DEVELOPMENT OF A SELF-INSTRUCTIONAL

PROGRAM ON THE SEWING MACHINE

by

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TABLE OF CONTENTS

Chapter | Page

LIST OF TABLES

CHAPTER I

INTRODUCTION

Modern science and technology have resulted in a tremendous increase in knowledge which has made it difficult for students and teachers to keep up with changes. These changes make education more essential to our progress. Students find themselves in overcrowded classrooms and teachers find themselves trying to meet the needs of each individual student. Such dilemma results in frustration for both. Steps have been taken to improve these conditions. Psychologists have advanced during the last decade a revolutionary new method of teaching and learning which may help to solve the problems of the increase in knowledge and overcrowding in the classroom. This method is popularly called automated or programed instruction. Briefly programed instruction takes the place of a tutor as it leads the student through a set of materials designed and sequenced to teach him to behave in a certain way.

"Automation" helps the teacher in many ways, especially by freeing her to have time to become more creative and by freeing her to give individual help to slow and fast students who are now often neglected. This individual attention is given to students during class time while other students are instructing themselves through the aid of a self-instructional device commonly known as a program.

Contributing to the high-level of interest in self-instructional programs has been the publication of a number of articles in the popular press which have stressed the advantages to be expected. These articles have said little about the time and effort and background of knowledge and experience that are required to develop an efficient self-instructional program from which students learn. In addition, they say little about the developmental cost.

Background for the Study

The staff in home economics education at the Woman's College, University of North Carolina, became interested in the spring of 1962 in the area of programed instruction and decided to conduct a pilot study in this area. At that time, according to Schramm (15,p.6)[1], 122 programs were available for purchase and 630 programs were in process. These program titles are listed in several catalogs. A careful study of the listings revealed that no programed instructional materials were available in the area of home economics.

Statement of the Problem

The primary purpose of the present study was the development of a program on the fundamentals of the sewing machine for first year clothing students at the seventh, eighth, or ninth grade level. Another purpose of this study was to provide some general guidance and information to those who may be interested in developing programed materials.

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[1]Throughout the paper the first number in parentheses indicates the number of that publication as it appears in the List of References; numbers after the comma, refer to page numbers. e.g. (15,p.6).

Relation of Present Study to Larger Project

A larger research project concerned with the development of programed materials for home economics classes is anticipated at the Woman's College, University of North Carolina. The present program on the sewing machine will be revised and used along with other programs. During the school year of 1962-63 plans were being formulated for the larger project.

Limitations

The first limitation concerned the selection of the sample. Since the present study involved a preliminary field test used to determine where the program needed revision, a representative sample was not needed. Three schools in the proximity of Greensboro, North Carolina were selected. Another limitation was that the writer had to finish developing the program and conducting the preliminary field test within the school year. After revision, it is anticipated that a publishing company will do a much larger and more extensive field test before publishing the sewing machine program.

Characteristics of Programed Instruction

Four important learning principles are applied in programed instruction. They are: (1) Students are individually paced; that is, each proceeds at his own pace. No students are left behind the class and no gifted students are held back. (2) Active participation on the part of the learner is required. (3) Correct responses are immediately reinforced. The student does not have to wait for the teacher to correct and return his paper to him before he knows whether or not he has responded correctly. (4) Teachers can evaluate student progress at any time. Evaluation is not limited solely to tests.

Hughes (7,p.53) reported a summarization by Briggs of advantages of using programed instruction in military training. Briggs listed as advantages of programed learning that:

> "1. An expert program writer can reach a large number of students.
> 2. Misconceptions held by minimally qualified instructors will not be passed on to students.
> 3. Errors are immediately corrected and do not lead to further errors in the problem sequence.
> 4. Each student works at his own rate.
> 5. Slow students are required to master the material, and fast students can save time.
> 6. Slow students are not embarrassed by their lower rate of learning.
> 7. Fast students can do extra assignments to develop further skills.
> 8. The need for examinations is greatly reduced.
> 9. The early and continued experiencing of success augments student motivation.
> 10. Good instructors can use their time to better advantage than performing rote drill." (7,p.53).

Research in schools, industry, and the military service has pointed out that programed instruction can be more effective than traditional teaching methods. Almost always programed instruction has demonstrated a reduction in learning time or an increase in knowledge or skill by the participants.

Schramm (15,p.18) pointed out that history concerning an instructional program dates back to Socrates whose program was intended to teach his students right thinking and virtuous living. Schramm also stated that

> "The roots of programed instruction are deep both in the theory of education and in psychological learning theory. Five hundred years ago, Comenius tried to specify a kind of education that would be active - that would cause a student 'to learn more, and the teacher to teach less.'" (15,p.18).

Sidney Pressey, a psychologist developed a machine prior to 1920 that could produce measurable amounts of learning in students, but after experimenting and publishing his results, he found little enthusiasm among either educators or psychologists. He, therefore, discontinued work on this research.

Several years ago the field of programing was limited to a few people. Now many are trying to produce materials.

Special Uses of Terms in the Present Study

The need for common definitions of terms in this area has become apparent to educators and to psychologists. Programed instruction is such a new field that leaders have not yet agreed on the vocabulary to be used. Two, three, and four terms are frequently used synonymously. When this is true, the writer has selected one term to use.

Programed instruction: the method of teaching in which the program becomes a tutor for the student. It is designed and sequenced to lead the student through a set of specified behaviors which make it more probable that he will behave in a given desired way. This term is synonymous with automated instruction and automated teaching.

Programing: the process of arranging the material to be learned into a series of steps, specifying some kind of response to be made by the learner and providing for reinforcement of the correct response.

Programer: the person responsible for developing the program. The programer may be a subject matter specialist, a psychologist, a person trained in programing techniques, or a combination of these.

Program: the sequence of carefully constructed frames leading the student to mastery of a subject with a minimum number of errors. It is synonymous with self-instructional program, auto-instructional program, self-tutoring device, and self-teaching device.

Linear program: the program in which an ordered sequence of frames is presented in which the student must construct a response and then receive immediate reinforcement of the correct response. The term is synonymous with Skinnerian program, constructed response program, and sequential program.

Branching program: a program in which the sequence of exposure of the program to the student is determined by his response to each frame. The branch usually consists of a single item explaining why a particular answer is incorrect and returning the student to the orriginal frame for another try. It is synonymous with multiple-choice program and intrinsic program.

Constructed response: a response which requires the student to complete a sentence, to solve a problem, or to answer a question. It is contrasted with selecting a response from a set of alternatives. It is synonymous with constructed answer.

Overt response: a response which is an oral or a written response, or a manipulative act on the student's part. The response can be recorded by an observor.

Multiple-choice response: a student's response requiring him to recognize and select the best of a number of alternative choices. It is contrasted with the constructed response in which the student recalls and records the correct response.

<u>Feedback</u>: a process of conveying knowledge of results to the learner. It may include discussion of why the answer is correct. Feedback may be broader than reinforcement or knowledge of results.

<u>Reinforcement</u>: the process of conveying to the learner immediate knowledge of the correct response. This term is synonymous with knowledge of results.

<u>Frame</u>: a single unit of material which the student considers at one time. It varies in length from one sentence to one page of materials and usually concludes by requiring a response from the student. This term is synonymous with item.

<u>Criterion frame</u>: a frame that tests whether the student has learned material from previous frames. It is synonymous with prover frame.

<u>Performance frame</u>: a single unit of material or a statement which directs the student to carry out some task other than constructing a written response. It may be considered a frame requiring one type of overt response.

<u>Panel</u>: a chart, a graph, a diagram, or a passage of text accessible during work on a portion of a program. This term is synonymous with exhibit.

<u>Cue</u>: a subtle hint which helps the student respond correctly. It may be a picture, a different color, an underlining, an italics, or a word. It is synonymous with prompt.

<u>Error</u>: the incorrect or non-appropriate response to a specific frame in the program.

Error rate: the percentage of incorrect responses of a given group responding to a specific frame, sets of frames, or a whole program. A high degree of errors indicates a need for revision of the program.

Vanishing: a technique whereby stimulus support for responses is gradually removed in successive frames. It is synonymous with fading.

Target population: the population of students for whom the program is prepared.

Terminal behavior: the behavior a program is designed to produce.

Pacing: the rate at which the student proceeds through the program. Most programs are self pacing. The student reads and responds at his own rate depending upon success on the previous frames.

Criterion examination: a test or examination given to the student at the completion of a program or during the development of the program to test how much the student has learned.

Organization of the Thesis

The remainder of the thesis will include a review of literature related to developing a program, an explanation of the methods and procedures used to develop the sewing machine program, a discussion of the findings obtained from the preliminary field testing of the sewing machine program, and a summary of the study, including further recommendations for revision and use of the sewing machine program.

CHAPTER II

REVIEW OF LITERATURE

The purpose of this study was the preliminary development of a self-instructional program on the fundamentals of the sewing machine. Since background information on how to program was needed before the researcher was ready to begin such a task, a review of literature was essential. This review of literature consisted of procedures for developing a program advocated by people who are now accepted as successful programers.

This is an area in which much more research is needed. Programing at present is more of an art than a science. It is suggested that new programers review programs as well as the literature on how to program before selecting techniques to be used.

Porter (14,p.4) compares the writing of a textbook to the writing of a program. Authors of programs and textbooks both select, organize, and subdivide their content with the hope that the reader will learn. The author of the textbook never gains the insight into how well his book teaches because he never knows how much students are influenced by learning in the classroom and the studying of related material. Porter states that

> "The programmer, however, can discover good and poor portions of his text by examining student responses to particular items, and he can rewrite those items on the basis of such information. This imposes demands upon the programmer that an author doesn't have to face. He is <u>forced</u> to think in terms of the responses students

> will make to specific items; he is forced to analyze carefully the exact behavior he is trying to teach, how it relates to previous learning history, and how it will aid in future performance; if certain facts or relationships are to be taught then he must provide the student with items designed to elicit responses appropriate to these learnings. The end result is that in writing materials...the programmer is able to 'shape up' his teaching program to a high level of perfection, a process that authors and publishers of textbooks are not currently able to undertake." (14,p.4).

Writers of programs start with the psychological principles of learning on which the method is based. Each writer implements these principles of learning in his own way.

The review of programing techniques will be discussed in the following order: types of programs, methods of programing, three systematic approaches to programing, and writing of frames.

Types of Programs

Programs may be classified into two general types, the linear and the branching. Skinner is credited with originating the linear programs and with the verbalization of the psychological principles back of linear programing. At the heart of his method lies what Skinner calls reinforcement theory. Through reinforcement the desired response is shaped. Crowder developed the first branching program and took issue to some extent with Skinner's theory of operant conditioning.

The Linear Program

The linear program consists of a fixed sequence of frames with questions which students answer by constructing a response or filling in one or more words. Schramm summarized very effectively the essential elements of a linear program.

"(a) an ordered sequence of stimulus items,
(b) to each of which a student responds in some specified way,
(c) his responses being reinforced by immediate knowledge of results,
(d) so that he moves by small steps,
(e) therefore making few errors and practicing mostly correct responses,
(f) from what he knows, by a process of successively closer approximation, toward what he is supposed to learn from the program." (15,p.2).

According to Schramm (15,p.2) nineteen out of twenty programs on the market today are of the linear or Skinnerian type.

Lysaught and Williams (10,p.70-91) classified the following linear models from which the programer may choose: basic linear, conversational chaining, modified linear, linear program with sub linears, and a linear with criterion frames.

A basic linear model is one in which material is presented in a rigid sequence where, regardless of whether the student responds correctly, he proceeds through the program in the same order as do other students.

Conversational chaining, originated by John Barlow, differs from the basic linear in that the correct response to each frame is contained within the content of the next frame in the form of capitalized words. There is no separate portion of the program on which correct responses are recorded.

A modified linear program is selected when there may be considerable differences among students in ability levels. When the subject matter requires much review for slow students, the program includes an approximate form of drill for them. To meet the needs of a fast student, the modified linear program allows for skipping review sequences.

A linear program with sub linears is a model which allows for enrichment material for the rapid student if he so desires. The linear sub-program can be taken by students who desire additional information and who can then return to the main program.

Linear programs with criterion frames are defined as having a long and short route. The student is guided in his decision of which route to take by his success or failure in responding to specified criterion frames. The short route consists of a series of criterion frames which are used to see if the student understands the information without the degree of detail included in the longer route in the program. If the student responds correctly, he skips to the next sequence in the program, since the criterion frames showed that he had previously mastered the information in this sequence. Criterion frames are used to help students select the route suited to their ability. For example, one route is available for students with an excellent background in this subject matter and the other route contains review and developmental frames for the student who has an inferior background.

The Branching Program

Crowder (2,p.109-16) is the founder of the branching program. This program differs from the linear in its flexibility.

The format of a branching program requires that the student have two or more available choices and that the wrong choice lead the student to information intended to correct his error and to get him back to the original page so that he can continue the program. For this reason, the branching program lends itself especially to presentation in an electronic type of teaching machine. A branching program may, however, be presented in the form of a scrambled book. On page one of a scrambled book the student will find a unit of information and a multiple-choice question. After each of the alternative answers a page number is given. The student chooses the answer which he believes to be correct and then turns to the page to which he is directed. If he is correct, the page will refer him to the next page of new information. Otherwise, it will inform him why he was not correct and refer him back to the original page where he will make another selection. The student, therefore, cannot continue the program until he has found the correct answer to each question.

The basic concept of Crowder is that students should be permitted to make errors. These errors are indicative of misconceptions of students which need to be corrected in their thinking. The programer uses further teaching to help the student to discriminate between partial truth and accepted truth. Thus errors are used by the student to build more thorough understanding of the subject.

Crowder differs from Skinner in that he believes the essential problem is that of controlling the communication process by use of feedback. Only in a branching program is each error interpreted as indicative of a need of the student for specific further learning. In this type of program the programer has to anticipate every move of the learner.

Crowder (3,p.3-4) points out that when the student's responses are used to operate the branching program rather than as a part of the learning process as such, the questions in the program may serve a variety of different functions, and that these different functions require different types of questions. Crowder says, "A routine question on a routine step in the program should serve to:

a. determine whether the student has learned the material just presented;
b. select appropriate corrective material if the student has not learned;
c. provide desirable practice with the concept involved;
d. keep the student actively working at the material;
and,
e. presumably, if the student gets the question right, serve a desirable motivational purpose." (3,p.3,4).

Lumsdaine reported that "despite all these similarities, the differences between the two approaches are very important and are in some ways fundamental, with respect to the implications that they have not only for how we proceed to increase practical efficiency in training, but also with respect to how we proceed to understand more about learning." (9,p.43).

Methods of Programing

Klaus's Steps

Klaus (8,p.130-42) indicated that programing is still a skill about which we know very little. Based on his experience in writing programs, he stated steps and rules as guides for anyone interested in programing.

The first step is to identify and list clear criterion behavioral objectives that are to be achieved by the learner.

The second step in the development of a program is the preparation with the assistance of a subject matter expert of a course outline covering the material to be taught.

The third step is the preparation of frames. Klaus assigns major units to different programers to prepare draft frames. These are then edited three times. The first editing is done by another programer who attempts to simplify the program, the second is done by a technical expert who reviews frames for technical accuracy, and the third is done by someone skilled in writing who sees that the program is enjoyable as well as instructional.

The fourth step consists of giving the frames to a trial subject who proceeds through the program in the way that a student would use the program in a classroom. Answers are recorded, and the program is revised on the basis of this first trial.

After the revision, the fifth and last step is to repeat the trial procedure on as many as ten or fifteen trial subjects until students have shown mastery of subject matter on a criterion test and have proceeded through the program without making errors. The frames are again revised by a technical expert before they are reproduced for a field trial.

Melching's Programing Steps

Melching (13,p.1-34) attempted to specify a set of steps by which anyone may program instructional materials. His basic premise is: "the best way to learn how to program is to practice programming, and then to try out the program on students to see if they learn from it." (13,p.3).

Successful programers have been experts in a subject matter area, persons with an abiding interest in programing, and persons with the ability to write clearly and precisely. The prospective programer should read in the area of programed instruction, should attend workshops and conferences, should study and work through programs prepared by others, should practice programing on small bits of material, and should test the programs to see where students make errors. Melching estimates that a period of somewhere between two to four months of full-time training and practice is required before a person is ready to prepare a program.

The first step in the development of the program is the specification of the objectives of instruction. Objectives should encompass only the knowledge and skills directly relevant to the desired behavior. Objectives should always be expressed in behavioral rather than in vague general terms.

Second, the criterion test is prepared. This test is based on the objectives of the program. The format of the test is dependent on the objectives involved and on methods available by which attainment of the objectives can be measured. After the test is drafted, it should be reviewed by other programers and subject matter experts for technical accuracy. Melching suggests the following guides in developing the test:

> "multiple-choice items are generally superior to true-false, completion, or other types of items; items must relate directly to the course objectives; items should be realistic; items should be stated clearly and precisely; each alternative should literally be a possible answer; items should proceed from easy to difficult and material need not appear in the test in the same order it appeared in the program." (13,p.13-14).

Melching's third step is the preparation of an outline of the subject matter to be programed. He suggests a rather unusual technique for determining sequence of subject matter. One student, after he has seen the course objectives, is asked what he would like to know or to do first in his attempt to progress toward attainment of the objectives. The student's questions are answered and he is given all the information that he requests. The student is then asked what he would like to do step by step. After the student stops asking questions, Melching recommends that the programer give him the criterion test. Responding to the test usually starts another sequence of questions from the student. (13,p.17-18). The outline for this program is thus developed from information received from the student, from textbooks, from manuals, and from lesson plans.

The fourth step is the preparation of frames for the program. The programer has a choice of a linear method or the branching method, termed by Melching the alternative method.

Melching suggests the following general principles in writing linear type frames

> "introduce items by relating to common knowledge when possible; make liberal use of examples; make use of figures, drawings, charts, either in frames or in supplementary reference material; withdraw prompts or cues gradually; phrase items carefully to avoid undesirable responses; indicate when there is more than one acceptable response; attempt to make content follow naturally and easily; schedule periodic reviews in the program; examine items carefully for technical accuracy; and provide sufficient opportunity for the student to practice making newly learned responses." (13,p.25,26).

Next, step five is the internal review of the program. A check for inaccuracies in content is made. Melching suggests, as a useful rule for reviewers, that they not criticize a frame without providing a better or more correct alternative statement.

The sixth step is a preliminary administration of the program and of the criterion test. The program is given individually to three or more selected individuals from the future student population. After completing the program, these students are given the criterion test so that the programer will know the extent to which they actually achieved the objectives of the program. Melching states that although a fixed value is not set, it is generally accepted that 90 per cent of the criterion test should be correct. He points out that most programers assume that error rate on the program should be 5 per cent or less.

The seventh step is testing the use of the program as an instructional tool. The effectiveness of the program may now be compared experimentally with the effectiveness of traditional teaching of the subject matter in the classroom. Melching suggests assigning randomly half of the students to programed instruction and half to standard instruction. Scores on the criterion test, time required to complete the learning, and cost of the two methods may be compared.

Melching points out that many programs need periodic review and revision to be sure they continually meet specifications.

Mager's Sixteen Steps

Mager (12,p.151-57) described sixteen steps which should be followed in writing a self-instructional program by a novice programer.

1. Begin by defining the target population narrowly to exclude other similar groups and to serve as a reference throughout the writing process.
2. Specify the instructional objectives in behavioral terms, since this is the only way in which success can be measured. At every point in the development of the program objectives serve as sign posts to keep the programer progressing toward the final goal. A well-written objective tells what the student will be doing, what special conditions the student will be working under, and what will be considered satisfactory performance.

3. Prepare the criterion examination early so that in the latter part of the development of the program the temptation to measure content will be avoided and so that preliminary drafts of the program may be tested. Criterion examinations establish a definite standard of achievement and eliminate measurement by the curve system.
4. List the prerequisites or prior knowledge of the subject which students are assumed to have. Terms which are used in the program should be either included in the content for mastery or listed among the prerequisites.
5. Prepare the content outline. Forty per cent of Mager's total programing time was spent on this content outlining. Many gaps in content are found which are not usually included in classroom teaching or in printed material.
6. Prepare an initial content sequence of learning experiences based on one of several strategies; sequence on basis of an internal logical organization, sequence in some traditional method, sequence on the basis of your judgment, or sequence in a way selected by a few students from the target population. Mager prefers the latter sequence on the assumption that what is meaningful to the instructor is not always meaningful to the student. He records and repeats this process with from three to five students.
7. Select or invent a programing strategy which will provide information to the student in small increments, cause him to make responses conducive to his developing the desired proficiencies, let him know how well he is doing at each step, and feed this

information back to the device so that it can adjust its presentation to fit the individual student.

8. Prepare the first draft to be used. Little attempt should be made to polish wording, grammar, and style, as this will be easier to change on later drafts.
9. Test the first draft on a sympathetic colleague or brother programer, asking for his comments. Be aware that the programer must accept the blame if the student does not understand.
10. Write the second draft by incorporating changes suggested by the reviewer. Again, avoid polishing. The second draft contains approximately twice as many frames as the first.
11. Test the second draft on learners of the target population to provide information for the third draft. The suggested strategy is to sit down with the student and read or tell the program to him. The programer is likely while talking to a student to think of simple, graphic analogies and clear explanations. The "talk-through" procedure reduces the number of program rewrites and thus makes the program more economical to prepare.
12. Prepare the third draft so that it is complete with diagrams and artwork.
13. Test the third draft on from four to six students independently and give the criterion test at the end. Indicate to students that the program rather than the student is being tested. All comments are written and response errors are tabulated. The criterion examination is used to evaluate the effectiveness of the program.
14. Prepare the fourth draft confining revisions to changes in wording, improvement of sentence structure, and minor mechanical corrections.

15. Test the fourth draft on from ten to twenty-five people. Up to this point no more than three or four persons have been tested at one time, due to cost of printing copies of programs and making revisions after each testing.
16. Prepare the program for presentation in the form that has been selected. This might be cards, slides, or film. (12,p.156).

The presentation of Mager's technique using sixteen steps excludes both theoretical discussions and descriptions of the detailed mechanics of frame preparation.

Quinn's Ten Steps

Quinn's (20,p.80-83) experience in writing and teaching others how to program convinced him that there are three aspects of the task: effective analysis of objectives, effective programing technique, and effective expression. The first two of the above aspects of the task are crucial activities for programers. The last is an art in itself and was not discussed by Quinn.

Quinn delineates ten steps in the procedure for developing a program. The first step is stating terminal behavior. This statement specifies what the student should be able to do after completing the program. Quinn agrees with everything that Mager says about objectives except that he prefers to have this statement include only the terminal behavior desired, excluding for the moment any specification of conditions or limitations surrounding the terminal behavior.

The second step is to determine competence required and relevant conditions after training under which competence will be demonstrated.

These conditions are specified if and only if they will affect the way the job is done.

His next step is development of the final test. This test is based on the job to be performed and will represent what is expected of the student. The scoring system used will indicate the degree of competence required.

Quinn's fourth step is identification of the student. This corresponds with Mager's identification of the target population. A pre-test is used to find out if the student is ready for the program and a post-test is used to find out how much he has learned from the program.

Consideration of implied objectives is the next step. The programer must find a way to bring the student from where the pre-test shows he is to where the final test indicates he must be. The programer, therefore, has to devise intermediate goals, each one of which will advance the student toward the desired terminal behavior.

Prover frames are constructed as the sixth step in order to "prove" or demonstrate that the student has reached the implied objectives. Prover frames test for the achievement of one intermediate goal on the way to the terminal objective. The frame appears at the end of a series of frames which lead up to the prover frame and which make it possible for the student to respond correctly.

Quinn's seventh step is arranging prover frames in good teaching sequence.

Next, "lead-up frames" are written in order to obtain continuity and gradual development toward ability to respond correctly to the prover frame. The lead-up frames and prover frame combined are called an achievement unit, a term which indicates its purpose.

Quinn, for his ninth step, completes the achievement unit by using cueing, redundancy, and fading.

Tryout and revision is the final step. This step may occur after all the achievement units have been written. One or more units, however, can be tried out at a time. The program is faulty if every response to every frame except the prover frame is correct. If this happens, the lead-up frames need reworking, frames are over-cued or misleading, or there is a gap the program has overlooked.

Quinn indicated that these ten steps are helpful in developing a plan of operation, but they do not substitute for the programer's powers of analysis and ingenuity.

Hughes' Programing Rules

Hughes (7,p.57-95) indicated that the writing of programs encompasses planning, writing, revising, and tryouts on students. He presents a number of basic rules in general nontechnical language for programers to follow. Before beginning the actual writing of the program, he recommends stating the specific educational goals the program is supposed to achieve. Other factors considered at this stage are level and pace at which the subject matter is to be presented. Hughes determines the level and pace by specifying the characteristics of his future students. The next problem discussed by Hughes is the construction of a comprehensive achievement test to measure attainment of the earlier established goals. The achievement test can be a written, an oral, or a performance test, whichever most closely fits the kind of behavior the program is designed to teach.

After the above decisions have been dealt with, the programer prepares the course outline. Hughes (7,p.62,63) suggests an outlining technique which uses a two-dimensional table where course goals are listed on the left side and course content categories are listed across the top in order of presentation in the program. Hughes calls this a blueprint technique. When the blueprint is complete, it is helpful to develop a flow chart or a content matrix showing sequence or broad subject matter areas.

After twenty-five to fifty frames have been written, Hughes recommends trying them out on a co-worker or another program writer in order to catch obvious omissions or ambiguities. Then the frames are tried on several typical students. Achievement test questions are also given to these students. Hughes uses extensive try-outs and revisions, for he believes this produces a program of high-quality. A subject matter specialist also reviews the program to find technical errors or omissions and to make suggestions for improvement.

Hughes believes variety is important in programing in the future, otherwise the saturation point of students for programs will soon be reached. He suggests some of the following variations: implicit rather than overt responding; summarizing material rather than constant use of short responses; and referral to outside sources such as the library, laboratory, TV, films, records, and textbooks rather than working only on the program.

Lysaught's and Williams' Nine Steps

Lysaught and Williams (10,p.1-167) suggest to the novice programer nine steps which they follow. The first step is to select the unit to be programed. The inexperienced programer is advised to select a unit in his field of study, something relatively easy to program, a short unit, an area that has been inadequately taught by teachers and an area that has inherant logical order.

After selecting an area to program, the second step is to make definitions and assumptions about the student for whom the program is planned. These are concerned with his ability, background, and motivational factors within the culture that impells him to learn.

The third step consists of selecting appropriate objectives for the program including immediate and ultimate objectives. The authors use what they call a ladder of abstraction (10,p.54) to arrange operationally defined objectives in such a way that tentative priorities can be established for the teacher and the programer. A volume of educational objectives in the cognitive domain by Bloom et. al. (10,p.58) was found to be useful to Lysaught and Williams. They suggest that studying the six classes of objectives - knowledge, comprehension, application, analysis, synthesis, and evaluation - increases the programer's awareness of the extent and variety of specific educational objectives, many of which are commonly neglected by teachers.

Selecting a program paradigm or model is the fourth step which the programer follows as he constructs his program. The authors indicate the paradigm or model selected should be on the basis of the unit involved, the students to be accomodated, and the objectives to be achieved.

(10,p.90). In other words, they believe all steps in the process should be linked to earlier steps.

The fifth step is the construction of the program. Lysaught and Williams suggest using a procedure for determining sequence of items. This procedure consists of aligning the behavioral aims into some logical order, then examining the order for internal logic and "flow" from beginning to end. Sequencing becomes almost self evident. If sequencing possibilities are not seen readily, then further breakdown of objectives may be necessary.

Information can be presented by using examples and simple definitions; by using appropriate context, including graphic illustrations to develop understanding of the information content; by using small steps with careful sequencing; and by using frequent but varied repetition.

To make sure appropriate student response is made, the programer can use mechanical devices, grammatical construction, common knowledge, or words with high association value, and fading or vanishing to reduce the number of cues gradually.

The sixth step consists of editing and reviewing items on the following points: accuracy and relevance of material, style, vocabulary, and content interest.

The seventh step is the first field trial with thirty to thirty-five students participating who fit the programer's assumptions. Lysaught and Williams appear to differ from other programers who suggest trying the program on individual students prior to a field test. These authors believe that before the field test is given, instructions, response sheets, and the post-test should be planned. They suggest that the programer observe a few students as they participate in the program. This helps the programer in the reviewing and rewriting of items.

After the field test the programer would examine errors committed by students in relation to item length, item difficulty, ambiguity, and cueing. The programer has two other concerns at this stage: are students accomplishing the objectives, and are students satisfied? The programer should continue to review and rewrite after finding the weaknesses and faults of the program.

The process of evaluation is the eighth step which includes error analysis, pre- and post-test analysis, and analysis of unit length. Assumptions about students, objectives, and model selection are also considered in the evaluation. Lysaught and Williams believe that each of the earlier steps in the development of the program are interdependent.

As a final step before publishing the program, the authors believe that supplementary material describing how the program was developed should be prepared.

Stolurow's Guides

Stolurow (19,p.85-95) suggests fifteen interim guides to the programer. The first of these guides is to start from the teaching objective and work back.

> "The programer has to begin by identifying: (a) The specific responses that constitute criterion behavior, (b) the particular cue-stimuli with which these responses will become associated, and (c) the sequencing or organizational requirement of the task to be learned; this is the task analysis in terms of criterion behavior." (19,p.85).

The second guide is to break material into stimulus-response elements. Stolurow thinks of the basic elements of the program as a set of simple sentences. After these stimulus-response elements have been identified, determine the relationship of one to the other.

The third guide is to keep the response simple. Stolurow recommends this from the standpoint that it is less complex to build a teaching machine to accomodate and record behavior when responses are simple. If the teaching objectives require complex responses, however, then complex responses should be provided for in the program.

The fourth guide is to program first information items then application items. Stolurow recommends presenting information before students are required to use this information. If the student does not give the correct response, then the program needs to be rewritten to clarify the information.

The fifth guide is to identify any need for association reversal. Research indicates that it is both useful and necessary to teach the student to make associations in two different directions. Stolurow uses the example of the need to make both the English-French and the French-English association. The programer determines in which direction the association is simpler and more meaningful before deciding which association to teach first.

The use of class-descriptive feature is the sixth guide. A class-descriptive feature is defined as

> "an aspect of a complex stimulus which is common to two or more but not all the stimulus objects that are the occasions for different responses in the learning task; for example color, shape, position or size may be class-descriptive features of complex materials." (19,p.87).

The class-descriptive method is contrasted with the object-descriptive method and is said to result in more efficient learning and better transfer to other situations. (19,p.89).

The seventh guide recommends that cues and responses be made asynchronous. Stolurow states that, "Programing according to the principle of asynchrony would place all instances of a concept together so that adjacent cues would be different in as many ways as possible." (19,p.91).

Continuity should be built into the program according to the eighth guide. After examples of rules are taught, the student should generalize the concept. Next, the program should lead to another generalization. Third, the program should give specific examples.

Guide nine is to repeat information with variations. If there is no variation, negative motivation is formed by the student. Repetition is acceptable when the context is varied.

The use of small steps is the tenth guide. Using small steps allows for meeting individual differences, since the learner who already knows them can cover them quickly. The programer should assume that the student possesses a minimum of information.

That the program should be augmented is guide number eleven. Augmentation is the building up of a compound or complex set of relationships. One concept is introduced at a time, and the relationship between concepts is taught. The objective in augmentation is to build a larger response unit or concept through small steps.

Guide number twelve is to build a web of association. Research has shown that more meaningful material is learned faster and retained longer. Seeing the new material in relation to a body of known and familiar content is important to the learner.

Guide thirteen recommends the gradual vanishing of the eliciting stimulus. The student becomes more self-reliant if prompts are gradually withdrawn. It is better to have the steps too small than to have them too large.

That induction and deduction be used is guide fourteen. Stolurow favors an inductive program. In this type of program instances of a general principle and various pieces of it are given to the student in steps which terminate with the general principle. Inductive and deductive sequences may be used in combination. Stolurow terms this an example of association reversal.

The last guide is that major points should be made salient first to highlight the overall outline, then gradually to add the detail. The reason for this, according to Stolurow, is that if critical material is presented first, then the student is able to master it early.

Skinner's Concepts

Stolurow summarizes (19,p.97-98) some of Skinner's concepts concerning techniques of programing. The student learns first some of the basic terms, concepts, or perceptual materials with which the program will deal later. After this technical terms are slowly inserted in the program, and gradually are included items which change the set of associations.

Skinner (17,p.62-68) recommends the following procedures: (a) vanishing as a technique to develop new responses; (b) a rich association context or understanding; (c) the teaching of operations as early as possible; (d) the use of such crutches as slang associations, rhyming, and analogy as stimuli for the correct response; (e) the forming of written verbal responses; (f) reinforcement of adequate written responses used progressively to shape the behavior; (g) the use of small steps; and

(h) the use of composition devices so that the student can practice making the response which will be used in criterion situations.

Three Systematic Approaches to Programing

Some writers, in an attempt to make programing more scientific, have designed methods for structuring the subject matter content prior to writing frames. These writers recommend three unique systems of organizing the subject matter. All of them are presently being tried experimentally.

Ruleg System

Evans, Homme, and Glaser (5,p.513-18) worked together at the University of Pittsburgh on the development of what they have called the Ruleg System. Their programing technique consists of breaking the subject matter into two classes called ru's for rules and eg's for examples. Rules and examples are further classified as complete and incomplete. The symbol for an incomplete rule or example is a tilde (~): $\widetilde{ru}$ and $\widetilde{eg}$.

These experts suggest steps for the development of the program. The first of these is to specify the criterion behavior by outlining the responses desired from the student at the end of the program. Step two consists of writing on separate cards all the rules necessary to teach the student the desired concept. The programer next collects all necessary support in the form of texts, notes, and advice. The preparation of a preliminary ordering of rules as they will be presented in the program is the fourth step. The student must be able to interrelate concepts or rules. For this reason a rule matrix is made. The rule matrix consists of listing the rules on a horizontal and on a vertical axis. The cells where the different rules interact are ordered pairs of rules. The programer uses these in a systematic plan for considering relationships among the rules. Rules are checked for similarities, differences, or any of a host of possible intraverbal connections. The major diagonal of the matrix is reserved for definitions of the rules. The sixth step is to look at each cell in the rule matrix and to construct examples for the program. These examples are chosen according to three considerations: first, an adequate number of examples must be provided to give practice; second, the full spectrum of examples should be used, that is, special cases, limiting cases, trivial cases, examples with inadequate information, and examples with redundant information; and third, generalizations of the rules must be as diverse as possible, and discriminations between rules should be adequate.

Numbering the cells in the original rule matrix to indicate the order in which the rules are to be presented and exemplified is the seventh step. Assembling the rules and examples into frames which consist of various rule-example combinations and combinations of incomplete examples and incomplete rules is the next step. The authors describe six frame types: frames to introduce new rules, frames to introduce new words and terms, analogy frames, inductive frames, incomplete examples with minimal cue frames, and error-detecting frames. Using the rule matrix as a prompt, assemble frames of various types into a program for the ninth step. Step ten consists of giving the program to students and doing an "item analysis" on their responses. After analyzing responses, revise the program on the basis of student responses and comments. This is the eleventh step. The programer must be careful not to overprompt and to insure prompts are faded, and must check to see that student responses are not made to a wrong set of stimuli, for example, underlining. The final step is to repeat the administration and revision procedures until the program is producing criterion behavior reliably and efficiently.

Mathetics System

Gilbert (6,p.1-73) developed a highly theoretical framework based on reinforcement or Skinnerian theory within which the programer should work. He coined a new word, mathetics, for what he conceived to be a developing science. Mathetics is defined by Gilbert "as the systematic application of reinforcement theory to the analysis and reconstruction of those complex behavior repertories usually known as 'subject-matter mastery,' 'knowledge,' and 'skill.'" (6,p.8). He thinks of mathetics as taking the guesswork out of programing by applying behavioral principles.

Mathetics is a production process consisting of four distinctive stages. Gilbert summarizes these as follows:

> "(a) Prescription, a description of the behaviors that constitute mastery in some subject-matter domain. The only behaviors made explicit in the prescription are those necessary to synthesize mastery performance. The behavior repertory that the prescription represents is called the synthetic repertory and is roughly equivalent to what is meant by the word 'practice' as distinguished from 'theory.'
>
> "(b) Development of the Domain Theory. In this process the essential elements of the subject-matter are extracted from the details and described in behavior terms. A domain theory is relevant only to the subject-matter reflected in the prescription. A new prescription is written describing the analytic observations of a subject-matter; this is the behavior we usually mean when we say a student has 'understanding' or knows 'theory.' This new prescription describes the analytic repertory.

"(c) Characterization. In this process an analysis is made of the behavior properties of the prescribed repertories; a description is made of the generalizations that are to be taught, of competition with adequate performance, and of the behavior available to overcome this competition. It is from this information that a plan of the lesson is developed.

"(d) Exercise Design. The exercises are designed according to a basic model, and in a sequence consistent with a lesson plan developed from the characterization." (6,p.9,10).

Gilbert's programing process is interesting from the standpoint that many of his learning operations are presented or sequenced in reverse order from the traditional way of teaching. Gilbert's analysis of animal learning resulted in his use of this backward process. The student learns the last step in a process before learning the prior steps which progressively lead to achievement of the objective.

Gilbert's programed instruction technique appears to be very difficult due to the technical vocabulary which he uses. Educators, as well as researchers, will be following with interest the field tests of programs developed using Gilbert's techniques. If these programs are superior to other programs, then study of the science of mathetics will become a prerequisite for programers.

Program Lattice Concept

Woolman (21,p.1-54) questions whether confused students are the rule because learning materials are confusing or because they lack the capacity to learn the kind of information we want them to learn. He constructed what he calls the concept of the program lattice in an attempt to relate the learning process to stages in conceptual development.

Woolman's conceptual lattice systematizes the content to be taught. Construction of the program lattice is the important initial step for the programer. A second lattice is then prepared to control the sequence of items to be written by the programing team. Woolman states,

> "The lattice specifies: (a) the organization and interrelationships of the information to be taught; (b) the over-all training goal or educational objective (which is always located in the upper right hand cell); and (c) the cells provide the basic sequence of information to be presented to the learner." (21,p.21).

Woolman's programing lattice is similar to Lysaught and Williams's ladder of abstraction. Their ladder specifically excludes negative and/or non-exsistent relationships. (10,p.33).

The concept of the program lattice is complex and is not recommended for the beginning programer unless special training in the use of this technique is available.

Writing of Frames

The following twelve rules are suggested by Klaus (8,p.136-41) for building frames. The first rule is to require active responding. This is required since Klaus believes that the student learns from making a response and not from hearing or seeing it.

The second rule for building frames is to use proper cueing. The proper response can be elicited by the use of wording, rhyming, synonyms, or particular word patterns already in the student's repertoire.

The third rule is to consider the appropriate context. The correct response must be made in the appropriate context, or the fact that the student can respond correctly is meaningless. As the student learns, he must gradually have fewer cues so that he is responding in the presence of relevant context without the help of the programer.

Klaus's fourth rule is to use small steps. His data have shown that students proceed faster through programs made purposefully longer by dividing frames into smaller steps than through a condensed program.

The fifth rule is to use careful sequencing of subject matter. Complex concepts should be built on simple concepts. The writer decides beforehand what the sequence of topics will be.

One of the basic principles of learning is that retention of a response depends on amount of overlearning that has occurred. Klaus emphasises that much variation in the cueing and the context is needed each time the response is repeated and he recommends as his sixth rule the use of frequent repetition.

Knowledge of the subject matter is the seventh rule. Material within the program must be technically accurate. It is possible for a program to be good in the sense that students learn what is in the program, but they may be learning wrong facts and concepts.

The eighth rule emphasizes teaching, not lecturing. The programer differs from the lecturer in that he not only provides facts to the learner but also helps him to learn. If the student does not learn from a program, it is the programer's rather than the student's fault.

The ninth rule is to evoke a relevant response. It is possible to select a trivial rather than an important word to be filled in by the student. When this is done, the student is led away from concentration on the important concept.

Don't provide more cues than necessary is the tenth rule. Subtle cues often insure appropriate responses. Let the student make his own generalizations and discover his own principles whenever possible.

The eleventh rule is don't assume too much knowledge. The programer can avoid this by giving frames to trial students. If the students make errors, the programer has assumed that the students had more previous knowledge than they actually had.

Don't present two new facts in one frame is the last rule on building frames. Programers often forget that students learn from responding rather than from reading. Presenting too many facts in one frame will result in errors on successive frames.

Klaus states,

> "These twelve rules sum up much of what we know about the art of programing at this time. ...they tend to be incomplete, and we have not yet achieved our objective of being able to provide firm directions to beginning programmers. The lack of definitive rules, however, does encourage many programmers to experiment and thereby produce new rules and new concepts of programming." (8,p.141).

Eigen (4,p.1-6) discusses the construction of frames. He thinks of frames as having three components: operation, data, and instruction. Operation is the part of a frame that requires the student to do something; data is the part of the frame that provides the learner with information; instruction is the part of the frame that tells the student what to do when he completes the operation of the frame.

Eigen goes on to further classify four different types of frames: the panel, the review, the instruction, and the force frame. The panel frame is an item which provides information and, at some point, instruction. Examples of panels are paragraphs, graphs, parts of a textbook, or object such as a pig that the student will be asked to dissect.

The review frame contains an operation and instruction. It assumes that the student has necessary information to complete the frame. Review frames can be broken down into three subclasses: rote review, restated review, and delayed review.

The instruction frame has instruction with no operation or data component.

The force frame contains no obvious data component. Eigen states, "The student is almost 'forced' to respond correctly even though there is nothing in his repertoire that would indicate that the response is a correct one." (4,p.3).

Eigen indicates four techniques which programers have used to help students to respond correctly. They are: the color cue, the spatial relation, the emphasizing technique, and the demonstrating technique. Color cue is a technique of pairing part of the stimulus with the answer by presenting them both in a color different from the general material. Spatial relation is used by placing the answer box in relation to some visual cue within the frame. The emphasizing technique is employed by underscoring or reproducing a word in a distinguishing color that the student will be required to construct in later frames. The demonstrating technique is used in teaching some sort of structure. This involves pointing out correct answers by use of an arrow or devices such as dotted lines.

Eigen points out that as students proceed through a program, they become aware of the programer's cueing techniques. The programer should be aware of this danger and should use varied techniques of cueing to avoid over cueing.

Hughes (7,p.80) considers the student's education and experience before he begins to write the frames. He suggests using cards so that sequence can be changed easily. Rarely should a frame consist of more than two or three sentences, or more than fifty words. Hughes summarizes his suggestions for the drafting of frames as follows:

> "a linear program consists of a combination of presentation, practice, and review frames in the optimum sequence and quantity. The program writer's judgment, imagination, and creativity are brought into play in assembling a sequence of different kinds of frames that (1) succinctly present the course material, (2) insure a high percentage of correct responses, (3) present many interesting examples and applications of the basic points covered, and (4) provide for sufficient practice and review. Doing these things well is a formidable challenge to the program writer. He must succeed in doing so, however, if the student is to achieve the command of subject matter that is expected of him." (7,p.80).

Summary of Review of Literature

This review of the literature about methods of programing showed consistencies in psychological principles on which the method is based but great diversity in techniques. Several writers, especially Gilbert and Woolman, recommend to the programer a highly technical system.

Many programs which are successful from the standpoint of attainment of desired terminal behaviors have been written using procedures which the average subject matter specialist who has a meager background in psychology can learn to follow. A number of the books and bulletins and journal articles which were reviewed are recommended for this purpose.

CHAPTER III

PROCEDURE FOR DEVELOPING THE PROGRAM

Purpose of the Study

The purpose of this study was to develop a self-instructional program on the fundamentals of the sewing machine for seventh, eighth, or ninth grade home economics students who had had no previous knowledge of the sewing machine. The final criterion of the program was whether the objectives of the program were actually achieved.

An area of home economics subject matter was to be programed since the investigator had had her training in this field. Fundamentals of the sewing machine were selected because there had been few, if any, attempts to program a skill in any field at the time this program was begun. Students find it difficult to operate and understand the sewing machine without calling on the teacher throughout the construction of their garments; many teachers lack knowledge, time, materials, confidence, or interest in teaching the fundamentals of the sewing machine. The investigator believed that this was a "small bit" of material for her first attempt at programing - this later proved to be a fallacy.

Training of the Programer

The investigator became interested in the art of programing during the spring of 1962 while listening to discussions about this method by the staff in Home Economics Education at Woman's College, University of North Carolina, and through reading articles in periodicals. After selecting this area for her thesis, she enrolled in a six weeks' course on programed learning at the University of Pittsburgh[1] during the summer of 1962.

Training at the University of Pittsburgh proceeded through lectures, discussions, and readings which were designed to familiarize the participants with the psychological foundation and techniques of programing. Time was alloted to study and respond to programs that had been developed previously by others. Each participant in the class was asked to begin the development of a program. The first step toward this was a statement of objectives. Next, students began trying to program by writing frames. Class and staff members tested these beginning frames to see if they were clear, were in correct sequence, and were in small steps. The writer valued the experience at Pittsburgh and considers it the minimum of time needed for training.

Smith (14,p.7) estimated that somewhere between two and four months of full time training and practice is required before a programer will be able to write a reasonable first draft. This emphasizes the slow progress that may be expected by beginning programers. Other prominent programers indicate that three people should be involved in the development of the program: the subject-matter specialist, a psychologist who has specialized in learning theory, and a programer who has had experience in classroom teaching. Some say that the programer should have experience in an animal laboratory observing how animals learn and then

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[1]Instruction at the summer school session was directed by Dr. Maurice Lindval. Guest speakers were Fahey and Glaser, University of Pittsburgh; and Adres and Klaus, American Institute of Research, Pittsburgh.

work with an experienced programer before beginning his own program. It would seem to the writer that we are still learning about the art of programing and that it is too early to set standards for the amount or the type of training that a programer needs. Programers are merely at the point of suggesting guides rather than rules.

Preparation of the Program

Definition of the Target Population

The writer, as a first step in the development of the program, defined the target population for whom the program was planned. The following definitions were made:

1. the student is in the seventh, eighth, or ninth grade.
2. the student is going to begin using a sewing machine.
3. the student does not know the parts of a sewing machine.
4. the student does not know how to thread a sewing machine.
5. the student can read at least at the seventh grade level.

Statement of Objectives

Researchers have concluded that because of the precise control over the learning process obtained in using programed instruction, it becomes especially important to develop a set of objectives for the program. These objectives differ from the usual teaching objectives in that they state what a student should be able to do when he is finished with the program rather than over-all objectives of instruction. The second step, then, in developing the program was to list the objectives in terms of behavior desired from the students.

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The classification of educational objectives by a committee of college and university examiners which is presented in a book edited by Bloom (1,p.1-207) was of help to the programer in developing objectives for the sewing machine program. No attempt was made, however, to go beyond knowledge, comprehension, and application in the hierarchy of educational goals. It would be the teacher's responsibility to guide students in the further use of knowledge gained to solve problems involving analysis, synthesis, or the making of judgments.

The programer first stated a relatively short list of objectives. After completing the program the students should be able:

1. To identify an electric or treadle sewing machine;
2. To identify the location of each of the following parts of a sewing machine and to verbalize the function of each:

   spool pin — hand wheel
   thread guide — slide plate
   tension regulator — stitch length regulator
   thread take-up lever — bobbin winder
   needle bar — needle
   presser foot — presser bar lever;
   feed dog
3. To thread the sewing machine and to wind thread on a bobbin in a reasonable length of time;
4. To center body with needle and have both feet flat on the floor when sitting at the machine.

Later, when it was decided to use the sewing machine program in the pilot study and as a part of this thesis, a number of objectives were added. The student should be able:

5. To bring the bobbin thread up through the hole in the throat plate;
6. To replace the needle when necessary;
7. To set the stitch length regulator;
8. To adjust the upper tension;
9. To adjust the pressure bar for varying kinds of fabric;
10. To place the bulk of the fabric in the correct position in relation to the machine;
11. To remove and replace the presser foot;
12. To remove the presser foot and replace it with the zipper foot;
13. To appraise and judge machine stitching;
14. To mark machine for guiding seam width with tape;
15. To stitch a straight seam by using the presser foot or tape as a guide; and,
16. To watch the small side of the presser foot as a guide for one-fourth inch edge stitching.

The research committee that is making plans for the final editing and field testing of the sewing machine program and for experimental studies in which the program will be used has defined the objectives in a slightly different form. A copy is included in the appendix. (See Appendix A).

The objectives of the sewing machine program served two purposes; first, they guided the programer in the development of the program; and second, they were useful in determining how much the student learned from the program.

Selection of Technique for Programing

Once the investigator had a clear idea of what the student was to be ready to do at the completion of the program, she was ready to determine which technique of programing to use. The linear technique was chosen because it was the method used at the University of Pittsburgh, because it seemed to be a good technique for programing a skill, and because it was thought to be the easiest technique for a beginning programer. Throughout the development of the program, however, there was concern as to whether it was the best technique for programing this particular subject matter.

The programer was first concerned with writing a set of frames that would exhibit the required behavior in the subject. In order to do this, she presented information in small units in which key or important words were partially or completely missing. Students were guided to fill these in. The object of each of the frames was to lead the student to make a response to the information presented in the frame. The construction of the frame was determined by the specific response desired. The technique known as cueing was used to induce the student to make the correct response. Such cues as underlining, letter prompts, cartoons, diagrams, and examples were used. Later in the sequence, frames were written in the form of completion test items which gave the student an opportunity to evaluate his progress. This first set of frames was made up from a series of steps which the programer believed she would use if she were teaching a group of students and if she were attempting to help them meet objective one.

Next, the number of cues was gradually decreased until the student could respond independently. Finally, practice was given so that the student would increase his mastery of the subject. Lack of sufficient practice may result in students' working the program easily but without performing accurately on the final test.

Because of the restrictions that a linear program presents, it is often necessary to provide supplementary or reference material to accompany the program. In this particular program this need was met through a diagram of the sewing machine which was placed at the back of the program for a reference. (See Appendix B). This diagram is called a panel.

Preparation of Illustrations

Illustrations were drawn on many of the frames as an aid to student comprehension of the position on the sewing machine of its parts and of techniques of threading and adjusting the machine. When they were available, commercial diagrams were clipped and pasted on the frames of the rough draft. When none could be found, the illustrations were sketched in by hand. Later, all illustrations were first sketched by an artist with a home economics background and then transferred to stencils for the preliminary field test. All drawings were made as simple as possible because of the limitations of the mimeographing process and for clarification. The large panel drawing was placed on a sheet of paper separate from the program, for reference by the student whenever the program directed attention to the panel.

Individual Testing During Development

Originally each small step or frame was written on a small note pad. These frames were then tested by two adults. After this trial the frames were typed on five-by-eight index cards. Cards of this size were selected for this program because of the number of drawings requiring considerable space. The researcher noted that the frames needed to be doubled after trying the program on the two adults. After typing the revisions on index cards she tested the program by some of the class members and by a guest lecturer at the University of Pittsburgh.

The first sixty or seventy frames based on objectives one to four, were tried on four adults and one sixth grade student. Adults were used rather than members of the target population because only one subject in the age group of the target population was available. Later a group of fifteen junior and senior high school students and adults who were not familiar with the sewing machine were used in Greensboro trials. Some of the students had extensive experience working with the programer before the program was mimeographed. They continued to try-out the program after each major revision.

The three or four students who first read the program sat with the programer and responded orally, making constructive comments or asking questions as they proceeded. This proved most helpful in anticipating problems which needed solution. From the time the programer first began working with students their comments influenced greatly each revision of the frames.

The decision was made to have the student not only to look at the sewing machine but to move certain parts and manipulate them as they later would be asked to do in the operation of sewing. This was essential since the objectives were dependent on the ability to perform at the sewing machine. It seemed natural to write frames in which students would be asked to carry out a small task at the machine.

Throughout the development of the program a specialist in the area of clothing and textiles at The Woman's College reviewed the program for accuracy and clarity.

Format

When time made it necessary to limit writing, improving, and revising the program, further decisions were made concerning the form in which it would be presented to students. Frames are usually presented either in a textbook, in a teaching machine, or on index cards. Since subjects using this program are required to perform at the sewing machine, their work space was limited. Cost was a major factor against using index cards or teaching machines in the preliminary field testing. Therefore, a format similar to index cards was selected. The factor determining the size of frames was the average number of words and size of illustrations. Three frames per page was selected.

The program was typed and the art work drawn on stencils and then the program was mimeographed on bond paper (see Appendix C). After mimeographing, the programer cut the pages into the three individual frames, the answers were folded back, and holes were punched in the left middle side of each frame. These mechanics were time consuming until machines to cut, fold, and punch holes were discovered and made available. Then the 321 individual frames were assembled and were placed on rings. Twenty-one copies of the program were cut and assembled, twenty copies to be used in the field test and one to be used for a working copy. Changes were made on this working copy as soon as need for change was noted in order to help in the later revision of the program.

The last half of the program was tried on several adults and two students before being mimeographed for a preliminary field test. It was believed that future revisions would be made on the basis of the responses of the three school groups to be sampled. All except the last six objectives were programed for current preliminary testing; work continues on this program as a part of the larger research study.

Supplementary Materials for Field Testing

A questionnaire was devised to learn whether any of the students had preliminary knowledge of the sewing machine before participating in this testing (see Appendix D). Information from this questionnaire is also to be used in the planning for the proposed larger research study.

The tentative form of the criterion test, based on the objectives of the program, was developed by Johnson[2] as a part of the proposed larger research project. This test was used both as a pre-test and a post-test. The test will be revised at a later date and will be administered to a larger group of students. An item analysis will then be made and reliability and validity will be computed.

A form was developed on which students could record time spent working on the program and number of errors they made (see Appendix F).

---

[2]Johnson, Hildegarde is chairman of Home Economics Education at The Woman's College and is director of this thesis committee.

Answer sheets were developed and mimeographed with numbers corresponding to the frames in the program. This was to serve three purposes: (1) to make it easy for the researcher to know where the errors were made; (2) to save student time; and, (3) to limit the number of copies necessary so the programs could be re-used.

A student reaction form was selected to be given at the end of the preliminary field testing in order to obtain personal reactions of the students toward this new method of learning (see Appendix G).

Testing of the Program

Once the program had been printed in its final form, it was ready for the preliminary field test in the schools. The purposes of giving the program to these three standard groups were as follows: (1) to know whether the program contained material too difficult for students to learn; and, (2) to determine whether there was an adequate number of practice problems to insure mastery of the subject content.

Source of Subjects

Three schools in Greensboro were selected on the basis of proximity to The Woman's College and the willingness of the principals to cooperate. The first step in obtaining the students was a letter which was sent to each of the three principals explaining the proposal (see Appendix H). After the principals indicated they would participate, an appointment was made to discuss the details of the study.

A total of forty, seventh and eighth grade students who met the specifications for the target population, participated in the field testing. There were twenty students from Curry School, the laboratory school associated with The Woman's College. Ten students from each of the other two schools participated.

The principals were asked to select some high achieving and some low achieving students who had no previous knowledge of the sewing machine. The principal of one school chose honor roll students for high achievers along with those willing to participate. Recorded I Q scores indicated that students with a wide range of academic ability rather than a dichotomy of high and low ability students had been used (see Appendix I).

Classroom Conditions

The regular instructors of the classes were not present when students learned to use the sewing machine by this method. Outside influences on students were not controlled. At the end of the six day testing periods some students indicated resentment since their study time had been limited. Students met on consecutive days and during the same school period each day.

Personnel Administering the Program

The writer was in charge of the classes at each of the three schools and was aided at various times by her major adviser who acted as an outside observer, although she answered an occasional student question.

Members of the staff in home economics education acted as observers for one class period at the laboratory school in order to find areas in the latter part of the program that needed revising. The assistants on this day helped in distributing supplies and aided in watching for students who were having difficulty in the program. On all other days the experimenting was done by the researcher.

Room Set-Up

Two students were assigned to each sewing machine and sat as close to it as possible. The sewing machine was placed on or near the end of the table and students sat on each side of the machine when this was possible.

Supplies were distributed when time permitted. At other times they were kept on a supply table near the center of the room for the students to obtain as needed.

It was decided to have two students at each sewing machine since most home economics classrooms have only one machine for two or three students. The preliminary testing at one school took place in an empty classroom since the home economics department was in use. Five portable machines were borrowed and transported to this school. In the other two schools sewing machines were provided and the testing took place in the home economics department.

Supplies other than sewing machines needed for the program included: contrasting thread for spool and bobbin for each sewing machine; scissors; fabric for stitching; pencils; and samples of light, medium, and heavy fabric.

Instruction to Subjects

Since none of the students had previous experience in using a self-instructional program, verbal directions were given by the researcher. Following is a typical introduction:

You were selected because you do not know anything about a sewing machine, but you indicated a willingness to learn. You are cooperating in a research study on a new way to learn. Perhaps some of you have heard about this method. It is known by several different names: programed learning, programed instruction, self-instruction, and teaching machines. In this study we are not going to use a teaching machine, but we are going to try to find out if you can learn how to use a sewing machine by teaching yourself with the aid of a program.

Here is a sample of the program. (A section of the program was held up). Since it is rather bulky to handle, we have divided it into three sections. As you turn the pages, you will see what we call frames. I am sure most of you recall a frame on a filmstrip. This is similar to a filmstrip frame in that you can see one thing at a time. On each of these frames we have a completed statement followed by a statement that is not completed. Here is where your part comes in: you need to complete these statements. You will be able to do this because the program will teach you the correct answer which you will find on the back of each frame after you have written your answer. Be sure to write down your answer before looking on the back, for this is the best way to learn. Each of these frames is numbered to help you keep track of them.

First of all we want you to take this test which is on top. Then please fill out a questionnaire. This will help us to find out what students your age know about a sewing machine and some of the things that you like to do. Underneath the questionnaire you will find a sheet of paper for you to keep track of the time you spend each day working on the program, the number of errors you make, and the number of frames you finish each day. Before beginning the program and before you leave each day, fill in the empty spaces under each of these columns. Before beginning to work on the program, write the date, the hour, and the number of the first frame you begin working on. At the end of the period each day fill in the total time spent on the program, the total errors you made, the last frame number you completed, and the total number of frames you completed. This information will help me to explain to teachers how long it takes to do the program and will show me places that have errors.

Attached to this Time and Error Sheet is an Answer Sheet. Look at it now. To the left of each number is a short line on which you will make an x if you make an error. Otherwise leave the short line on the left side blank. To the right of each number is a longer line on which you will write your answer. Sometimes you will read a frame but will not have to write an answer. On these numbers I have typed 'no response' so you will not get confused.

If I have done a good job of developing a program, you should not make any errors so do not feel bad when you make one. If you make errors, it is my fault, not yours. I need to know where you make errors so that I can make changes. In this way students who take the program after you will not make as many errors.

Remember this is <u>not</u> a <u>test</u>, it is just a new way of learning by teaching yourself.

Do the following in this order: (1) take the pre-test, (2) fill out the questionnaire, (3) write down the time, date, and first number of the frame on the time and errors sheet, (4) then begin to work on your program.

Remember you are helping us to find out if students can learn by teaching themselves. We want you to do your very best so work as fast as you can but, do not feel as if you have to rush. Some people find it difficult to work when others are talking, therefore, you need to be as quiet as possible so that everyone can do his best.

Raise your hand if you have any questions.

All instructions were given at the same time so that the students could continue to work without wasting time waiting for others to finish.

CHAPTER IV

FINDINGS

Results of Preliminary Research

In this chapter the information obtained from the first field testing will be discussed. Since this was a preliminary field trial, conducted in order to make revisions on the sewing machine program, no extensive statistical analysis was planned. Tables, however, were prepared to help summarize the results. The data will be presented and discussed first. The second section of the chapter contains a discussion of student reaction to programed teaching.

Treatment of Data

Pre- and Post-Test Comparison

On the first day of the preliminary field trial the pre-test was given to each student, and when the program had been completed, the students were tested again. Comparisons between the pre-test and the post-test scores were made. While the theoretical range was 0-69, the actual range on the pre-test was 0-18 and on the post-test, 25-67 (see Table 1).

The pre-test median scores for the three schools in the study were: School A, 6.6; School B, 7.5; School C, 4.5. The composite median score was 6.2 (see Table 2). These low pre-test scores indicate that the students had very little preliminary knowledge of the kind measured by the criterion test.

TABLE 1

FREQUENCY DISTRIBUTION OF SCORES, ON THE PRE- AND POST-TEST

Pre-test scores	Frequency N=40	Post-test scores	Frequency N=40
18	1	67	2
16	1	66	1
15	1	65	1
13	1	63	3
12	1	62	3
11	1	61	6
10	3	59	2
8	6	58	1
7	3	57	1
6	6	56	1
5	2	54	1
4	4	53	2
3	2	52	1
2	3	51	1
1	2	50	1
0	3	49	1
		48	1
		46	1
		45	1
		44	1
		43	1
		38	1
		36	1
		35	1
		34	2
		27	1
		25	1
	Total		40

TABLE 2

COMPARISON OF MEAN AND MEDIAN SCORES
ON THE PRE- AND POST-TEST IN THE THREE SCHOOLS

Schools	N	Pre-test		Post-test	
		Median	Mean	Median	Mean
A	20	6.6	7.15	55.0	52.25
B	10	7.5	6.60	61.3	59.10
C	10	4.5	5.10	48.0	47.60
		6.2	6.50	56.5	52.80

The questions on the post-test were the same as those used for the pre-test. The post-test was given to the students immediately after they completed the program. The median post-test scores were: School A, 55.0; School B, 61.3; School C, 48.0. The composite median score was 56.5.

As a result of students' reading and responding to the sewing machine program, their scores on the criterion test increased considerably. The post-test distributions are negatively skewed, the mean scores being lower then the median scores.

In evaluating the value of the post-test scores these two factors must be considered: first, the experimental situation was not a normal one; second, there was little control on cheating since neither teaching machines nor proctors were used.

Sex Comparisons

Post-test and gain scores of boys and girls were compared. The post-test median of the boys was 57.50 and that of the girls was 53.00. Using the Mann-Whitney U Test (16, p. 119-120) the programer found the probability of a difference of this magnitude resulting from chance to be .10. The gain scores of the boys were also higher than those of the girls ($p < .12$). The median gain scores of the boys was 49.5 and that of the girls was 46.5. Perhaps this slight superiority on the part of the boys may be explained by the fact that boys more than girls are exposed to and enjoy mechanical learnings.

In a study by McNeil (11, p. 37) boys learned significantly more than girls through programed instruction. If McNeil's findings prove to be generally true, this would account for the scores of the boys on on this criterion test being higher than the scores of girls.

Relation of Intelligence Quotient to Post-Test Quotient

Intelligence quotient scores and post-test scores were correlated by using Kendall's (16, p. 213-23) formula for computing a rank correlation coefficient. The resulting coefficient of correlation was very low, .16. This estimate of rho is not significantly different from zero. Several different intelligence tests had been used in the schools, and the investigator made to standardize the intelligence quotient scores. All that can be said in this case, therefore, is that intelligence quotients, as indicated by the various measures used, were not related to post-test scores.

Time Needed to Complete the Program

An average of four and three-fourths hours was used by students to complete the 321 frames in the program. Two students were assigned to use each sewing machine. Since there were many performance frames, each student spent some time waiting for a machine. The program could undoubtedly be completed in four class periods by the slowest students if a teacher arranged to have part of a class do the program at a time, giving each student a machine at which to work.

Student Errors

There was an average of 7.07 errors per student. The percentage of errors on the 321 frames of the program was 2.2 per cent. Approximately one-fourth of the frames were performance frames, and incorrect to be generally true, this would account for the scores of the boys on on this criterion test being higher than the scores of girls.

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There was an average of 7.07 errors per student. The percentage of errors on the 321 frames of the program was 2.2 per cent. Approximately one-fourth of the frames were performance frames, and incorrect responses on these frames were not recorded. During the time the students responded to the program there was no control over cheating. For these reasons, 2.2 per cent is an underestimate of the error rate on the program. An error rate of 5 to 10 per cent or less is generally considered acceptable for a self-instructional program.

Analysis of Student Reaction

Each student was asked to indicate his reaction to this new method of instruction on the form entitled Student Reaction to Programed Teaching (see Appendix G). The report of these student reactions must be interpreted cautiously, for the student attitudes were based on very limited experience with programed instruction and many years of experience with classroom teaching.

Student reactions toward programed teaching were favorable in all schools in this study (see Table 3).

Thirty-eight of the forty students agreed that programed teaching is a good way to learn because students are not held back by the class. Thirty students agreed that programed teaching is good because students are not left behind the class. Thirty-nine students agreed that programed teaching is a challenge because it makes one think. Thirty-three students agreed that programed teaching is more interesting than regular teaching. Seven students agreed that teachers can teach much better than programed teaching, fifteen students were uncertain about their reaction to this statement, and eighteen students disagreed with it. One student agreed that programed teaching is a boring way of learning; thirty-eight students disagreed with this statement. A somewhat larger proportion of students in School B than in the other schools agreed very much with statements three and four, disagreed with statement five, and disagreed very much with statement six. A larger proportion of students in School A were uncertain about their reaction to statement five.

TABLE 3

STUDENT REACTION TO PROGRAMED TEACHING

Student Reaction	Schools	Agree very much	Agree	Un-certain	Dis-agree	Disagree very much
1. Programed teaching is a good way to learn because students are not held back by the class.	A	11	8	1	0	0
	B	7	3	0	0	0
	C	7	2	0	0	1
		25	13	1	0	1
2. Programed teaching is good because students are not left behind the class.	A	8	7	3	2	0
	B	5	4	0	1	0
	C	3	3	3	1	0
		16	14	6	4	0
3. Programed teaching is a challenge because it makes me think.	A	14	6	0	0	0
	B	8	2	0	0	0
	C	6	3	0	0	1
		28	11	0	0	1
4. Programed teaching is more interesting than regular teaching.	A	11	6	3	0	0
	B	9	1	0	0	0
	C	5	1	2	0	2
		25	8	5	0	2
5. Teachers can teach much better than programed teaching.	A	1	2	10	5	2
	B	0	1	2	7	0
	C	1	2	3	4	0
		2	5	15	16	2
6. Programed teaching is a boring way of learning.	A	0	0	1	7	12
	B	0	0	0	2	8
	C	1	0	0	4	5
		1	0	1	13	25

CHAPTER V

SUMMARY AND RECOMMENDATIONS

Summary

This study had two purposes, first, the development of a sewing machine program and second, the provision of some general guidance and information for persons interested in developing a program.

The development of the program followed the sequence advocated by many current programers. The target population was defined as seventh, eighth, and ninth grade students enrolled in a first year home economics class. Sixteen objectives were stated as guides for the development of the program. The linear technique was used in the development of the program. A set of 321 frames was written in the form of partially completed statements or performance frames requiring student response. The frames included a number of illustrations which were sketched by an artist with home economics background. After sixty or seventy frames were written, the program was tried on fifteen individual subjects who were not familiar with the sewing machine. Continuous revisions were made on the program based on individual student responses.

The program was mimeographed with three frames on a page. These were later cut into separate frames, the answers were folded back, and holes were punched so that frames could be held together with rings.

A questionnaire, a criterion test, a time and error sheet, and answer sheets were developed, and a student reaction form was selected to use during the preliminary field test.

To participate in the preliminary testing of the sewing machine program, the programer selected forty seventh and eighth grade students from three schools in the proximity of Greensboro.

The preliminary field test indicated that: (1) scores on the criterion test increased considerably as a result of students' reading and responding to the sewing machine program; (2) boys scored significantly higher than girls; (3) intelligent quotient scores were not related to post-test scores; (4) the sewing machine program could be completed in four class periods if a sewing machine per student were available; and, (5) student reaction to programed instruction as a teaching method was favorable.

After the preliminary field test staff members in The Home Economics Education Department at Woman's College, University of North Carolina, met each week for a two-hour session to revise the sewing machine program. The staff also developed separate frames to be used with different sewing machine models.

Recommendations

Further steps recommended by the investigator for the completion of the sewing machine program are:

1. Revise the criterion test and develop a performance test. Administer the tests to large enough groups of students to secure estimates of reliability and item analyses.
2. Sketch new illustrations for the revised frames.
3. Mimeograph the revised sewing machine program using two colors of paper, one color for performance frames and a second color for all other frames.

4. Develop for teachers a set of instructions which will accompany the revised sewing machine program. These must include special instructions for teacher reinforcement of performance frames.
5. Test the revised sewing machine program on a group of students. One sewing machine should be provided for each student. The program, except the performance frames, may be taken home. Performance frames should be completed at school and the responses reinforced by the teacher.
6. Revise the sewing machine program and submit it to some publisher for publication.

The investigator recommends the following research in which the sewing machine program might be used:

1. Compare students who completed the sewing machine program with students who received traditional classroom teaching in the use of the sewing machine with respect to:
   a) scores on the criterion test and the performance test;
   b) scores one month after completion of the program on the criterion test and the performance test;
   c) scores on an interest-in-sewing inventory; and,
   d) number of constructed garments which were not required by the teacher.
2. Compare the students who completed the program at school with students who completed the program at home (with the exception of performance frames) with respect to: (a) scores on the criterion test and (b) student reaction to the program.

3. Study the relationship between: (a) academic ability and criterion test scores and (b) academic ability and student reaction to the sewing machine program.
4. Study the relationship between: (a) scores on an interest-in-sewing device and criterion test scores and (b) scores on an interest-in-sewing device and student reaction to the programed instruction.
5. Develop and try out methods of teaching a divided class, part of whom are working on a self-instructional program and part of whom are taught by some other method.
6. Develop a branch to the program for rapid learners. This might be in the use of sewing machine attachments, in the use of an automatic machine, or in the construction of a simple garment, such as a torn apron, for which no pattern is needed.
7. Develop self-instructional programs on the use of a commercial pattern, construction processes, clothing selection, and textiles.

APPENDIX A

REVISED OBJECTIVES OF THE SEWING MACHINE PROGRAM

Re: REVISION OF SEWING MACHINE OBJECTIVES BY RESEARCH SEMINAR GROUP

Date: MARCH 22, 1963

OVERALL OBJECTIVE

The learner will acquire a knowledge of and skill in the use of

(indicate models of sewing machines) ______ machines.

MAJOR OBJECTIVES:

1. The learner, upon completion of the program, will be able to identify, locate, and verbalize the function of the following parts:

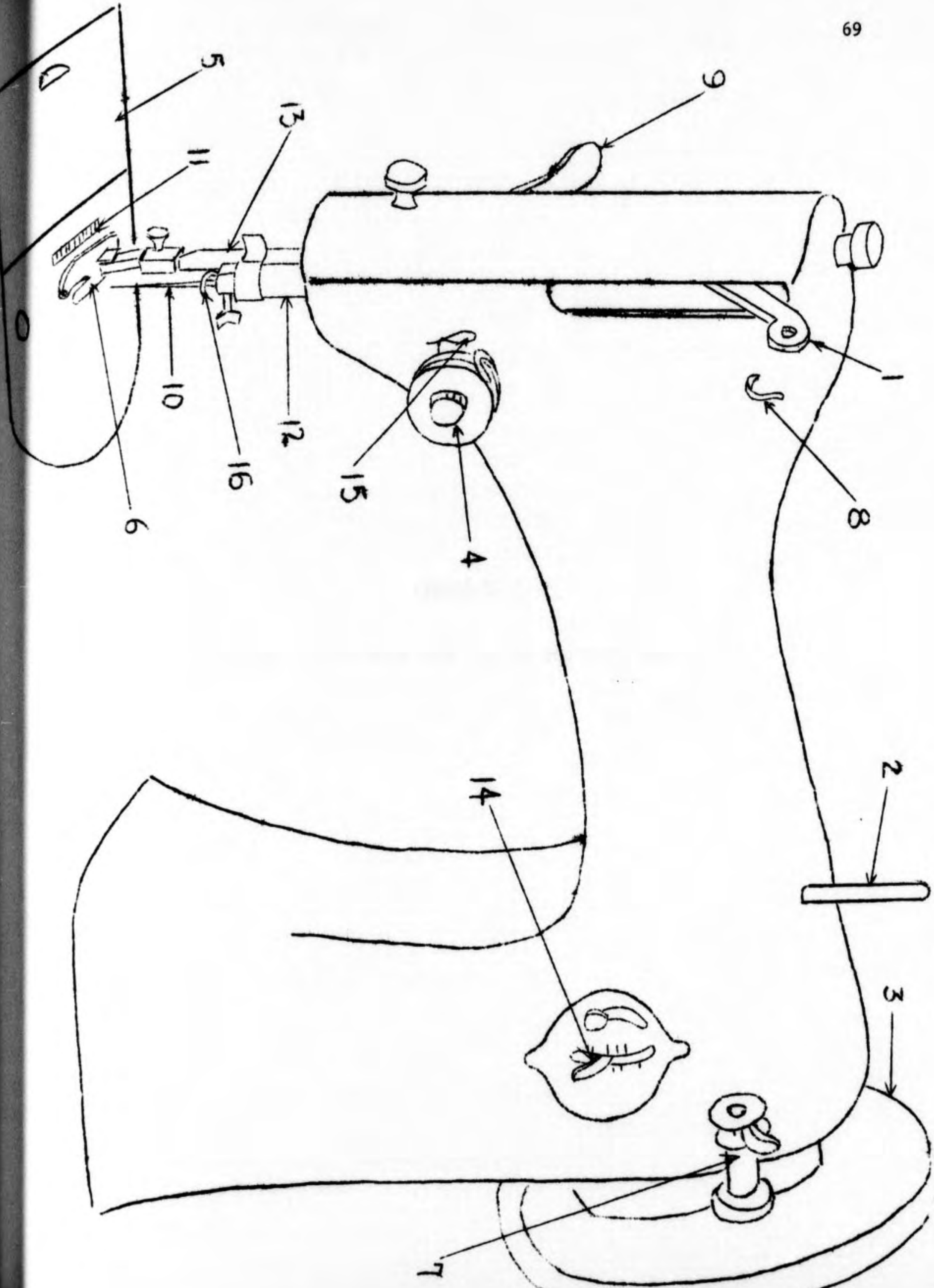
   spool pin
   thread guides
   tension regulator
   thread take-up lever
   needle bar
   presser foot
   feed dog
   hand wheel
   slide plate
   throat plate
   stitch length regulator
   bobbin winder
   bobbin
   needle
   presser bar lever
   pressure bar
   bobbin case
   stop motion screw
   knee control
   foot control
   treadle

2. The learner will be able to perform the following operations:

   a. thread upper part
   b. wind bobbin
   c. thread underpart
   d. bring bobbin thread up
   e. begin and stop stitching with thread, fabric, and all parts in proper position
   f. appraise stitching for medium weight fabric
   g. adjust tension
   h. adjust stitch length
   i. remove presser foot and replace zipper foot
   j. make varying widths of seams, using a guide (either presser foot or seam guide)

APPENDIX B

PANEL DRAWING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APPENDIX C

SAMPLE FRAMES FROM THE SEWING MACHINE PROGRAM

28.

Recognize this use of tension from advertisements?

Well, the tension you are about to learn about is different.

Read on to find out what it is!

(no response)

(no response)

29.

Tension keeps the thread from becoming too loose or too tight. The thread is kept from becoming too loose or too tight by ____________.

tension.

30.

Ready for a break? Try the TENSION ERERCISE!

1. **Remove thread and hold it loosely between thumb and first finger of the left hand.**
2. **Pull thread through these fingers with right hand.**
3. **Repeat 1 and 2, holding thread <u>tightly</u> between thumb and first finger.**

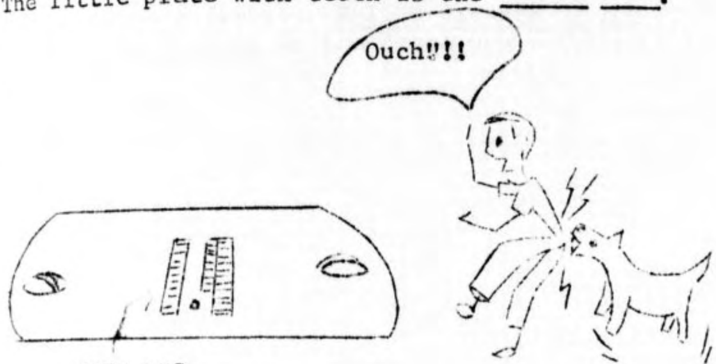
What has happened?

The thread becomes more difficult to pull through your fingers or the tension becomes tighter.

Please replace thread for the next person.

73.

The feed dog is a little plate with "teeth". The little plate with teeth is the ______ ____.



FEED DOG

Answer: feed dog.

74.

The feed dog is located directly under the presser foot. Directly under the presser foot is the ________ _____.

Answer: feed dog.

75.

The feed dog moves the cloth along with each stitch. The cloth is moved along by the ______ ___.

Answer: feed dog.

142.

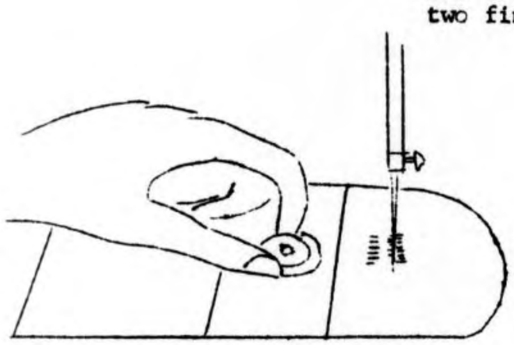
Look at the next 3 frames and choose the one that is most like the machine you are using. Skip the other frames. Follow directions for removing the bobbin on the frame you selected.

(no response)

(No response)

143. TO REMOVE THE BOBBIN

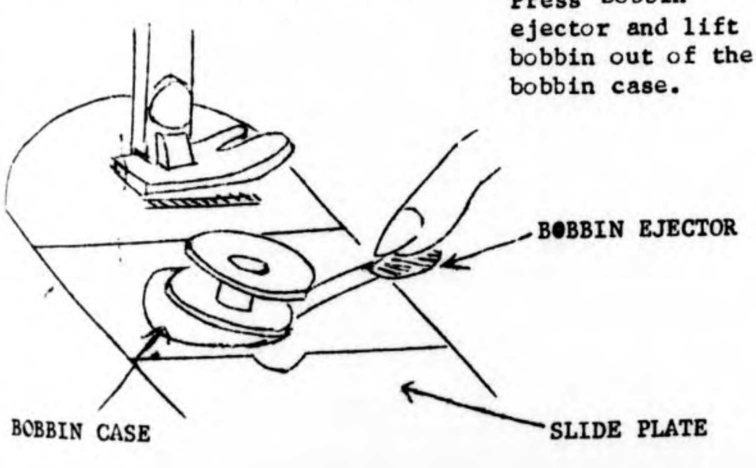
Lift bobbin up from the bobbin case with two fingers.



√

144. TO REMOVE THE BOBBIN

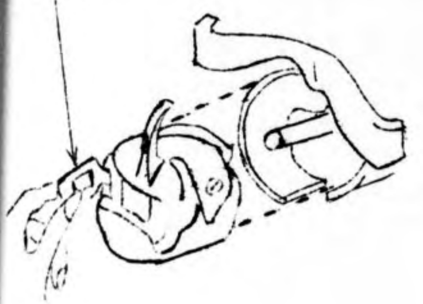
Press bobbin ejector and lift bobbin out of the bobbin case.



√

145. TO REMOVE THE BOBBIN CASE WHICH HOLDS THE BOBBIN

LATCH



1. Raise take-up lever to highest point.
2. Grasp bobbin case latch with thumb & forefinger of left hand, and lift out bobbin case.
3. Release latch & remove bobbin from the case.

Bobbin case →

146.

You are now going to put thread on this empty bobbin.

(no response)

No response.

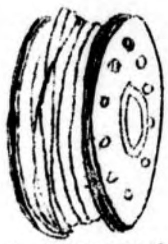
147.

In order to work properly in the machine, the bobbin must be wound evenly. To insure proper working be sure the ______________________ ____________. (in your own words).

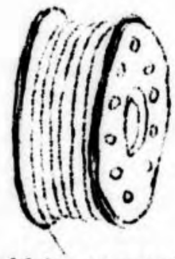
bobbin is wound evenly.

148.

In your own words describe the difference between a correctly wound and an incorrectly wound bobbin as shown in the diagram.



Bobbin incorrectly wound



Bobbin correctly wound

On the correctly wound bobbin the thread is parallel and smooth. On the incorrectly wound bobbin it is <u>not</u> parallel and is irregular. (or in your own words)

149.

The bobbin is filled with thread identical to that used on upper threading of the machine. Upper thread is identical to that used to fill the _______.

bobbin.

150.

If the bobbin has old thread on it, remove thread to insure smooth winding of thread on bobbin.

To insure even winding remove ________________ ____________________________.

old thread on bobbin before filling.

187. <u>Step 2</u> - Hold bobbin so that thread leads in direction shown. (counter clockwise)

BOBBIN

STEP 2

✓

188.

Now you are ready to thread the part of the bobbin case which places the bobbin thread under <u>tension</u>. This is an <u>important</u> part of threading the underpart of the machine.

(no response)

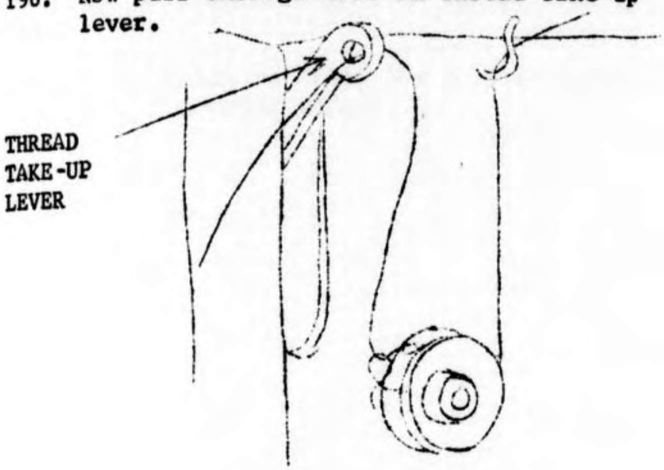
no response

189. <u>Step 3</u> - Place bobbin in bobbin case. Lead thread into <u>slot</u> 1 and under <u>spring</u> 2.

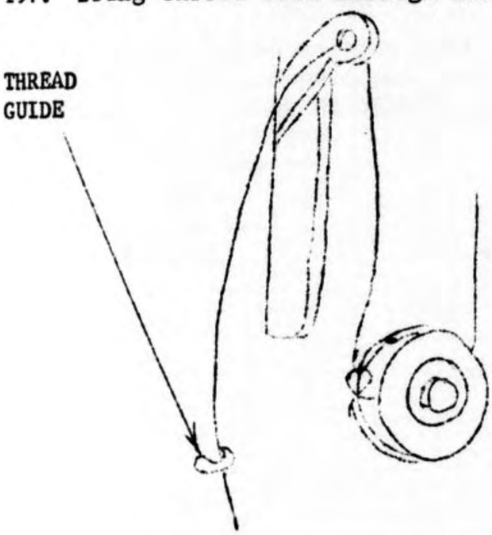
STEP 3

✓

196. Now pull through hole in thread take-up lever.



197. Bring thread down through next thread guide.



198.

Needles are threaded differently on different machines. Some are from right to left, some are left to right, and some from front to back. The machine will not work if threaded in the wrong direction.

(no response)

no response

202.

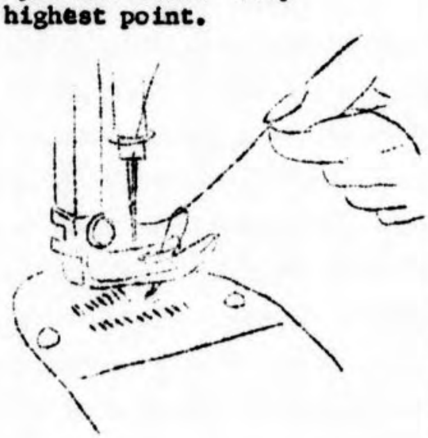
Now you are going to bring the bobbin thread up to meet the upper thread.

(no response)

no response

203.

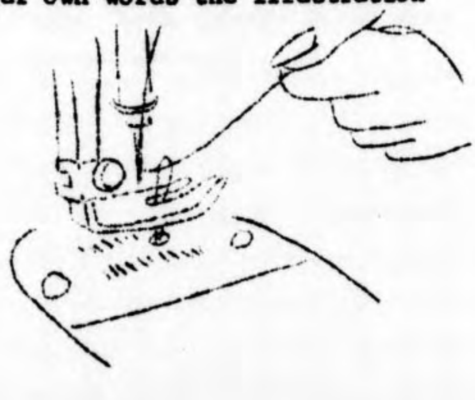
1. Hold upper thread in left hand loosely.
2. Turn hand wheel toward you one turn. Stop with take-up lever at highest point.
3. Pull on upper thread until bobbin thread loops as shown.
4. Use a pin to pull on this loop.



✓

204.

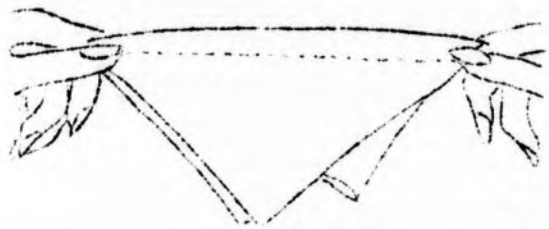
Describe in your own words the illustration below.



Upper thread is held in left hand while turning hand wheel until bobbin loop comes to the surface.

238.

Another way to test tension is to stitch across a diagonally folded square of cloth. Now stitch across a diagonally folded square of cloth provided by the teacher. (See illustration below).



✓

239.

Hold cloth tightly at each end where it is stitched and pull gradually until the thread breaks.

✓

240.

When upper and lower tensions on the sewing machine are correct <u>both</u> the top and bottom threads will break. Both threads break when ____________________________.

upper and lower tensions are [illegible] balanced.
OR
when both tensions are correct.

APPENDIX D

QUESTIONNAIRE

NAME________________________________

QUESTIONAIRE ON THE SEWING MACHINE

1. Have you ever used a sewing machine?

2. When did you first use a sewing machine? (How old were you?)

3. Who helps you when you have trouble with the sewing machine?

4. What was the most difficult thing for you to learn about using the sewing machine?

5. How badly do you want to use a sewing machine?

6. Why do you want to use a sewing machine?

7. Do you have a sewing machine in your home?

8. How would your mother feel about your learning to use a sewing machine if you do not now know how?

9. What advantages do you see in becoming a person skilled in sewing?

10. Suppose you knew how - which would you rather do? Check one.
    a. embroider a pillowcase
    b. knit a sweater
    c. sew a blouse

11. Which are things you would like to do by yourself as a hobby? Check as many as you wish.
    a. watch TV
    b. read
    c. practice shooting with basketball
    d. sew something for yourself
    e. sew something for someone else
    f. cook
    g. play piano
    h. go hunting
    i. earn money babysitting

APPENDIX E

CRITERION TEST

TO OUR WILLING WORKERS:

You were chosen to help us with this research because you do <u>not</u> know how to operate a sewing machine. As a first step in the research we need your answers to a test. Don't be unhappy if you can't answer the questions because we really do not expect you to be able to answer many of them. Do, please, read each one carefully and answer any that you can. It will help you to get some answers right if you read to the end of each sentence before filling in the blank(s).

Sewing Sue

NAME ______________________________

EXAMINATION FOR OPERATOR'S LICENSE

DIRECTIONS: Fill in the blanks. Then copy the answers in the column at the left. Place just one word in each blank.

Connie wants to become a good seamstress so she can sew many pretty dresses for herself. She realizes that she must first understand the sewing machine well enough to use it correctly and know what to do with it when it needs minor adjustments. Can you help her with this?

______________(1)
______________(2)
______________(3)
________-______
____
______________(4)
____
______________(5)
____

Two threads are used to form the stitches, one from the spool pin and one from the (1)_______ . The upper thread must go through the (2)_________ to hold it a little tight and keep it from looping in the fabric. The (3) _______ ____ -___ _______ pulls the thread when each stitch is made to lock it. On every machine there are a number of (4)_______ _______ to keep the thread in proper position to pass through the next really important part of the machine. The (5)_______ _______ must be moved before the bobbin can be removed.

One day when Connie was first learning to sew, she threaded the machine, then tried to stitch two pieces of cloth together. The stitch looked all right on the top side but on the underside it formed little loops instead of locking tightly. It looked like this:

______________(6)
______________(7)
____
______________(8)
______________(9)
____
____
______________(10)

Connie needed first to check whether the (6)______ part of the machine is threaded correctly (be specific). If it is, she needs to tighten the (7) ________ _________. She can do this by turning the screw to the (8) _______. If the stitches are too small she needs to adjust the (9)________ _______ ____________ so there will be (10) _______ stitches per inch.

______________(11)
____
______________(12)
____

Connie saw her neighbor having a lot of trouble. The cloth did not move along when she started to sew. She had forgotton to lower the (11) ______ ____ so the cloth was not held in place. The cloth could not be moved along by the (12) ______ ___ unless it was held down firmly. Connie noticed that her neighbor did not get any sewing done on this day because she had to wait for the teacher to help her with the machine.

__________(13)
____
__________(14)
____
__________(15)
____
____

Connie ran out of bobbin thread. When she wound the bobbin she first had to loosen the (13) _____ _______ ______ on the hand wheel so that the needle would not go up and down while she wound the bobbin. She placed the bobbin correctly on the (14) _______ ________ then pushed this against the (15) ________ ________;

__________(16)
__________(17)
____
__________(18)
____
__________(19)
____

When Connie threaded the machine again it was not enough to drop the bobbin into the proper place. She needed (16) ________ on the bobbin thread so it would not loop in the cloth. She pulled the thread into the diagonal opening in the (17) _________ _____ with one hand while she held the bobbin with the other hand. To bring the under thread up through the hole in the throat plate, she held the (18) _______ ________ loosely while taking one stitch with the (19) ______ _______.

__________(20)

There is a great deal of fabric in the gathered skirt which Connie is making. She needs to place the bulk of it to the (20)_____ of the needle.

__________(21)
__________(22)
____
____
__________(23)
____
____
__________(24)
__________(25)

She needs to turn a square corner on her patch pocket. She can do this by stopping with the needle (21) ______, then lifting the (22)_________ ____ _______, turning the fabric, lowering the (23)_________ ____ ______ and continuing to sew. She starts and stops the machine with her (24)_______. When she is through stitching, Connie should always stop with the take-up lever at it's (25)_________ point.

Now Connie is eager to start sewing on her blouse. <u>Number the steps</u> in the order in which she should do them.

__________(26) ------- (26) thread the machine
__________(27) ------- (27) bring lower thread up through hole in throat plate
__________(28) ------- (28) wind bobbin
__________(29) ------- (29) try the stitching on two thicknesses of cloth

__________(30)
____
__________(31)

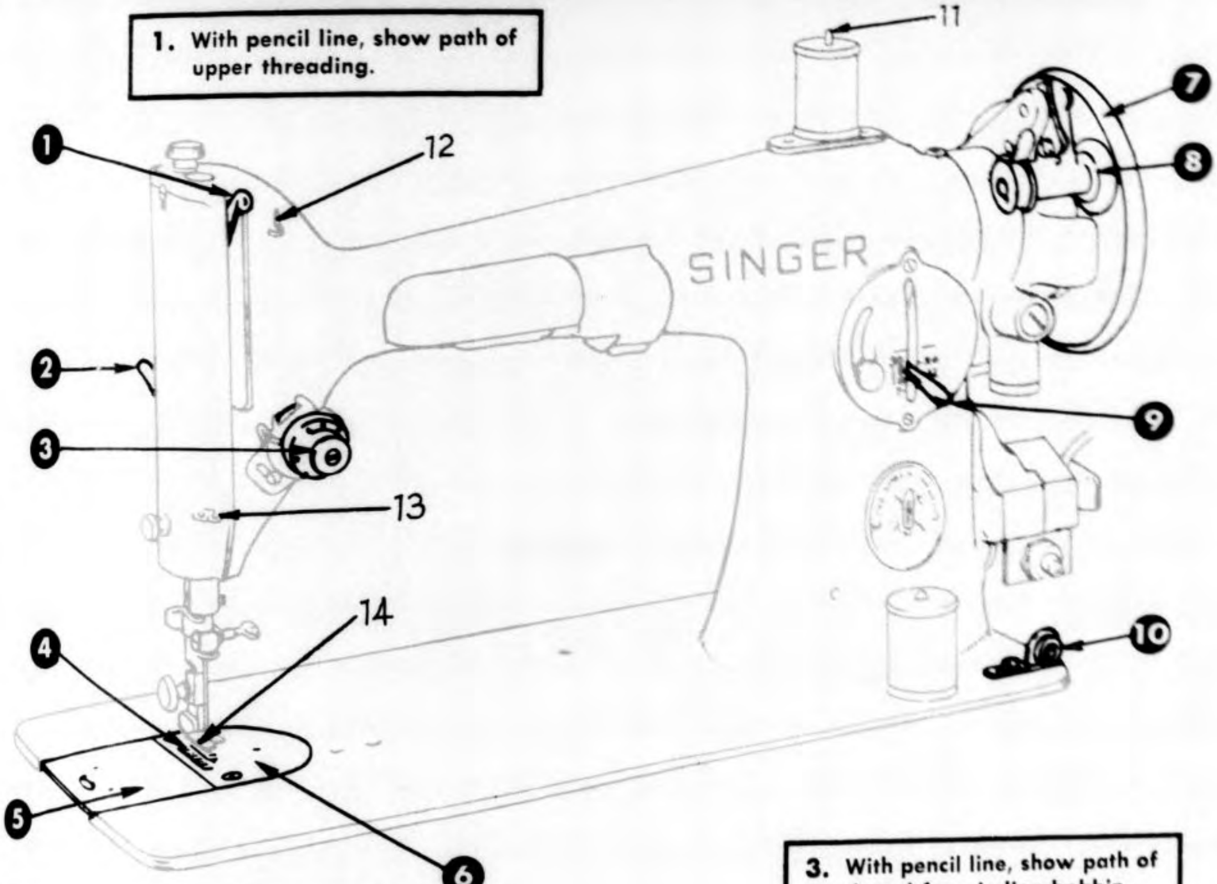
The machine Connie uses at home is differnt than the one she uses at school. She does not know how to thread the machine at home. She knows that she can tell what is the thread take-up lever because when she turns the hand wheel it will go (30)___ and ______. She knows that the thread should always go through the tension (31)_________ before it goes through the

____________(32) ____________	thread take-up lever. She can safely place the thread in each (32) ________ ________ along
____________(33) ____________	the way. She must find a way to put the thread throught the (33) _________ ___________ so that the thread pulls a little bit tight. Connie
____________(34) ____________	knows that some machines thread from left to right and some from right to left. If the last (34) _______ _____ is on the right, then it
____________(35)	threads from the (35)_______. If the last (36) ________ ______ is on the left, then it
____________(36) ____________	threads from the (37)_____.
____________(37)	

SINGER

TEST CHART
No. 201 Machine

1. With pencil line, show path of upper threading.



3. With pencil line, show path of thread for winding bobbin.

2. Name the numbered parts.

1 ______________________

2 ______________________

3 ______________________

4 ______________________

5 ______________________

11 ______________________

12 ______________________

6 ______________________

7 ______________________

8 ______________________

9 ______________________

10 ______________________

13 ______________________

14 ______________________

APPENDIX F

TIME AND ERROR SHEET

SEWING MACHINE PROGRAM

Individual Student's Time (Min.)

Name or Number of Student ______________________________

Date	Beginning Frame No.	Last Frame No.	Total Frames	Number of Errors	Beginning Time	Ending Time	Total Time

APPENDIX G

STUDENT REACTION FORM

*STUDENT REACTION TO PROGRAMED TEACHING

INSTRUCTIONS: The method by which you have learned is called programed teaching. How do you feel about programed teaching? Circle the words which best tell how you feel about each of the following statements.

If you agree very much with Statement 1 that "Programed teaching is a good way to learn because students are not held back by the class," circle the words agree very much. If the word agree describes best how you feel about the statement circle agree. If you are not certain how you feel, circle uncertain. If you disagree, circle disagree. If you disagree very much, circle disagree very much.

1. Programed teaching is a good way to learn because students are not held back by the class.

agree very much / agree / uncertain / disagree / disagree very much

Did you circle the words that tell how you feel? Now go on to Statement 2.

2. Programed teaching is good because students are not left behind the class.

agree very much / agree / uncertain / disagree / disagree very much

3. Programed teaching is a challenge because it makes me think.

agree very much / agree / uncertain / disagree / disagree very much

4. Programed teaching is more interesting than regular teaching.

agree very much / agree / uncertain / disagree / disagree very much

5. Teachers can teach much better than programed teaching.

agree very much / agree / uncertain / disagree / disagree very much

6. Programed teaching is a boring way of learning.

agree very much / agree / uncertain / disagree / disagree very much

*Gotkin, Lassar G. and Leo S. Goldstein, "Programed Instruction for the Younger Learner: A Comparison of Two Presentation Modes in Two Environments," The Center for Programed Instruction, 365 West End Ave., New York 24, N. Y. 1962. Appendix A. (Reprinted by permission)

APPENDIX H

LETTER TO PRINCIPALS

THE WOMAN'S COLLEGE
OF THE UNIVERSITY OF NORTH CAROLINA
GREENSBORO

SCHOOL OF HOME ECONOMICS

November 16, 1962

Dear Mr. ______________,

Undoubtedly you have been reading about teaching machines and programed learning and have become interested in this area of learning.

The Home Economics Education Department at Woman's College is conducting an exploratory study this year in the area of programed learning. We are now at the place in our project where we need to have junior high school students use and react to some of the materials which have been developed. We chose your school as one in which we would like to conduct this testing of the program. Only 20 students would be needed from your school.

Miss Catherine Moore, my research assistant, and I would welcome an opportunity to come and talk to you about what we are doing and the kind of help we would need. After Thanksgiving Miss Moore will phone for an appointment with you. We would be happy to have your home economics teacher sit in on this conference if she would like to.

Cordially,

Hildegarde Johnson
Chairman
Home Economics Education

APPENDIX I

TABLE OF RAW DATA

SEWING MACHINE PROGRAM RESULTS

STUDENTS	SEX	GRADE	IQ	IQ TEST USED	PRE TEST SCORES	POST TEST SCORES	GAIN	TOTAL ERRORS	TOTAL TIME IN MINUTES
School - A									
1	M	7	129	Kuhlman-Finch	8	57	49	3	202
2	M	7	107	Kuhlman-Finch	2	34	32	8	265
3	M	7	116	Pintner-Durost	6	63	57	3	321
4	F	7	141	Pintner-Cunningham	10	49	39	0	369
5	F	7	120	Pintner-Durost	8	52	44	15	216
6	F	7	115	Pintner-Cunningham	6	63	57	4	410
7	F	7	110	Pintner-Cunningham	5	36	31	8	308
8	F	7	128	Pintner Pri.	10	38	28	1	317
9	F	7	103	Kuhlman-Finch	8	35	27	6	261
10	M	8	117	Pintner-Int.	6	56	50	6	267
11	M	8	132	Kuhlman-Finch	6	54	48	4	180
12	M	8	139	Pintner-Int.	15	67	52	18	219
13	M	8	120	Pintner-Int.	18	61	43	1	169
14	F	8	137	Pintner-Cunnignham	1	62	61	6	270
15	F	8	129	Otis Beta	6	62	56	9	347
16	F	8	96	Otis Beta	3	48	45	12	351
17	F	8	126	Pintner-Int.	1	34	33	12	245
18	M	8	109	Pintner-Cunningham	2	63	61	14	305
19	M	8	99	Otis Beta	6	61	55	19	344
20	M	8	106	Pintner-Cunningham	16	50	34	1	355
School - B									
21	M	8	87	Calif. Mental Maturity	4	66	62	40	304
22	M	8	106	"	0	67	67	3	345
23	F	8	109	"	2	61	59	2	315
24	M	8	112	"	8	65	57	16	268
25	M	8	133	"	7	58	51	5	250
26	F	8	120	"	13	61	48	14	195
27	F	8	98	"	12	53	41	4	328
28	F	8	114	"	4	61	57	0	272
29	M	8			8	46	38	8	337
30	F	8			8	53	45	5	222
School - C									
31	F	7	118	Calif. Mental Maturity	5	59	54	14	300
32	F	7	114	Otis Alpha & Beta	7	59	52	2	281
33	F	7	123	Pintner-Inter.	7	51	44	1	285
34	M	7	116	Longe Thorndike, F.A.	0	45	45	1	276
35	F	7	97	PPVT	4	25	21	1	311
36	F	7	123		10	61	51	2	280
37	M	7	117	Calif. Mental Maturity	0	27	27	2	223
38	F	7	119	Pintner Gen. Ability	11	62	51	0	260
39	F	7	108	Otis Beta	3	44	41	9	274
40	M	8	122	Pintner-Cunningham	4	43	39	6	242

LIST OF REFERENCES

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1. BLOOM, BENJAMIN S., et. al. Taxonomy of Education Objectives - The Classification of Educational Goals Handbook I: The Cognitive Domain. New York: Longmans, Green, 1956. 207 p.

2. CROWDER, NORMAN A. "Automatic Tutoring by Means of Intrinsic Programming." Automatic Teaching: The State of the Art. (Edited by Eugene Galanter.) New York: John Wiley & Sons, Inc., 1959, Chapter 10, p. 109-16. (a)

3. CROWDER, NORMAN A. "Simple Ways to Use the Student Response for Program Control." Educational Science Division, U. S. Industries, Inc., (250 Park Avenue), New York: 1961. 12 p. (Offset) (b)

4. EIGEN, LEWIS D. "The Construction of Frames of an Automated Teaching Program." New York: Center for Programmed Instruction (365 West End Avenue), 1959. 6 p. (Offset)

5. EVANS, JAMES L.; GLASER, ROBERT; AND HOMME, LLOYD E. "The Ruleg System for the Construction of Programmed Verbal Learning Sequences. The Journal of Education Research 55: 513-18; June-July 1962.

6. GILBERT, THOMAS F. "Mathetics: The Technology of Education." The Journal of Mathetics 1:1-73; January 1962.

7. HUGHES, J. L. Programmed Instruction for Schools and Industry. Chicago: Science Research Associates, Inc., 1962. p. 57-95.

8. KLAUS, DAVID J. "The Art of Auto-Instructional Programming." AV Communication Review Vol. 9, No. 2, p. 130-42; March-April 1961.

9. LUMSDAINE, ARTHUR A. "Some Differences in Approach to the Programming of Instruction." Programmed Learning Evolving Principles and Industrial Applications. (Edited by Jerome P. Lysaught) Ann Arbor: The Foundation for Research on Human Behavior, 1961. p. 37-52.

10. LYSAUGHT, JEROME P., AND WILLIAMS, CLARENCE M. A Guide to Programmed Instruction. New York: John Wiley and Sons, Inc., 1963. 167 p.

11. MCNEIL, JOHN D. "Programed Instruction as a Research Tool in Reading: An Annotated Case." The Journal of Programed Instruction Vol. 1, No. 1, p. 37-42, 1963.

12. MAGER, ROBERT F. "A Method for Preparing Auto-Instructional Programs." IRE Transactions on Education E-4: 151-57; December 1961.

13. MELCHING, WILLIAM H. A Procedural Guide to the Programming of Instruction Preliminary Report. Research Memorandum. Fort Bliss, Tex.: Hum RRO, U. S. Army Air Defense Human Research Unit, March 1962. 34 p. (Offset)

14. PORTER, DOUGLAS. "Teaching Machines." Harvard Graduate School of Education Association Bulletin 3:4; March 1958.

15. SCHRAMM, WILBUR. Programed Instruction Today and Tomorrow. The Fund for Advancement of Education, Ford Foundation, November 1962. 74 p.

16. SIEGEL, SIDNEY. Non-Parametric Statistics for the Behavioral Sciences. McGraw-Hill Book Company, Inc., 1956. 312 p.

17. SKINNER, BURRHUS F. "The Programming of Verbal Knowledge." Automatic Teaching: The State of the Art. (Edited by Eugene Galanter.) New York: John Wiley & Sons, Inc., 1959. Chapter 4, p. 63-68.

18. SMITH, ROBERT G., JR. Teaching Machines and Programmed Instruction. Research Memorandum. Fort Bliss, Tex.: Hum RRO, U. S. Army Air Defense Human Research Unit, August 1961. p. 7. (Offset)

19. STOLUROW, LAWRENCE M. Teaching by Machine. U. S. Department of Health, Education, and Welfare, Office of Education, Cooperative Research Monograph No. 6. Washington, D. C.: Superintendent of Documents, Government Printing Office, 1961. p. 85-95.

20. QUINN, A. K. "How to Program (In 10 Difficult Lessons)." Audiovisual Education 8: 80-83; February 1963.

21. WOOLMAN, MYRON. "The Concept of the Program Lattice." Washington, D. C.: The Institute of Educational Research, Inc., (2226 Wisconsin Avenue, N. W.), 1962. (Working Paper)