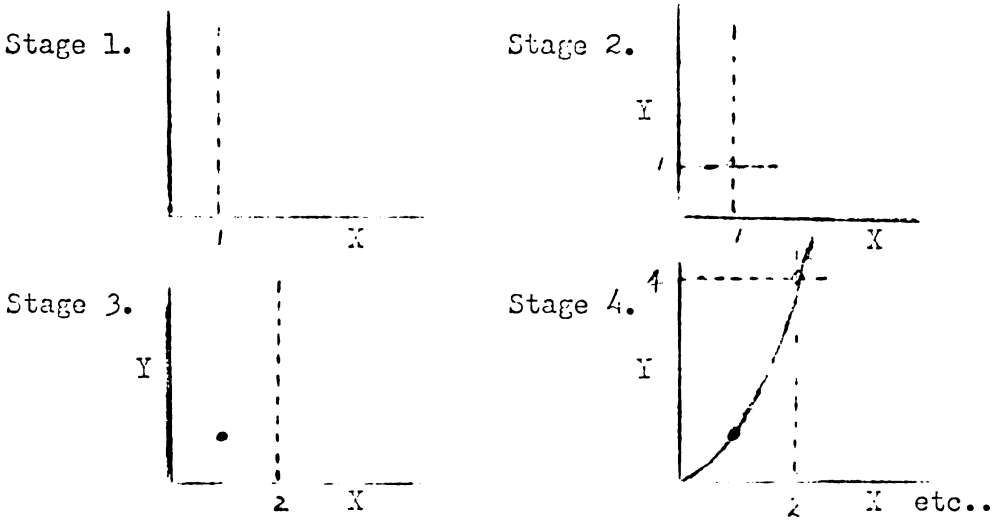
FRAME 45 (Your words, any order)

1. "Increase"
2. "But"

FRAME 50 EGRULE seems to be favored by most programmers. Theory of learning experts are divided. Probably both methods should be used depending on the material to be programmed, the entering behavior of the students, and whether a change of presentation would lead to increased interest.

FRAME 53 (Your words) All students work through the same sequence of steps, irrespective of prior learning or learning processes.

FRAME 55 Response A You did not plot the points correctly. The
Response B stages in the drawing should be:



The correct response was C. Now plot the following points

Values

X readings	1	2	3	4	5
Y readings	2	3	4	5	6

(DO NOT DO THIS. A series of frames on graphing would follow. If the student performed successfully, he would be referred back to the main program. If not successful, then a second series of remedial frames could be used.)

(TURN BACK TO FRAME 55 AND CONTINUE.)

FRAME 55 Response B Your graph is not correct if you plotted X-values along the X-axis, and Y-values along the Y-axis.

Check back to Frame 55 to see whether you mixed up the axes.

However, your graph would be acceptable if you had named the axes on the graph to suit your method of plotting.

The correct response was C.

(TURN BACK TO FRAME 55 AND CONTINUE.)

FRAME 55 Response C You were correct. Although the values were whole numbers, the procedure would be the same for any set of values. Good work.

(TURN BACK TO FRAME 55 AND CONTINUE.)

FRAME 55 Response D Your response is not correct. Although you may have plotted the points correctly, you forgot to draw a smooth curve touching as many points as possible. Check back to Frame 55 to see which graph you would get if you had drawn a smooth curve. Select another response after you have smoothed out your curve.

(TURN BACK TO FRAME 55 AND CONTINUE.)

FRAME 55 Response E You are not correct. Return to Frame 55, and check through your working. If you end up with the same graph as before, ask your teacher for assistance.

(TURN BACK TO FRAME 55 AND CONTINUE.)

FRAME 56 (Your words) Placing Frame 55 before the sequence on graphing would mean that it would act as a pretest.

Once you do this, the linear type of program is not the best.

FRAME 58 A represents a linear program; C represents a sequence of frames not normally considered in the programming of a specific topic as students should come together at the end to achieve common behavioral objectives.

Response B is correct. This is a branched program.

FRAME 59 (1) Response A. Psychologists probably favor this one because:
(2) (Your words) As the student moves through the loop in sequence A, he is :
(a) still moving "forward" in the program,
(b) working through a new set of frames. After all, he has failed the original set once, so why force him to work through them again.

FRAME 65 Yes. The instruction can be given that if a frame is answered correctly, then the student should jump to a frame farther on in the program. The other alternative is that if the student is incorrect, he should work through a remedial set of frames elsewhere in the program or in another program.

Thus while constructed response frames are typical of a linear program, some branching may occur within the program.

FRAME 68 (Your words)

Type	No. of errors	Inference
MC	none	too easy, or students already knew the material, etc.
MC	medium	suitable
MC	very many	too hard, or poorly written, etc.
CR	very few	suitable
CR	many	too hard, or poorly written, etc.

FRAME 69 (Your words)

Type	Errors in program	Post-test errors	Conclusions
MC	none	many	program too easy, or unrelated to post-test.
MC	medium	none	good program
CR	many	none	poorly written and probably knew the material in any case
CR	few	many	Start again. If the post-test was a good one the programm does not teach what you thought it would.

FRAME 71 (Your words)

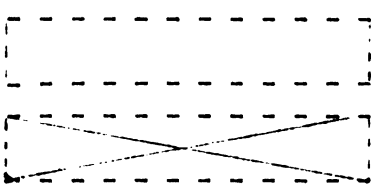
Method	Advantage(s)	Disadvantage(s)
Textbook	1. available to all 2. portable 3. relatively inexpensive 4. some flexibility	1. possible to peek 2. less motivating 3. may be consumable
Machine	1. peeking eliminated	1. not available to all students 2. not very portable 3. subject to mechanical failure 4. reasonably inflexible
Computer	1. peeking eliminated 2. may be very flexible i immediate feedback 4. initially motivating	1. not available to all students 2. expensive

FRAME 76 (Your opinion) Here are some suggestions:

1. Inadequate textbook
2. Wide range of entering behaviors
3. Wide range of learning rates
4. Wide variety of errors made by students on traditional methods
5. Wide range of interests

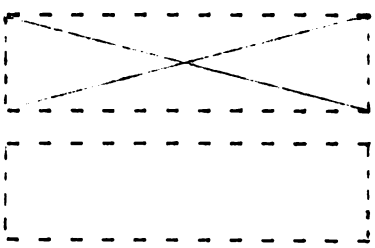
etc.

FRAME 79 Population

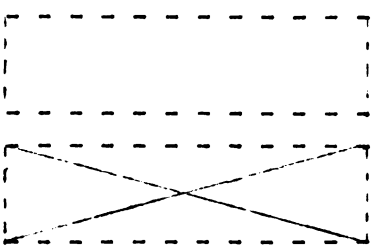
a. 

In this analysis, we are concerned with the filling out of the forms.

Common errors

1. 

We are concerned with legibility.

2. 

If no information is available, then it may be necessary to leave an item blank.

Behavioral objective (Your words) The objective should indicate some activity.

Here is one:

Researchers responsible for filling out the project report forms, will be able to complete them legibly to the extent of the information available.

FRAME 83 (your opinion) Here are some suggestions:

1. Purpose or objectives
2. Assumed entering behavior
3. Brief description of the program including supplementary equipment required
4. Sample post-test
5. Error rates on program and post-test
6. Working time

SECTION 1 (follows Frame 23)

TABLE 1 Characteristics of Programs

1. _____

2. _____

3. _____

(Frames 2, 3, 8-10)

TABLE 2 Printed Formats

Type	Advantage(s)	Disadvantage(s)
Horizontal		

(Frames 11-23)

TABLE 3 Types of Responses

Type	Definition	Advantage(s)	Disadvantage(s)

(Frames 4-7)

TURN TO FRAME 24, BOOKLET 1 AND CONTINUE.

SECTION 2 (follows Frame 60)

TABLE 4 Types of "Leads"

Example	Type
The capital of France is P_ _ _ _	
All men are mortals but not all mortals are _____.	
An apple is a _____ (pome/achene)	

(Frames 24-29)

TABLE 5 Types of Frames

Example	Type	Characteristics
$X^5 \cdot X^6 = ?$	C_____	
$X^2 \cdot X^3 = X^5$ $X^1 \cdot X^2 = X^3$ $X^5 \cdot X^6 = ?$	T_____	

(Frames 34-35)

TABLE 6 Types of Programs

Type	Sketch	Advantage(s)	Disadvantage(s)

(Frames 51-59)

TURN TO SECTION 3, PAGE 17 IN BOOKLET 1.

SECTION 3 (follows Frame 73)

TABLE 7 Generalizations about Programs

Name of program type	Suggested by	Length of frames	Error rate in program	Post-test error rate
Constructed response				
	Pressey		variable	

(Frames 61, 63-69)

TABLE 8 Methods of Program Presentation

Rate each method on each criterion using :

H - high
M - medium
L - low

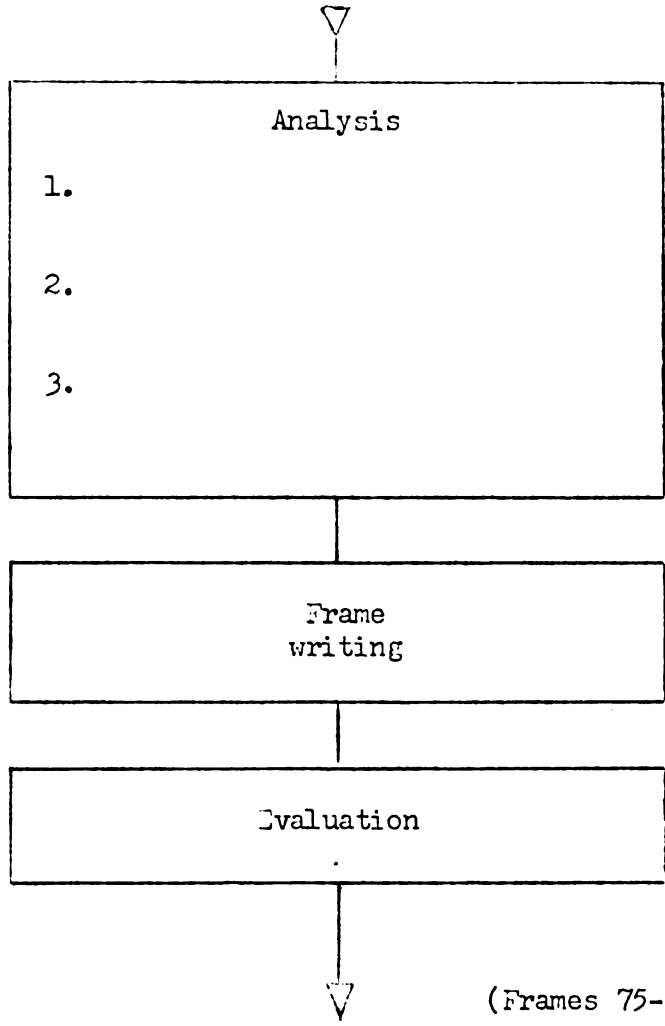
	Textbook	Machine	Computer
Flexibility in program			
Expense			
Control of peeking			
Portability			

(Frames 70-72)

TURN TO FRAME 74 IN BOOKLET 1 AND CONTINUE.

SECTION 4 (follows Frame 79)

TABLE 9 Model for Program Writing



TURN TO FRAME 80

Registration No._____ S

Name _____

BOOKLET 3

SIMULATED PROGRAM WRITING AND EVALUATION

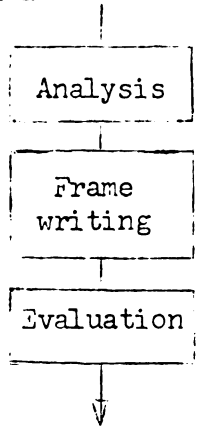
This booklet provides simulated program writing experiences, and several evaluation procedures within this Workshop on Programmed Instruction.

This booklet should be used in conjunction with Booklet 4.

All responses will be treated as confidential.

WRITING A PROGRAM

In the first part of this Workshop, programs were looked at from a user's point of view. This part considers programs from a writer's standpoint.



The approach to program writing which has been suggested consists of three parts:

1. Analysis
2. Frame writing
3. Evaluation

Each one of these can be broken down into a number of stages.

FRAME 1 "Analysis" may be divided into three stages. These, in order, are:

1. _____

2. _____

3. _____

(Your words) 1. Definition of a specific topic.
2. Characteristics of the students.
3. Statement of behavioral objective.

The "Frame writing" part can be divided into two stages. Most writers consider that the criterion frames should be written first to provide the skeleton.

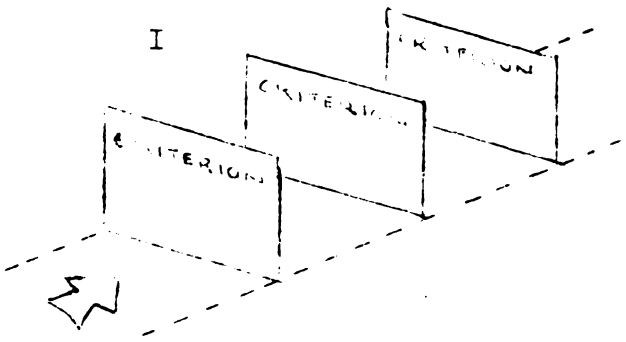
FRAME 2 Criterion frames follow logically from the _____

_____.

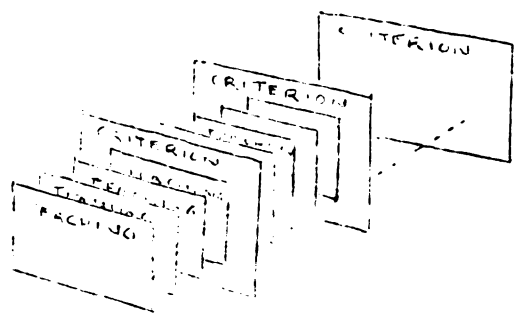
Behavioral objectives

Then the teaching frames are written to lead up to the criterion frames.

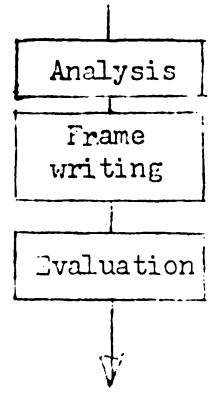
I



II



It is at the writing stage that the various techniques mentioned in the earlier part of this Workshop are incorporated.



Just as in good classroom teaching, a program should be evaluated a number of times, and revisions made to improve the program.

One sequence of testing is:

1. Individual testing using persons considered to be typical of the population who will eventually use the program. This is repeated a number of times, and three methods are commonly used.

   a. "Face-to-face interview" in which the student is asked to work through the program in the presence of the programmer. The student is asked to verbalize his "feelings" as well as record his responses.

      However the programmer must be extremely careful not to bias the student by his questioning techniques, facial expressions, etc.

   b. "No-feedback mail" technique in which the program (without correct answers) is sent out to persons typical of the population. The student is asked to respond to the frames, and write in comments on the frames as he works through the program.

   c. "Feedback mail" technique in which the program (with correct answers) is sent out to persons typical of the population. As for the "no-feedback mail" method, the student is asked to respond to the frames, and to add comments.

Of course, it is not necessary to use all three of these evaluation methods on any one program. Each method has its own strengths and weaknesses. The choice depends on the programmer, but often two methods may be used at the same time.

FRAME 3 Of the three methods of individual testing, which would you consider to be:

a. the most time consuming? _____

b. the most likely to be biassed by peeking? _____

---

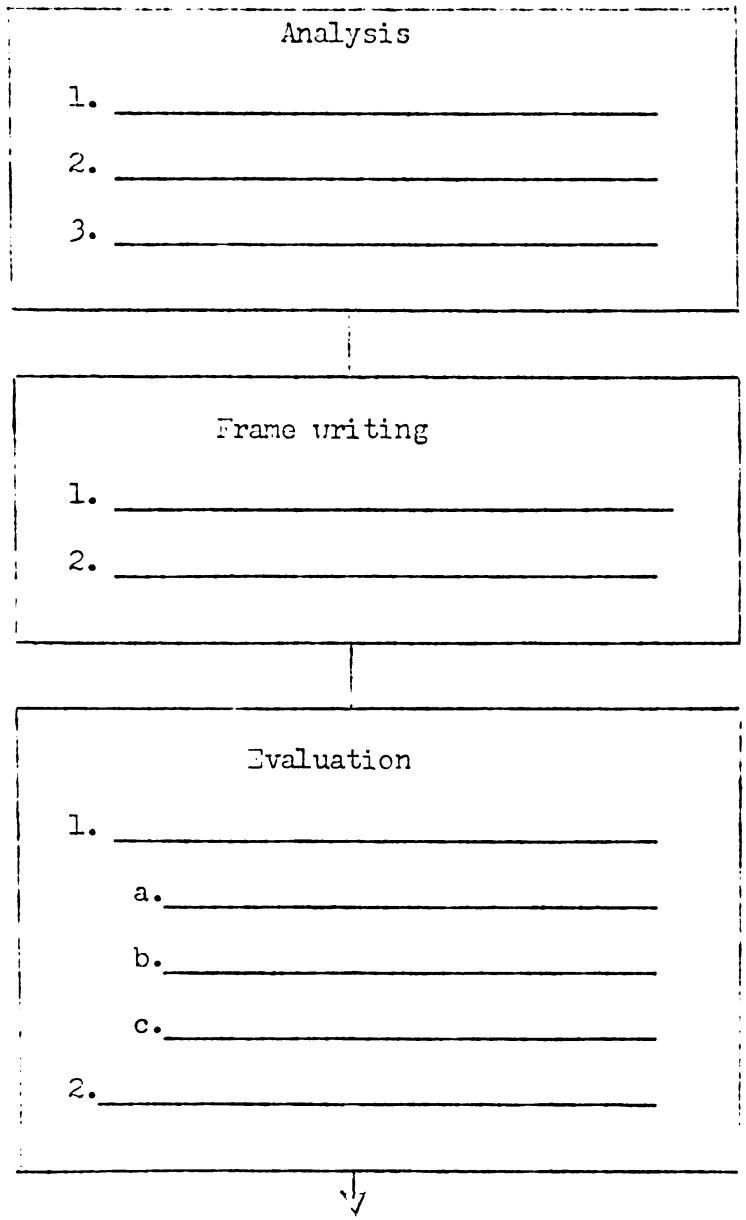
a. Face-to-face is very time consuming as results can be obtained from only one person at a time.
b. "Feedback mail" because there is no control on peeking.

Information received from individual testing is used as a basis for revision of the program until the programmer is satisfied that the program is doing what it was intended to do.

2. Field testing in which the program, in its final form, is given to larger groups of students.

   From the results of the field testing, the programmer should compile characteristics of the program. These characteristics should be available to persons, such as teachers, who wish to use the program in their classes.

FRAME 4 Complete the following model for writing a program.



Analysis 1. Definition of topic
2. Characteristics of students.
3. Statement of behavioral objectives.

Frame writing 1. Criterion frames.
2. Teaching frames.

Evaluation 1. Individual
a. "Face-to-face.
b. "No-feedback mail".
c. "Feedback mail"
2. Field testing.

SIMULATED PROGRAM WRITING AND EVALUATION

In this part of the Workshop, you will have an opportunity to write two short programs, and to evaluate them using the three methods suggested for individual testing.

This will involve "simulation". By simulation, we mean that the essential elements of the task are reconstructed and used in a situation other than the "real thing". Simulation techniques are often used to reduce time, or expense, or danger. In our case, we are concerned with saving time but, at the same time, giving you the experience necessary to do the "real thing".

As is often the case in simulation, you will be required to assume certain roles. In this workshop, there are two roles which you will assume from time to time.

1. Role of the programmer
2. Role of the "typical student".

In the role of the student, you will be expected to perform as a student, typical of the population for whom the program has been written.

Booklet 4 is a workbook for this part of the Workshop, and it should be used in conjunction with this one.

Instructions for preparing the programs and their evaluation are on the pages which follow.

WRITING EXPERIENCE I - "FACE-TO-FACE INTERVIEW". (about 30 minutes)

In this, you are required to write a program for more able Junior High School physics students to teach them how to recognize the resistance of a resistor.

Work through the following steps.

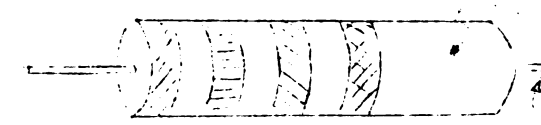
1. Read through the information given about resistors.

Background information Some of your more able students in a science club wish to make their own simple wireless circuits using non-wire wound resistors. However, they are not able to identify the resistances of the resistors in the spare parts boxes.

You wish to write a short sequence of frames which will enable them to identify resistances using the standard color-coding of the resistors.

The following information about color-coding is taken from a book of Chemical and Physical Tables.

Standard color-coding uses four colored bands painted around the resistor.



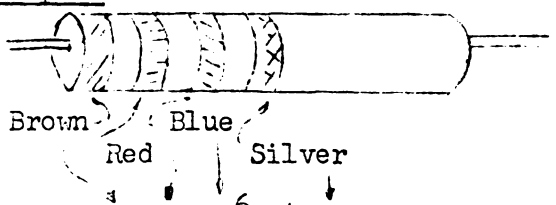
Band # 1 2 3 4

Band #1 indicates the "first significant figure of the resistance".
Band #2 indicates the "second significant figure of the resistance".
Band #3 indicates the "multiplier".
Band #4 indicates the "tolerance".

The colors used are:

Figures (Bands 1 & 2)		Multiplier (Band 3)		Tolerance (Band 4	
Black	0	Black	x 1	Silver	± 10%
Brown	1	Brown	x10	Gold	± 5%
Red	2	Red	$x10^2$		
Orange	3	Orange	$x10^3$		
Yellow	4	Yellow	$x10^4$		
Green	5	Green	$x10^5$		
Blue	6	Blue	$x10^6$		
Purple	7				
Gray	8	Silver	x.01		
White	9	Gold	x.1		

For example:



Resistance = 1 2 x10^6 ± 10%
= 12000000 ± 10% ohms.

Or

	1	2	3	4	
Resistor #1	Gray	Blue	Silver	Gold	0.86 ± 5%
Resistor #2	Yellow	White	Orange	Silver	49000 ± 10%

2. Read through, and complete the following Analysis Report.

Analysis Report

Topic area — The resistance of non-wire wound resistors.

Population — More able Junior High School physics students interested in learning color-coding of non-wire wound resistors. They are familiar with index notation (i.e. powers of ten), the concept of tolerance, resistance and resistors. The students have access to the color-code chart (given on the previous page)

Behavioral analysis

Common errors:

1. students read bands starting from the wrong end of the resistor.
2. in the sequence in which the bands are "read".

Population should:

Behavioral objective

3. Write a criterion frame on the basis of the information in the Analysis Report and the Background Information.

   Criterion Frame

4. Prepare a series of frames which "lead" to the criterion frame. This should be a short series of less than 8 frames. The last part of Booklet 4 contains blank pages which may be used.

Write out your complete series on the sheets provided in Booklet 4. The first page of your program should be Page 1 in Booklet 4.

EVALUATION 1 -"FACE-TO-FACE INTERVIEW" (about 30 minutes)

To evaluate your program by the "face-to face interview" method, work through the following steps, assuming whichever role is required.

1. Pair up with another person who has a completed program.

2. As a team, decide which of the programs will be evaluated first. (Both will be evaluated eventually.) The writer of the program to be evaluated assumes the role of "programmer". The other member of the team assumes the role of a "typical student".

3. Conduct an interview in which the program is discussed.

   During the interview, play the role you have adopted.

   As a programmer:

   Conduct the interview with your "student".

   Introduce the "student" to the program, and ask him to work through the frames responding either orally or by writing down his responses. Ask for any comments he may have about relevance, difficulty, etc.

   Be careful not to bias the "student's" responses and comments.

   When the "student" has completed the program, fill in the "Programmer's Evaluation Form" on Page 9 of this booklet.

   As a "typical student":

   You are to assist the programmer in evaluating his program. He has selected you because you are typical of the students who will use his program.

   Act like a student! Respond to his program, and make comments about the frames as they would appear to a typical student.

When you have completed his program, complete the "Student's Evaluation Form" on Page 10 of this booklet.

4. Compare evaluations. When you have finished, the programmer should have his program and two evaluation forms; one written by the "student" and his own.

5. Change roles and evaluate the other program by working through Steps 3 and 4 again. This time the programmer in the last interview situation will be the "typical student", and the writer of the second program will conduct the interview.

At the conclusion of this writing and evaluation session, each programmer will have his own program and two evaluations of it.

The second writing experience starts on Page 11 of this booklet.

PROGRAMMER'S EVALUATION FORM FOR THE "FACE-TO-FACE INTERVIEW"

As a result of the "Face-to-face interview", check the appropriate boxes below. (Ignore your feelings about your program from before the interview situation.)

1. Were the frames written in terms appropriate for "more able" Junior High School students?

   ☐ yes ☐ no

2. Did any frames contain unnecessary words or diagrams?

   ☐ yes ☐ no

   If "yes", which frames? _____

3. What was the "student's" error rate (approximately)?

   ☐ 0% ☐ 10% ☐ 20% ☐ 30% ☐ more than 30%

4. Do you feel that this series of frames would lead to the achievement of the behavioral objective?

   ☐ yes ☐ no

5. Was your criterion frame stated in behavioral terms?

   ☐ yes ☐ no

6. Do you feel that you biassed the "student's" responses or comments?

   ☐ yes ☐ no

   If "yes", in what way? _____

   _____

   _____

7. What changes would you make to your program as a result of the interview?

   _____

   _____

   _____

   _____

STUDENT'S EVALUATION FORM FOR "FACE-TO-FACE INTERVIEW"

Check the appropriate boxes for the program you have just worked.

1. Were the frames written in terms appropriate for "more able" Junior High School students?

   ☐ yes ☐ no

2. Did any frames contain unnecessary words or diagrams?

   ☐ yes ☐ no

   If "yes", which frames? _____

3. What was your approximate error rate?

   ☐ 0% ☐ 10% ☐ 20% ☐ 30% ☐ 40% or more

4. Do you feel that this series of frames could teach color-coding of non-wire wound resistors?

   ☐ yes ☐ no

5. Did the frames form a logical sequence?

   ☐ yes ☐ no

6. Do you feel that the programmer biassed your responses or comments?

   ☐ yes ☐ no

   If "yes", in what way? _____

   _____

   _____

7. What suggestions for improvement can you make to help the programmer?

   _____

   _____

   _____

   _____

(After you have compared your evaluation with the one made by the programmer, give this evaluation sheet to him. It may help him.)

WRITING EXPERIENCE IIA (about 30 minutes)

In this section, you will write a program and have it evaluated by both the "no-feedback mail" and the "feedback mail" methods.

To simulate mailing, the programs will be placed in "mailing piles" indicated by the supervisor. Each program will then be collected by another member of the Workshop who will work through it without contacting the programmer. If possible, programmer and "student" should not know the identity of the other. Therefore, it is essential that your registration number should be placed at the top of the program. Then this will approximate the conditions when a publisher mails programs throughout the United States.

After being worked, your program will be "mailed back" to the worked pile indicated by the supervisor.

As a programmer, work through the following steps:

1. From the following list of topics, select one for which you will write a short program.

   a. Structure of the atom.
   b. Acids and bases give salts and water.
   c. Color changes of indicators in acid/base.
   d. Geological faults.
   e. Factors preventing soil erosion.
   f. Determination of the sequence of sedimentation from fossils.
   g. Conservation of energy.
   h. Concept of momentum.
   i. Relationship between current, resistance, and voltage.
   j. Balance between gravity and forward velocity to produce a circular orbit of a space vehicle.
   k. Stages in the germination of a seed.
   l. Parts of a flower, and their functions.
   m. Life cycle of the mosquito.
   n. Simplified circulation of blood in a mammal.
   o. Structure of a typical insect.
   p. (Your choice)

2. Select one specific aspect of the topic you have selected. The program you are about to write should have not more than about 8 frames. Be specific as there is a time limit on this part of the Workshop.

3. After you have selected a specific aspect of the topic, complete the Analysis Report on the following page.

   Make any reasonable assumptions about the students who will use your program. Define these clearly as these will affect the writing of the program; and the "student" who will evaluate your program will need to know what these assumptions are.

Analysis Report IIA

Topic area (select one small aspect of the total topic area.)

Population (make any reasonable assumptions, but define them clearly.)

Behavioral analysis

Common errors:

Population should:

Behavioral objective

4. Write a criterion frame for your program.

5. Decide whether you will evaluate your program using the "feedback mail" method or the "no-feedback mail" **method.** If you are evaluating by the "feedback mail" method, then your program must have the correct answers to the frames somewhere in the program.

6. Write out your program on pages from Booklet 4. Leave a large margin so that the "student" can add comments about the frames.

7. Complete Page 16 at the back of this booklet and use it as a cover page for your program. It will provide the "student" with enough information to adopt an appropriate role.

8. Staple your pages together and then place them in the place indicated by the supervisor. That is, if you have written a program to be evaluated by the "no-feedback mail" method (i.e. without correct answers written in), place it in the "no-feedback evaluation" pile.

9. Take a program, other than your own, from the programs in one of the evaluation piles.

EVALUATION IIA (about 15 minutes)

As a "student", work through the following steps:

1. Work through the program you have just collected from one of the evaluation piles. Make the necessary responses, and add any comments you consider appropriate.

2. When completed, return the program to the place indicated by the supervisor for worked programs.

3. Collect your own worked program from the worked programs pile.

As a programmer:

1. From the comments, and the responses made by the "student", evaluate your program.

WRITING EXPERIENCE IIB (about 15 minutes)

As a programmer;

1. Incorporate any improvements you consider desirable as a result of the comments and responses you received in Evaluation IIA.

2. Rewrite the program you used for Evaluation IIA using pages from Booklet 4. This time, write it so that it will be evaluated by the other "mail" method. For example, if your program was evaluated by the "feedback mail" method last time, write it now so that it will be evaluated by the "no-feedback mail" method.

   Your program will need a cover page giving your registration number, and assumptions about the population so that the "student" can evaluate it meaningfully. The cover page you used last time may do.

3. Staple the pages together, and place them in the appropriate pile as indicated by the supervisor.

4. Take a program, other than your own or the one you worked through last time. Make sure the program has been written to be evaluated by the alternative method to the one you used last time. (In this way, you will be the "student" for a program written for "feedback mail" evaluation and for a program written for "no-feedback mail" evaluation.)

EVALUATION IIB (about 15 minutes)

As a"student", work through the following steps:

1. Work through the program making responses and adding comments where appropriate.

2. When completed, return the worked program to the worked programs pile.

3. Collect your own worked program from the worked program pile.

As a programmer:

1. Read through your worked program, and evaluate it.

FRAME 5 Which evaluation method do you consider to be the most useful?

_____

Why? _____

_____

_____

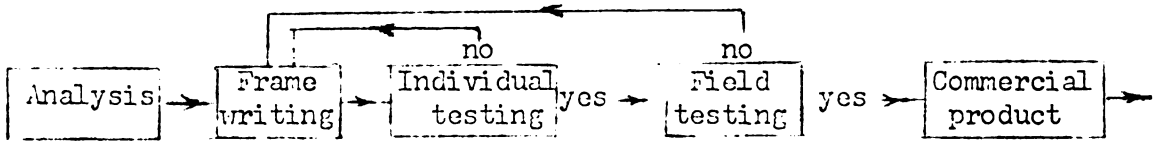
(Your opinion) The "Face-to-face interview" method depends on good rapport; under ideal conditions a programmer can get very useful information by this method; easily biassed.

The "feedback mail" method can be used for large samples so that the analysis of results is probably more likely to give results similar to those of the population who will use the program; may be biassed by peeking; some may not return the programs so that another bias may have to be considered.

The "no-feedback mail" method is not likely to be biassed by peeking, but students may feel disappointed as there is no confirmation of results.

Now you have used three methods to evaluate your programs. As a result of evaluations similar to these, the programmer would revise and retest his program until he was satisfied that it was, in fact, doing what it was intended to do.

After this, the program would be "field tested" using a large representative sample of the population working through the complete, final form of the program.



Analysis of results from the field test would supply useful information for the teacher who was considering using the program with his class. This information should be available in printed form.

DISCUSSION QUESTIONS

1. Are there any aspects of learning which cannot be programmed?

2. What devices (or techniques) can be used to prevent a student from becoming bored by a program?

3. Should all three evaluation methods, indicated in this Workshop, be used for the individual evaluation phase of program writing?

4. What are the strengths and weaknesses of this Workshop on Programmed Instruction?

Registration No. _____

COVER PAGE FOR THE "MAIL EVALUATION" PROGRAMS.

(The programmer should complete the following, so that the "student" may adopt a role appropriate for the program.)

Method of evaluation (Check one)

"FEEDBACK MAIL" ☐
"NO-FEEDBACK MAIL" ☐

Topic area (Rewrite the topic area you have selected to program. Do not write in your behavioral objective.)

Population (Define grade level, abilities, specific skills, etc., which you assume your students possess.)

Registration No. _____ S

Name _____

BOOKLET 4

WORKBOOK FOR SIMULATED PROGRAM

WRITING AND EVALUATION

This booklet provides materials needed to prepare and evaluate programs as directed in Booklet 3.

All responses will be treated as confidential.

Registration No._____

COVER PAGE FOR THE FACE-TO-FACE INTERVIEW PROGRAM

Population

You are a more able Junior High School student interested in making wireless circuits as an activity in the science club.

You are familiar with the index notation, the concept of tolerance, resistor, and resistance.

During your club activities, you have access to the following chart on color-coding of resistors.

Figures (Bands 1 & 2)		Multiplier (Band 3)		Tolerance (Band 4)	
Black	0	Black	x 1	Silver	± 10%
Brown	1	Brown	x10	Gold	± 5%
Red	2	Red	$x10^2$		
Orange	3	Orange	$x10^3$		
Yellow	4	Yellow	$x10^4$		
Green	5	Green	$x10^5$		
Blue	6	Blue	$x10^6$		
Purple	7				
Gray	8	Silver	x.01		
White	9	Gold	x.1		

PROGRAM

SUPERVISOR'S MANUAL

WORKSHOP ON PROGRAMMED INSTRUCTION

Sections marked with an asterisk (*) have been added as a result of three trials in which this Workshop was evaluated.

INTRODUCTION

This Supervisor's Manual has been developed to assist supervisors in conducting the Workshop on Programmed Instruction.

The Workshop has been divided into two parts, each of which requires approximately three hours to complete.

The first part uses self-instructional materials to give an overview of the features of programs. It is designed for potential users of programs

The second part, when used after the first, is for potential writers of programs as it gives participants an opportunity to write and evaluate frames.

In its development, the following constraints were applied.

1. It should be of one working day, or two half days duration.
2. It should be as independent of expert supervision as possible
3. The equipment used should be as unsophisticated as possible.
4. The materials and procedures should be equally useful for small groups or large groups.
5. At the completion of the workshop, participants should be able to take away any materials used.

This Manual outlines the requirements for a workshop, the role of the supervisor, time requiremnts, and field test results.

TABLE OF CONTENTS

PART I : "PROGRAM" SECTION

General Description — This part of the Workshop is for potential users of programs, but at the same time it presents examples of frames and programs for those who wish to write programs.

Participants use self-instructional materials contained in Booklets 1 and 2. Both booklets are used simultaneously. Booklet 1 presents factual material about programs, whereas Booklet 2 is used for the confirmation of those frames which require longer answers, or where some discussion of the confirmation is required, and it contains review tables to be completed by the participant. This second booklet illustrates how a student may be referred out of the main program.

Behavioral Objectives — The following are the objectives for which the "Program" section of the Workshop was designed.

At the completion of the workshop, participants will :

1. be able to identify techniques used in programs and the ratuonales underlying their use, and the characteristics of programs.

2. be able to evaluate single frames, a program sequence, and programs from exerpts from test findings.

3. have a more favorable attitude towards programmed instruction.

Requirements — Each participant will require copies of Booklets 1 and 2, and a pen or pencil.

* Writing tables should be available rather than tablet chairs.

It is suggested that the supervisor make available commercial programs of different types. Although these do not form an integral part of the workshop, they may be used by participants as examples to illustrate features mentioned in Booklet 1.

Presentation — The supervisor should briefly introduce the workshop by indicating that :

1. this part of the workshop gives participants background information about the types of programs commonly used. This information is presented as self-instructional material.

2. the second part of the workshop gives tha participants an opportunity to apply this information in several frame writing exercises. The series of frames are also evaluated.

3. "Rest pauses" have been written into the program but participants should feel free to rest at any stage.

4. If commercial programs are available, an announcement to this effect should be made.

5. The supervisor should be available to assist with individual questions.

Each participant should be given Booklets 1 and 2.

* Time Requirement — The average working time for this part is two hours and ten minutes, and the range is from one hour and thirty minutes to three hours and five minutes.

* Results of Field Testing — As a result of individual testing, small group testing, and three workshops involving a total of sixty-three participants, the following conclusions can be drawn :

1. significant gains occur in knowledge of techniques and the rationales underlying their use, and the characteristics of programs.

2. there is conflicting evidence as to the change produced in the ability to evaluate.

3. there is no significant change in the attitudes of the participants over the three hour session.

* Some suggestions — As Booklets 1 and 2 require concentrated effort, it may be advisable to use Part I and Part II on separate days, or Part I could be worked independently by the participant before coming to the workshop. Then only Part II would be presented in the workshop situation.

Answers to the Tables in Booklet 2 — Some answers are based on opinion, and some are generalizations. The answers, with response percentages obtained in the field test workshops, are given on Page II-4.

* The first percentage after each answer is the percentage answering correctly. The percentage in parenthesis is the percentage of the total who answered incorrectly.

Percentage omitting the item = 100 - (R + W)

where R is the prrcentage correct
W is the percentage incorrect.

SECTION 1 (follows Frame 23)

TABLE 1 Characteristics of Programs

1. Logical sequence of steps 91 (0)
2. Active responses 88 (2)
3. Immediate feedback 91 (0)

(Frames 2, 3, 8-10)

TABLE 2 Printed Formats

Type	Advantage(s)	Disadvantage(s)
Horizontal	Reduces peeking 84 (5)	Frustrating, Time consuming 86 (4)
Vertical 58 (0)	Saves time, more immediate feedback 58 (2)	Peeking possible 60 (5)

(Frames 11-23)

TABLE 3 Types of Responses

Type	Definition	Advantage(s)	Disadvantage(s)
Overt 86 (2)	Responses are recorded 79 (4)	Probably better learning occurs 82 (4)	Time consuming, consumes programs 70 (7)
Covert 84 (2)	Internal responses, not recorded. 67 (12)	Saves time, does not consume the program 72 (9)	Less effective learning, no record. 70 (2)

(Frames 4-7)

SECTION 2 (follows Frame 60)

TABLE 4 Types of "Leads"

Example	Type
The capital of France is P_ _ _ _	cue 53 (28)
All mean are mortals but not all mrrtals are _____.	prompt 47 (30)
An apple is a _____ . (pome/achene)	prompt 28 (28)

(Frames 24-29)

TABLE 5 Types of Frames

Example	Type	Characteristics
$X^5 . X^6 = ?$ $X^2 . X^3 = X^5$	Criterion 68 (5)	A testing frame, requires prior knowledge 54 (4)
$X^1 . X^2 = X^3$ $X^5 . X^6 = ?$	Teaching 67 (2)	Frame contains enough information for student to work out the correct response. 56 (4)

(Frames 34-35)

TABLE 6 Types of Programs

Type	Sketch	Advantage(s)	Disadvantage(s)
Linear 67 (5)	0-0-0-0-0- 67 (4)	Easier to write, easier to follow 60 (4)	All students work through same frames irrespective of ability 58 (2)
Branching 67 (5)	0-0——0-0 0-0-0-0 58 (7)	Allows for ind. differences 60 (2)	More difficult to write and follow. 42 (2)

(Frames 51-59)

SECTION 3 (follows Frame 73)

TABLE 7 Generalizations about Programs

Name of program type	Suggested by	Length of Frames	Error rate in program	Post-test error rate
Constructed response	Skinner 32 (0)	short 40 (16)	low 44 (7)	low 44 (0)
Multiple choice 61 (5)	Crowder 26 (2)	medium - long 40 (4)	medium 42 (4)	low 40 (2)
Adjunct auto-instruct 30 (9)	Pressey	variable 12 (12)	variable	variable 23 (4)

(Frames 61, 63-69)

TABLE 8 Methods of Program Presentation

Rate each method on each criterion using :

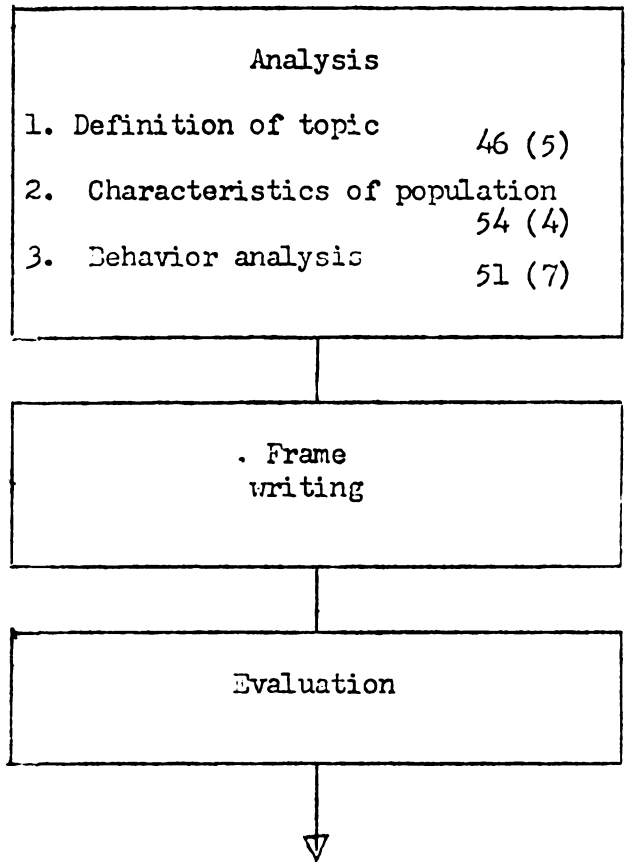
H - high
M - medium
L - low

	Textbook	Machine	Computer
Flexibility in program	H 63 (21)	L 67 (16)	M 72 (12)
Expense	L 79 (5)	M 82 (2)	H 79 (4)
Control of peeking	L 79 (5)	H 77 (5)	H 77 (7)
Portability	H 84 (0)	H 84 (0)	L 75 (7)

(Frames 70-72)

SECTION 4 (follows Frame 79)

TABLE 9 Model for Program Writing



(Frames 75-79)

PART II : "SIMULATION" SECTION

General Description — This part of the Workshop was developed for potential writers of programs. Participants should have either worked through Part I , or have a good background in program techniques.

Booklet 3 presents instructions for three writing experiences in which series of frames are written, and procedures for the evaluation of the three series.

Booklet 4 is a workbook. Both books should be used simultaneously.

Behavioral Objectives. — At the completion of both parts of the workshop, participants will :

1. be able to identify techniques used in programs and the rationales underlying their use, and the characteristics of programs.
2. be able to evaluate single frames, program sequences, and programs from test findings.
3. be able to identify an acceptable program-writing sequence, and be able to write a series of frames.
4. have a more favorable attitude towards programmed instruction.

Requirements — Each participant will require copies of Booklets 3 and 4, and a pencil and eraser.

The supervisor should provide at least one stapler for the group, and place cards labelled : "No Feedback Evaluation", "Feedback Evaluation", and "Worked Programs".

Presentation — The supervisor should give a brief overview of the three writing experiences, and the three evaluation exercizes. In addition, he should :

1. indicate the time allocation for eaxh phase of the session, and the need for this restriction. Some suggested times are given in the section headed 'Time Requirement' below.
2. emphasize that, in the color-coding exercize, participants must limit themselves to frames as indicated by the Analysis Report which has been partly completed for them.
3. The nature of "role playing".
4. provide assistance where possible.

At the completion of the "face-to-face interview" evaluation experience, he should discuss difficulties and errors which he may have observed. Some of the following may be relevant :

a. long complicated frames

b. attempting to teach material not required by the analysis of the problem.

c. difficulty in expressing how the resistor should be oriented.

d. the final criterion frame should be behaviorally oriented. For example a frame such as this might be suitable : Take a resistor from the spare-parts box. What is its resistance? ____
(Check your result with your teacher)

e. linear v. branching series.

f. use of diagrams, representation of colors in black and white programs.

At the completion of the discussion, the supervisor should explain that the place cards indicate where programs should be placed after being written, and after being worked by another member of the group.

The final discussion should permit a free flow of ideas between participants and with the supervisor. The questions listed in Booklet 3 may provide a guide for discussion, but they are not intended to be restrictive. Some points which the supervisor may wish to add are given below.

Question 1 : Opinions differ, but probably anything that does not require the interaction of two or more people can be programmed. The limit is probably the skill of the programmer.

Question 2 : Boredom may be reduced or eliminated by a number of factors. Here are some :

a. use programs matched to the ability of the student.

b. use programs interspersed with conventional teaching.

c. use various types of programs, and programs which employ a variety of techniques.

Question 3 : Each evaluation method has its own merits. Maximum information is probably derived from using all three methods.

Time Requirements The following is a suggested schedule :

Introduction	10 minutes
Writing Experience 1	30 minutes
Face-to-face Evaluation	20 minutes
* Discussion	10 minutes
* Introduction	5 minutes
Writing Experience 2A	30 minutes
Evaluation 2A	15 minutes
Writing Experience 2B	15 minutes
Evaluation 2B	15 minutes
Discussion	20 minutes
TOTAL TIME	2 hours 50 minutes

* Results of Field Testing Both parts of the workshop produce :

1. significant gains in knowledge about the techniques used in programs, and the characteristics of programs.

2. no change in the ability to evaluate single frames, program sequences, and programs from test findings

3. significant gains in the ability to recognize a program-writing sequence, and in the ability to write a series of frames.

4. no change in attitudes over a six-hour period.

APPENDIX B

ATTITUDE SCALE

APPENDIX B

ATTITUDE SCALE

TABLE B.1.--Discriminative Indices of the Original Fifty Items for the Attitude Scale

	Item	Discriminative Index
	If a workshop on writing step-by-step programs was offered, I would volunteer to attend.	0.616
3.[a]	Programmed instruction is based on the same principles as good classroom teaching.	0.675
9.	By using programmed materials, the teacher has more time to give to the individual needs of the student.	0.630
	Teaching machines teach all children fairly.	0.486
	Programmed instruction can reduce the teaching load for each teacher.	0.261
	Programs force all children to go through the same learning steps.	0.171
4.	Programmed instruction hinders the social development of the student.	-0.549
	Almost any topic can be programmed.	0.423
7.	Programmed instruction supplements and complements the teacher's efforts.	0.623

[a]indicates the item number in the final form of the attitude scale.

TABLE B.1.--continued

	Item	Discriminative Index
8.	Teachers can build a strong case against programmed instruction.	-0.594
6.	The advocates for programmed instruction should press harder for its adoption.	0.702
	Only mathematics and science can be effectively taught by programmed instruction.	-0.207
	Research into programmed instruction will lead to new theories of learning.	0.333
2.	Programs encourage the students to cheat.	-0.522
12.	A program consists of a large number of trivial steps which are repeated over and over again.	-0.729
	Programmed instruction liberates the individual.	0.648
	Most commercial programs are not appropriate for the classroom.	-0.270
20.	Using programmed instruction techniques dehumanizes teaching.	-0.702
	I would volunteer to try out a program with my class.	0.720
1.	Programmed instruction can develop problem-solving techniques.	0.639
	Writing programs is very difficult.	0.117

TABLE B.1.--continued

	Item	Discriminative Index
	I would like to try writing a program for my class.	0.567
	It is very difficult to recognize a good program.	-0.171
	Programmed instruction techniques will untimately allow one person to control another.	-0.387
5.	Workshops to teach programming to teachers should be available.	0.558
	By using programs, a student can only learn bits of factual information.	-0.549
	Teaching machines will replace teachers.	-0.090
	Using programmed materials will make education more expensive.	-0.369
	All programmed instruction devices will be replaced by computers.	-0.117
	Widespread adoption of programmed instruction will mean that fewer teachers will be employed.	-0.315
	A student using a teaching machine can concentrate on learning for the sake of learning.	0.672
	A good program uses the results of research in human learning.	0.324

TABLE B.1.--continued

	Item	Discriminative Index
	Adopting programmed instruction requires the teacher to radically change his teaching style.	-0.342
17.	Working through a program is boring.	-0.747
	Commercial programs are thoroughly tested prior to publication.	0.297
16.	Programmed instruction is not as effective as other instructional techniques.	-0.648
	The only future for programmed instruction is in industry.	-0.423
15.	Programs threaten the teacher's role.	-0.504
	Programmed instruction techniques save time over other methods.	0.405
19.	Programmed instruction allows for individual differences.	0.702
	The first step in making a program is to define specific objectives.	0.153
13.	If programs were available in my school, I would not volunteer to use them.	-0.783
	Programmed instruction has not been widely accepted in education because teachers are reluctant to change their practices.	0.162

TABLE B.1.--continued

	Item	Discriminative Index
18.	Programmed instruction is not needed for efficient education.	-0.585
	Programmed instruction allows the more able student to progress faster than would be possible in a traditional course of instruction.	0.441
14.	By using programmed instruction, a teacher will probably become a better teacher.	0.648
	Current hostility among teachers to programmed instruction is due to misconceptions of its purpose.	0.414
	Programs should be written by psychologists rather than teachers.	0.126
11.	Programs can use the best instructional techniques available.	0.657
10.	Teachers will find programmed instruction techniques successful.	0.801

Registration No. _____ A

Name _____

ATTITUDE SCALE

WORKSHOP ON PROGRAMMED INSTRUCTION

In this Attitude Scale, the term 'Programmed Instruction' refers to a method of instruction in which the subject matter is presented in a sequence of steps; the person being instructed is required to make responses as a result of which he receives immediate feedback. The subject matter may be presented in textbooks, by teaching machines, or by computer.

There are 20 statements about Programmed Instruction. Consider each statement separately and indicate the extent to which you agree (or disagree) with it by circling the appropriate symbol to the right of the statement.

The symbols used are:
SA - strongly agree
A - agree
N - no opinion
D - disagree
SD - strongly disagree

All responses will be treated as confidential.

1.	Programmed instruction can develop problem-solving techniques.	1.	SA A N D SD
2.	Programs encourage the students to cheat.	2.	SA A N D SD
3.	Programmed instruction is based on the same principles as good classroom teaching.	3.	SA A N D SD
4.	Programmed instruction hinders the social development of the student.	4.	SA A N D SD
5.	Workshops to teach programming to teachers should be available.	5.	SA A N D SD
6.	The advocates for programmed instruction should press harder for its adoption.	6.	SA A N D SD
7.	Programmed instruction supplements and complements the teacher's efforts.	7.	SA A N D SD
8.	Teachers can build a strong case against programmed instruction.	8.	SA A N D SD
9.	By using programmed materials, the teacher has more time to give to the individual needs of the student.	9.	SA A N D SD
10.	Teachers will find programmed instruction techniques successful.	10.	SA A N D SD
11.	Programs can use the best instructional techniques available.	11.	SA A N D SD
12.	A program consists of a large number of trivial steps which are repeated over and over again.	12.	SA A N D SD
13.	If programs were available in my school, I would <u>not</u> volunteer to use them.	13.	SA A N D SD
14.	By using programmed instruction, a teacher will probably become a better teacher.	14.	SA A N D SD
15.	Programs threaten the teacher's role.	15.	SA A N D SD
16.	Programmed instruction is <u>not</u> as effective as other instructional techniques.	16.	SA A N D SD
17.	Working through a program is boring.	17.	SA A N D SD
18.	Programmed instruction is <u>not</u> needed for efficient education.	18.	SA A N D SD
19.	Programmed instruction allows for individual differences.	19.	SA A N D SD
20.	Using programmed instruction techniques dehumanizes teaching.	20.	SA A N D SD

TABLE B.2.--Score Weights Assigned to Attitude Scale Items

	Item	Weights SA	A	N	D	SD
1.	Programmed instruction can develop problem-solving techniques.	4	4	3	1	0
2.	Programs encourage the students to cheat.	0	1	2	4	5
3.	Programmed instruction is based on the same principles as good classroom teaching.	5	4	3	2	2
4.	Programmed instruction hinders the social development of the student.	1	2	3	4	5
5.	Workshops to teach programming to teachers should be available.	4	3	2	2	1
6.	The advocates for programmed instruction should press harder for its adoption.	5	4	3	1	0
7.	Programmed instruction supplements and complements the teacher's efforts.	4	3	1	1	0
8.	Teachers can build a strong case against programmed instruction.	1	3	4	5	5
9.	By using programmed materials, the teacher has more time to give to the individual needs of the student.	5	3	2	2	2
10.	Teachers will find programmed instruction techniques successful.	5	4	3	1	0
11.	Programs can use the best instructional techniques available.	5	4	3	2	1
12.	A program consists of a large number of trivial steps which are repeated over and over again.	1	1	2	4	5
13.	If programs were available in my school, I would not volunteer to use them.	1	1	2	3	5

TABLE B.2.--continued

	Item	Weights SA	A	N	D	SD
14.	By using programmed instruction, a teacher will probably become a better teacher.	5	5	3	2	1
15.	Programs threaten the teacher's role.	0	1	3	3	4
16.	Programmed instruction is not as effective as other instructional techniques.	1	2	3	4	5
17.	Working through a program is boring.	1	1	2	4	5
18.	Programmed instruction is not needed for efficient education.	2	2	3	4	5
19.	Programmed instruction allows for individual differences.	5	4	3	1	1
20.	Using programmed instruction techniques dehumanizes teaching.	1	2	3	4	5

TABLE B.3.--Face Validities of Attitude Scale Items[a]

Item Number	Face Validity	Item Number	Face Validity
1	0.583	11	0.667
2	0.750	12	0.583
3	0.667	13	0.833
4	0.750	14	0.833
5	0.917	15	0.833
6	0.583	16	0.500
7	0.833	17	0.667
8	0.667	18	0.667
9	0.833	19	0.750
10	0.500	20	0.750
		Overall	0.750

[a]Calculated from rating by three persons on a five-point scale with a validity index of:

1.000 = very high face validity
0.750 = high face validity
0.500 = medium face validity
0.250 = low face validity
0.000 = very low face validity.

APPENDIX C

TEST BOOKLET

Registration Number _____ T

Name _____

TEST BOOKLET

WORKSHOP ON PROGRAMMED INSTRUCTION

From the choices given, select the BEST answer to each of the following questions. Place the appropriate number in the box to the right of the question.

All questions refer to Programmed Instruction.

All responses will be treated as confidential.

1. All programs have the following three characteristics:

   1. a logical sequence of steps, active responding, immediate feedback.
   2. immediate feedback, a series of short frames, active responding.
   3. a negligible error rate, a logical sequence of steps, linear progression.
   4. a series of short frames, branching sequences, negligible error rate.

2. Covert responding has an advantage over overt responding because it:

   1. gives a record of progress.
   2. leads to more effective learning.
   3. takes less time.
   4. reduces peeking.

3. Feedback is:

   1. branching back in the program.
   2. knowledge of results.
   3. reference to another section of the program.
   4. another name for overt responding.

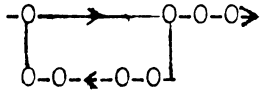
4. Which of the following statements about "cues and prompts" is <u>not</u> true?

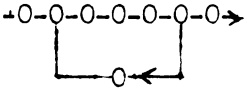
   1. They are the same thing.
   2. Both reduce error rate.
   3. Both serve the same function.
   4. They can occur in the same frame.

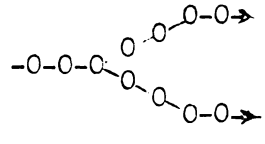
5. Another name for "testing frame" is:

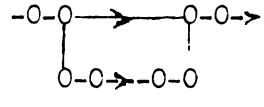
   1. discrimination frame.
   2. production frame.
   3. criterion frame.
   4. teaching frame.

6. Which of the following diagrams best represents a remedial branch? (A circle represents a frame, and an arrow represents the direction of working through the frames.)

   1. 

   2. 

   3. 

   4. 

7. Skinner and his followers advocate using:

   1. constructed response programs.
   2. "scrambled book" programs.
   3. covert response programs.
   4. multiple choice programs.

8. Which of the following statements is true?

   1. Only linear programs allow for individual differences.
   2. All programs allow for some individual differences.
   3. Only branching programs allow for individual differences.
   4. Neither linear nor branching programs allow for individual differences.

9. A line is used to separate the frame from the correct answer in most programs because it:

   1. compartmentalizes the page.
   2. has aesthetic appeal.
   3. is traditional.
   4. acts as a visual barrier.

10. Research has shown that peeking in a textbook program has undesirable effects:

    1. if done before making an overt response.
    2. if done before making a covert response.
    3. if done after making either kind of response.
    4. on the time taken.

11. In general, a good program is superior to traditional teaching because it has:

    1. immediate feedback, provision for individual differences.
    2. a logical sequence of steps, student motivation.
    3. specific behavioral objectives, repetition.
    4. provision for individual differences, a logical sequence of steps.

12. The report of test results for a multiple choice program states that:

"while working through the program, students made very few errors."

"on a post-test, the error rate was high."

Which of the following conclusions would you be justified in making on that information alone?

1. Probably a good program.
2. The post-test was probably too difficult.
3. The program did not teach well.
4. None of the above.

13. The research report for a constructed response program gave the following data:

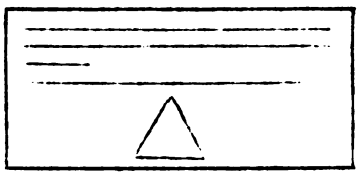
"Program error rate = 5%"

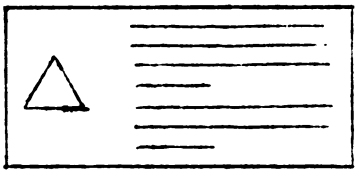
"Post-test error rate = 1%"

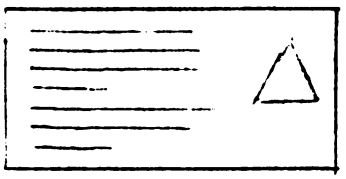
On this information, which of the following conclusions should you make?

1. A good program for your class.
2. The post-test was too easy.
3. The program worked well.
4. The program was too easy.

14. Which of the following frame layouts is considered the best? (Lines represent the text, and the triangles represent diagrams illustrating the text.)

1. 

2. 

3. 

15. Programs can be tested by giving the program to subjects either with the correct answers in it (i.e. feedback) or without the correct answers in it (i.e. no-feedback).
Probably the major disadvantage of the "feedback" method of evaluation is that:

1. the programmer gets unwanted feedback.
2. it takes longer to work.
3. the student does not learn as much.
4. the results may be inflated.

16. Which of the following is the best criterion frame for a series of frames on setting up a simple electrical circuit?

1. Draw a diagram of the circuit you would use to show - - - - (etc).

2. Describe the circuit you would use to show - - - - (etc).

3. The diagrams below represent the parts you would need to show - - - (etc).

   Draw lines to show how you would connect up the parts.

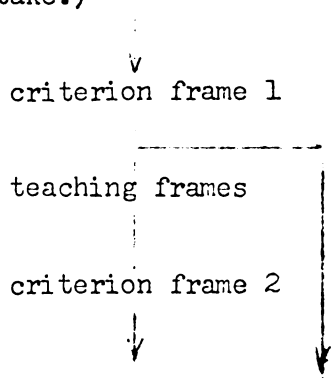
   (Diagrams supplied)

4. Connect up the circuit that you would use to show - - - - (etc).

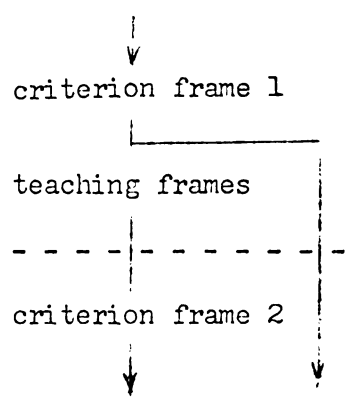
   (Parts supplied)

17. For a group of students with a wide range of abilities and previous knowledge, which programming sequence would be preferred? (All frames mentioned refer to one specific topic. Broken lines indicate other frames not in the series, unbroken lines indicate alternative paths students may take.)

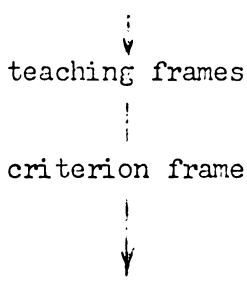
1.



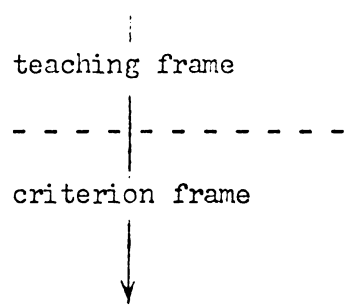
2.



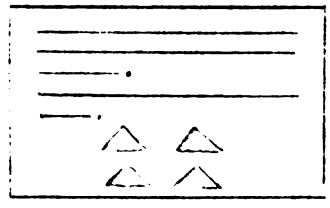
3.

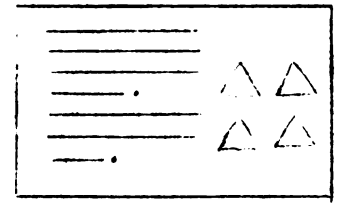


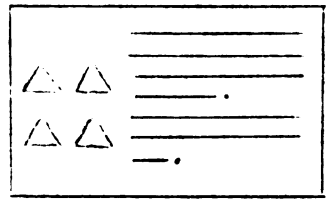
4.

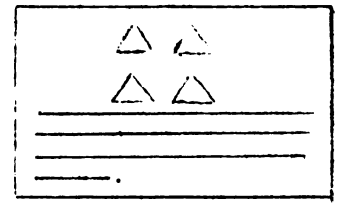


18. Which of the following frames is considered the best for a multiple choice program? (Lines represent text, and triangles represent diagrams of possible alternative choices.)

1. 

2. 

3. 

4. 

19. Imagine that you are considering using a program with your class. You have only one copy of the program and no supplementary information about the objectives, test results, etc.
Using the program as the only guide, which of the following would give you the best indication of how suitable it would be for your class?

1. Format.
2. Criterion frames.
3. Title.
4. Length of the frames.

20. You have assessed a program as being excellent for your class.
However, as your students work through the sequence, most of them fail, for various reasons, on one particular frame.
Which of the following proposals seems the best for future classes?

1. Wait until the next class has difficulty, then teach the point causing trouble.
2. Do nothing, and let the class skip the frame.
3. Discard the program as a failure.
4. Prepare a supplementary branching program to overcome the problem.

21. Which of the following is the generally recommended sequence through which a programmer would go in writing a program?

1.
   a. state objectives
   b. define the population
   c. prepare teaching frames
   d. write criterion frames
   e. test.

2.
   a. define the population
   b. state objectives
   c. write criterion frames
   d. prepare teaching frames
   e. test.

3.
   a. state objectives
   b. write criterion frames
   c. prepare teaching frames
   d. test
   e. define the population.

4.
   a. define the population
   b. write criterion frames
   c. prepare teaching frames
   d. test
   e. state objectives.

22. You have a group of students with similar abilities and entering behaviors.

Write a short linear program to teach finding the square of a number. (For example, four squared is equal to sixteen, or in other words, $4^2 = 16$.)

Write your program on this page and the next.

TABLE C.1.--Criterion Correlations and Difficulties of Test Booklet Items

	Item Number	Criterion Correlation[a]	Difficulty[b]
Subtest 1			
	1	0.659	0.962
	2	0.860	0.472
	3	0.754	0.849
	4	0.800	0.566
	5	0.800	0.566
	6	0.622	0.509
	7	0.551	0.547
	8	0.574	0.717
	9	0.117	0.604
	10	0.612	0.340
	11	0.725	0.755
Subtest 2			
	12	0.523	0.132
	13	0.379	0.547
	14	0.415	0.509
	15	0.456	0.679
	16	0.699	0.415
	17	0.543	0.491
	18	0.518	0.660
	19	0.635	0.736
	20	0.640	0.962

[a]Computed by the GITAP program with n = 53.

[b]Computed from the number of correct responses (n = 53). If all participants correctly answer the item then the difficulty index is 1.000.

TABLE C.2.--Face Validities of Test Booklet Items[a]

Subtest 1		Subtest 2		Subtest 3	
Item Number	Face Validity	Item Number	Face Validity	Item Number	Face Validity
1.	0.750	12.	0.583	21.	0.750
2.	0.833	13.	0.750	22.	0.917
3.	0.917	14.	0.583		
4.	0.667	15.	0.667		
5.	0.917	16.	0.750		
6.	0.833	17.	0.750		
7.	0.750	18.	0.667		
8.	0.667	19.	0.750		
9.	0.583	20.	0.833		
10.	0.583				
11.	0.750				

[a]Calculated from ratings by three persons on a five-point scale. A validity index of:

1.000 = very high face validity
0.750 = high face validity
0.500 = medium validity
0.250 = low face validity
0.000 = very low face validity.

APPENDIX D

NOTES, DEMOGRAPHIC DATA AND RAW SCORES FROM THREE TRIAL INGROUP SESSIONS

APPENDIX D

NOTES, DEMOGRAPHIC DATA AND RAW SCORES FROM THREE TRIAL INGROUP SESSIONS

In this appendix, each trial InGrouP session is discussed separately giving the research design, demographic data, raw scores and comments. Some of this information also appears in the text but as grouped data.

Three trial InGrouP sessions were conducted. For reference purposes these have been numbered sequentially.

Trial InGrouP Session 1

Science teachers from 126 junior high schools and parochial elementary schools within a radius of about seventy miles of Lansing were invited by letters through their school principals to attend a training session at Michigan State University on Saturday, May 24, 1969. Superintendents and curriculum coordinators were asked to follow-up the letters.

In all, thirty-nine teachers indicated that they would attend. Reminder notes were sent to these.

By thirty minutes after the scheduled starting time, twenty-two teachers had started the program. Two more did not participate because they had expected a workshop on how to teach science.

Of the twenty-two who started, only fourteen returned after the lunch break for the second part. Some of those who left explained that as it was a very busy time of the school year, they could not afford any more time.

Procedure and Research Design

With twenty-two participants, the following research design was used:

R	AT	PS		(1100 series)[a]
R		PS	AT	(1200 series)

where: R indicates random assignment of participants to treatment groups.
A indicates administration of the attitude scale.
T indicates administration of the test booklet.
P indicates the program section (booklets 1 and 2).
S indicates the simulation section (booklets 3 and 4).

The participants were assigned to the treatment groups by the registration numbers on cards they received as they entered the room. These cards had been arranged so that the numbers were in random order.

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[a]Each participant was assigned a unique number. The first digit from the left indicates the trial InGrouP session number, the second digit indicates the treatment group, and the remaining numbers are unique for a particular participant.

Demographic Data and Raw Scores

Table D.1 contains demographic data about the participants. This information was collected from a checklist on the back of the registration card.

Table D.2 contains the test scores from the attitude scale and the test booklet. It also contains an analysis of the results.

Comments and Observations

In the discussion session at the conclusion of the simulation section, the following comments were made:

(1) As it was a training session on programmed instruction, the materials should be programmed where possible.

(2) The program section was a good section.

(3) The attrition rate would have been higher if the subject matter had been presented as a lecture.

(4) Perhaps there could have been more discussion at the "breaks" indicated in the booklets. However the critic realized that this may not be possible as the participants were working through the materials at their own rates.

(5) If the materials were made available, one participant wanted to try out the training session in his own school.

TABLE D.1.--Summary of Demographic Data from Trial InGrouP Session 1

Characteristic	Pretest (n = 11)	Posttest (n = 5)[a]
Male	3	3
Female	8	2
From Lansing	8	3
From Michigan outside Lansing	3	2
Total Teaching Experience		
1 - 2 years	1	0
3 - 4 years	1	2
5 - 6 years	1	2
7 - 8 years	2	0
More than 8 years	6	1
Science Teaching Experience		
0 years	3	0
1 - 2 years	2	3
3 - 4 years	2	1
5 - 6 years	1	0
7 - 8 years	1	0
Grades Taught 68/69 Year[b]		
5	2	0
6	4	1
7	2	2
8	4	3
9	1	0
10	1	0
11	1	0
12	1	0
Average Use of Programmed Materials 68/69 Year		
0 periods/wk.	8	4
1 period/wk.	1	1
3 periods/wk.	2	0

[a]Of the eleven teachers assigned to the posttest group, only five completed the session.

[b]A number of teachers reported teaching more than one grade during the 68/69 school year.

TABLE D.2.--Raw Scores and Analysis for Trial InGrouP Session 1

	Registration Number	Attitude Scale	Subtest 1	Subtest 2	Subtest 3
Pretest	1101	77	8	3	8
	1102	72	4	6	0
	1103*	69	3	4	1
	1104*	62	5	8	9
	1105*	66	4	5	0
	1106*	89	5	7	3
	1107*	89	4	6	5
	1108*	65	7	4	0
	1109	72	4	4	0
	1110*	72	3	3	0
	1111*	68	4	3	1
	Total	801	51	53	27
	$Mean_{pre}$	72.82	4.64	4.82	2.45
Posttest	1201*	96	5	4	1
	1202*	72	10	7	6
	1203*	74	10	3	4
	1204*	63	9	7	1
	1205*	74	9	7	7
	Total	379	43	28	19
	$Mean_{post}$	75.80	8.60	5.60	3.80

TABLE D.2.--continued

	Attitude Scale	Subtest 1	Subtest 2	Subtest 3
$Mean_{post} - Mean_{pre}$	2.98	3.98	0.78	1.35
Standard Error	5.39	0.93	0.97	1.74
t ratio	0.553	4.255	0.810	0.773
$Significance_{(0.05)}$[a]	-	sign.	-	-

*indicates that the participant completed the session.

[a]For a one-tailed test of significance at $p = 0.05$ with 14 degrees of freedom, the required value of t is 1.761.

(6) One member asked where the coffee urn was (!).

(7) The participants worked harder than was customary in a workshop.

The supervisor noticed that the participants became tired towards the end of the session, indicating that there may be some justification for dividing the materials into two parts to be treated in two separate sessions.

The attrition rate was attributed to the concentrated nature of the session and that at the end of spring term teachers are busy and perhaps not as highly motivated a would be expected earlier in the school year. This was supported by responses to a questionnaire sent out to those who had left early.

When tablet chairs were used, many of the participants experienced some difficulty when working through two stapled booklets at the same time. Those participants who were using tables did not seem to experience this problem.

In the simulation section in which time restrictions were imposed by the supervisor, some confusion occurred when changing from the "face-to-face interview" evaluation exercise to the "mailing" exercises. Instructions for the second and third exercise could be given at the completion of the first exercise to overcome this problem leading to a smoother transition between exercises.

Trial InGrouP Session 2

Approximately 200 teachers of science and mathematics at the secondary school level were invited to attend either this trial InGrouP session or the third one. The teachers were attending National Science Foundation summer institutes or curriculum courses at Michigan State University.

Although twenty-seven teachers indicated that they would attend this session only fourteen started on Saturday, June 21, 1969. Only eleven completed the session.

Procedure and Research Design

The design was the same as that used in the first session except that a short discussion session was held at the completion of the first evaluation exercise. The pretest group were given registration numbers in the 2100 series and the posttest group in the 2200 series.

Comments and Observations

In the discussion session, the following comments were made by participants:

(1) The subject area for the writing experience in the "face-to-face interview" exercise was too difficult.

(2) Materials used to teach programmed instruction should be programmed.

Some questions were asked about the answers to some parts of the review tables in booklet 2. In all cases the answers to these questions were contained in the explanatory

TABLE D.3.--Summary of Demographic Data from Trial InGrouP Session 2

Characteristic	Pretest (n = 7)	Posttest (n = 7)
Male	2	1
Female	5	6
From Lansing	1	2
From Michigan outside Lansing	1	1
From Out-of-state	5	4
Total Teaching Experience		
1 - 2 years	1	2
3 - 4 years	4	3
5 - 6 years	1	1
More than 8 years	1	1
Science Teaching Experience		
0 years	1	5
1 - 2 years	2	0
3 - 4 years	3	1
More than 8 years	0	1
Grades Taught 68/69 Year[a]		
5	1	0
6	1	2
7	2	3
8	4	2
9	4	2
10	2	2
11	0	2
Average Use of Programmed Materials 68/69 Year		
0 periods/wk.	6	6
3 periods/wk.	0	1
More than 3 periods/wk.	1	0

[a]A number of teachers reported teaching more than on grade during the 68/69 school year.

TABLE D.4.--Raw Scores and Analysis for Trial InGrouP Session 2

	Registration Number	Attitude Scale	Subtest 1	Subtest 2	Subtest 3
Pretest	2101*	64	5	5	0
	2102*	82	5	5	8
	2103	82	5	3	0
	2104	70	8	5	11
	2105	64	5	5	1
	2106*	82	6	4	1
	2107*	62	6	5	1
	Total	506	40	32	22
	$Mean_{pre}$	72.28	5.71	4.57	3.14
Posttest	2201*	66	10	7	8
	2202*	71	9	4	5
	2203*	49	9	3	9
	2204*	79	7	5	7
	2205*	75	9	7	7
	2206*	64	9	6	9
	2207*	81	10	8	11
	Total	485	63	40	56
	$Mean_{post}$	69.28	9.00	5.71	8.00

TABLE D.4.--continued

	Attitude Scale	Subtest 1	Subtest 2	Subtest 3
$Mean_{post} - Mean_{pre}$	- 3.00	3.29	1.14	4.86
Standard Error	5.45	0.57	0.74	1.83
t ratio	0.553	5.811	1.540	2.652
$Significance_{(0.05)}$[a]	-	sign.	-	sign.

*indicates that the participant completed the session.

[a]For a one-tailed test of significance at $p = 0.05$ with 12 degrees of freedom, the required value of t is 1.782.

portions in the booklets, not in the parts presented as programmed materials. This seems to indicate that the participants may tend to skip over the explanatory notes between frames.

Only a few members of the group (less than twenty percent) looked through any of the commercial programs available on the supply trolley.

In this session only writing tables were used. The tables seemed to overcome problems experienced with handling two stapled booklets at the same time on a tablet chair.

The discussion and orientation session held at the completion of the first writing and evaluation exercise seemed to produce a smoother transition into the remainder of the simulation section. It appeared to overcome the difficulty experienced in the first trial InGrouP session, and gave the participants a short break.

Trial InGrouP Session 3

Sixty-five secondary-level teachers from the summer institutes and from curriculum courses indicated that they would attend this trial InGrouP session which was to be held in two parts on Thursday, June 19, and Tuesday, June 24 from 7pm to 10pm. Of these, thirty-one attended but only eleven completed the session.

Procedures and Research Design

The participants were randomly assigned to three groups. The control group of nine was pretested with

the attitude scale and the test booklet. One experimental group of ten was tested after completing the program section and was known as the "midtest group." The other experimental group was tested at the completion of the simulation section.

The research design was:

R	AT	PS			(3100 series)[a]
R		PS	AT		(3200 series)
R		P	AT	S	(3300 series)

where: R indicates random assignment to treatment groups.
A indicates administration of the attitude scale.
T indicates administration of the test booklet.
P indicates the program section.
S indicates the simulation section.

As in the second session, a short discussion and orientation session was held after the first writing and evaluation exercise.

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[a]The first digit from the left indicates the trial InGrouP session number, the second digit indicates the treatment, and the remaining numbers (represented by 0 here) were assigned to give a unique number of each participant.

TABLE D.5.--Summary of Demographic Data from Trial InGrouP Session 3

Characteristic	Pretest (n = 9)	Midtest (n = 10)	Posttest (n = 4)
Male	5	6	2
Female	4	4	2
From Michigan outside Lansing	4	4	3
From Out-of-state	5	6	1
Total Teaching Experience			
1 - 2 years	0	1	1
3 - 4 years	0	1	2
5 - 6 years	5	4	1
7 - 8 years	1	1	0
More than 8 years	3	3	0
Science Teaching Experience			
0 years	2	3	2
1 - 2 years	1	2	1
3 - 4 years	2	1	0
5 - 6 years	1	3	1
7 - 8 years	1	0	0
More than 8 years	2	0	0
Grades Taught 68/69 Year[a]			
7	4	5	2
8	3	5	2
9	1	1	1
10	3	4	1
11	1	1	1
12	1	2	1
Average Use of Programmed Materials 68/69 Year			
0 periods/wk.	7	9	4
2 periods/wk.	1	0	0
More than 3 periods/wk.	1	1	0

[a]A number of teachers reported teaching more than one grade during the 68/69 school year.

TABLE D.6.--Raw Scores and Analysis for Trial InGrouP Session 3

	Registration Number	Attitude Scale	Subtest 1	Subtest 2	Subtest 3
Pretest	3101	71	5	3	0
	3102	58	5	5	1
	3103	67	4	3	2
	3104	74	4	5	5
	3105	62	8	5	0
	3106	81	4	4	0
	3107*	52	5	4	0
	3108*	73	7	4	3
	3109*	65	5	5	1
	Total	603	47	38	12
	$Mean_{pre}$	67.00	5.22	4.22	1.33
Midtest	3301*	76	8	6	9
	3302	66	9	4	2
	3303	72	11	7	10
	3304	42	7	3	3
	3305*	85	8	8	10
	3306	57	8	6	0
	3307*	71	8	8	3
	3308*	62	9	6	3
	3309	65	8	5	0
	3310	67	7	7	10
	Total	663	83	60	50
	$Mean_{mid}$	66.30	8.30	6.00	5.00

TABLE D.6.--continued

	Registration Number	Attitude Scale	Subtest 1	Subtest 2	Subtest 3
Posttest	3201*	96	9	5	2
	3202*	62	11	6	9
	3203*	68	10	5	9
	3204*	62	10	6	9
	Total	288	40	22	31
	$Mean_{post}$	72.00	10.00	5.50	7.75
$Mean\ square_{between}$		48.776	38.911	7.679	58.103
$Mean\ square_{within}$		131.005	1.483	1.528	11.138
F ratio[a]		0.372	26.242	5.026	5.217
$Significance_{(0.05)}$[b]					
	Pretest - midtest	-	sign.	sign.	-
	Midtest - posttest	-	-	-	-
	Pretest - posttest	-	sign.	-	sign.

[a]With 2 and 20 degrees of freedom, an F ratio greater than 3.49 is required for significance at $p = 0.05$.

[b]Significance within the table was determined using Scheffé's method of comparisons of means.

*Indicates that the participant completed the session.

TABLE D.7.--Summary of the Demographic Data from All Sessions (as percentages)[a]

	Session 1 (n = 16)	Session 2 (n = 14)	Session 3 (n = 23)
Sex Distribution			
Male	38	22	56
Female	62	78	44
Geographic Location			
From Lansing	69	21	0
From Michigan outside Lansing	31	14	44
From Out-of-state	0	65	56
Total Teaching Experience			
Median	7-8 years	3-4 years	5-6 years
Grades Taught 68/69 Year[b]			
5	13	7	0
6	30	21	0
7	25	36	48
8	44	43	43
9	6	43	13
10	6	29	35
11	6	14	13
12	6	0	17

TABLE D.7.--continued

	Session 1 (n = 16)	Session 2 (n = 14)	Session 3 (n = 23)
Average Use of Programmed Materials 68/69 School Year			
Median	0 pds/wk.	0 pds/wk.	0 pds/wk.

[a]All percentages are rounded to whole numbers.

[b]A number of teachers reported teaching more than one grade during the 68/69 school year.

Reasons for not completing the Trial InGrouP Sessions

In all three trial InGrouP sessions there was a high attrition rate.

Although not basic to this study, the causes of this high drop-out rate were of interest and may be important in the overall plan to develop a number of InGrouP sessions for teachers of all grades in all subjects and in a number of countries.

To determine the reasons why participants did not complete the sessions, a questionnaire was developed. The items on the questionnaire were written to be approximately equally unattractive, and a second section was included as a check to the responses made in the first section. Finally space was provided for general comments on how the trial InGrouP session could be improved.

Twenty-eight questionnaires were mailed out with stamped, return addressed envelopes to the addresses given by the participants on the registration cards. Twenty-two were returned.

The number of responses made to each item have been placed in the box to the left of the item and the general comments have been grouped into categories, and the number of responses in each category appears in parenthesis.

APPENDIX E

SURVEY OF REASONS WHY PARTICIPANTS DID NOT COMPLETE THE TRIAL INGROUP SESSIONS

Comments

Section 1	1.	Conflicting assignments, other work.	(4)
	2.	Recruited under false pretences.	(2)
	3.	Reward not commensuate with time spent.	(3)
	4.	Information available elsewhere.	(1)
	5.	No purpose in continuing.	(2)
	6.	Too long.	(1)
	7.	Thought it was something different.	(3)
Section 2	1.	Explanation of long range aims.	(3)
	2.	Not so long.	(1)
	3.	Improve the "atmosphere".	(1)
General	1.	Warn that tests would be given.	(5)
	2.	Shorten the program.	(2)
	3.	Make the session practical.	(1)
	4.	Schedule at another time (daytime, year).	(2)
	5.	Prior preparation by participants.	(1)
	6.	Give assistance to flounderer.	(1)
	7.	Learn science, use programs.	(2)

APPENDIX F

RESPONSES TO ATTITUDE SCALE ITEMS

TABLE F.1.--Responses to Attitude Scale Items

Item	All Pretest Responses[a]					All Posttest Responses[b]				
	SA	A	N	D	SD	SA	A	N	D	SD
1. Programmed instruction can develop problem-solving techniques.	6	17	4	0	0	5	9	1	0	1
2. Programs encourage the students to cheat.	1	5	4	14	3	0	3	4	6	3
3. Programmed instruction is based on the same principles as good classroom teaching.	3	15	7	2	0	6	10	0	0	0
4. Programmed instruction hinders the social development of the student.	0	3	8	14	2	0	6	5	3	2
5. Workshops to teach programming to teachers should be available.	16	10	1	0	0	6	9	1	0	0
6. The advocates for programmed instruction should press harder for its adoption.	3	7	12	5	0	3	3	8	2	0
7. Programmed instruction supplements and complements the teacher's efforts.	9	18	0	0	0	6	10	0	0	0
8. Teachers can build a strong case against programmed instruction.	3	4	10	8	2	0	5	4	5	2
9. By using programmed materials, the teacher has more time to give to the individual needs of the student.	10	14	1	2	0	6	7	2	1	0
10. Teachers will find programmed instruction techniques successful.	3	15	7	2	0	3	10	2	1	0
11. Programs can use the best instructional techniques available.	2	19	6	0	0	4	9	1	2	0
12. A program consists of a large number of trivial steps which are repeated over and over again.	0	5	2	18	2	0	2	3	6	5
13. If programs were available in my school, I would not volunteer to use them.	1	1	2	14	9	0	1	1	10	14
14. By using programmed instruction, a teacher will probably become a better teacher.	3	14	9	1	0	3	2	4	2	0
15. Programs threaten the teacher's role.	1	0	0	18	8	0	0	2	7	7
16. Programmed instruction is not as effective as other instructional techniques.	0	2	9	12	4	0	2	6	6	2
17. Working through a program is boring.	0	2	7	17	1	0	4	3	7	2
18. Programmed instruction is not needed for efficient education.	0	6	11	8	2	0	5	2	7	2
19. Programmed instruction allows for individual differences.	7	14	4	2	0	7	8	0	1	0
20. Using programmed instruction techniques dehumanizes teaching.	0	3	5	14	5	0	3	2	8	3

[a]Responses from 27 pretested participants.

[b]Responses from 16 posttested participants.