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ABSTRACT

The project described in this report attempted to provide a special project for the selection, counseling, testing, assessment, training, placement, and follow-up of prison inmates whose many problems prevented their profiting from conventional programs in vocational training. The mathematical approach to programing was used in developing the programed materials for the project. The report gives a short definition of mathematical programing and describes its use in this context. A second section of the report discusses the selection and evaluation of existing programed materials. It suggests that a proposed program be considered in the context of target population, adaptability, time, motivational characteristics, measurable outcomes, and budget. (JY)

DEVELOPMENT, EVALUATION, AND USE of

Programmed MATERIALS

a report on the activities

of the

MATERIALS DEVELOPMENT UNIT

MDT Vocational Experimental-Demonstration Project

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PREFACE

The experiences described in this paper occurred in an experimental-demonstration project, funded by the Departments of Health, Education, and Welfare and Labor under the Manpower Development and Training Act. The program is conducted at Draper Correctional Center, a state prison in Alabama.

The Draper Vocational E&D Project has been in operation since September of 1964 and serves an incarcerated youthful offender population. The project's purpose is to provide a special program for the selection, counseling, testing, assessment, training, placement, and follow-up of inmates whose many problems prevent their profiting from conventional programs in vocational training. Programmed instruction and several allied training methods are being developed and used to instruct the inmates in an effort to overcome their defeatist attitudes and to reduce the vocational training time without sacrifice of the quality or quantity of their learning.

In order to make its findings of value to other prison systems and similar training programs for the disadvantaged, the Draper project is currently preparing guidelines for dissemination and utilization. While the Federal Government sponsors encourage E&D Projects to express their own judgment freely, the points of view stated in this report do not necessarily represent the official position or policy of the U. S. Departments of H.E.W. or Labor.

DEVELOPMENT, EVALUATION, AND USE OF PROGRAMMED MATERIALS AS DEVELOPED IN THE DRAPER EXPERIMENTAL AND DEMONSTRATION PROJECT

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A number of years ago I became interested in programmed instruction (P.I.)--a new instructional method which seemed to be ideal for vocational education. P. I. had certain characteristics that allowed an instructor to individualize his course according to the needs of each student. More impressive than the characteristics were the results obtained with this method. Learning was assured, even though the rate of learning varied with the individual's ability and interest. Programmed instruction permitted the instructor to devote more time to the students requiring special attention.

At this time, I was a frustrated Distributive Education Coordinator looking for instructional materials which would make my course more effective. Here I was, trying my best to teach at least 20 different subjects at the same time since each of my 20 students was placed in a different distributive occupation. Of course, I had study guides for related information in each subject, but their use presented a number of problems. For instance, adaptation of the material was almost always required. Checking answers to questions on each job sheet was an endless task, not to mention the job of testing every student as he completed a lesson.

When I first heard of programmed instruction and its advantages, I began investigating the possibility of using these materials in my related study classroom. I could imagine myself assigning each student a programmed course with the assurance that he would learn whatever was required for his occupational training. Unfortunately, such was not the case. My

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investigation did not turn up the kinds of programs which would have been appropriate for Distributive Education (DE). However, I learned enough through reading research reports on P. I. to become convinced that its use was an improvement over the study guide and other traditional aids to instruction.

Since DE programs were not on the market at the time, I began to study the different techniques used in the development of P. I. materials in the hopes that I could learn to write them. The more I studied, the more I realized that programming is no easy task, particularly if one is going to write programs which will truly teach.

Fortunately, I heard about a unique educational experiment in the use of P. I. materials with inmates at Draper Correctional Center, Elmore, Alabama. This experiment was conducted by Dr. John M. McKee, a clinical psychologist, who was at that time the State Director of Mental Hygiene. Later, he resigned his position with the state to accept the full-time job of Director, Draper Experimental and Demonstration Project in Academic Education, which was financed by the National Institute of Mental Health. (This project has been in operation for the past five years.) One of the findings of this experiment pointed up the need for additional education in the area of vocational training.

Consequently, Dr. McKee asked Mr. J. F. Ingram, Director, State Division of Vocational Education, for advice and assistance in planning a vocational training program. After several discussions with Mr. Ingram and other MDTA officials, Dr. McKee decided to submit a proposal for an E&D

Project under the MDTA. As the result of Mr. Ingram's reference to me as a vocational educator who was interested in P. I., Dr. McKee asked me to serve as a consultant in planning and writing the proposal which was approved in September, 1964.

Needless to say, my original interest in P. I. and my involvement in developing the proposal for the MDT Project led me to give up my job as a DE Coordinator to become the MDT Program Director under Dr. McKee's direction as administrator of the contracting agency, the Rehabilitation Research Foundation. The Foundation is a private, non-profit organization that is presently conducting research in human behavior.

One experimental and demonstration feature of the vocational training project is the Materials Development Unit (MDU) which is responsible for investigating and developing programmed instructional materials. For example, the investigation includes the evaluation and use of programs, and the methodology of programming. The unit develops all types of programs and other special training materials, such as wall charts, diagrams, and transparencies for overhead projectors.

Presently, the MDU staff consists of an editor-coordinator, one program writer, one artist, two production assistants and subject-matter specialists who work by the hour when needed. Each member of the staff performs several tasks with respect to instructional materials. However, since my topic pertains to our programmed materials, I shall confine my remarks to the step-by-step procedures necessary in the development, evaluation, and use of the individualized lessons that I have on display here today. These mathetical training materials are different from traditional training publications in that they reflect the principles and techniques defined and developed by several experimenters who have systematically applied the reinforcement learning theory of B. F. Skinner.

The system of mathetics, which was developed by Thomas E. Gilbert, is used by our MDU staff in preparing the programmed lessons. Gilbert defines mathetics as..."the systematic application of reinforcement theory to the analysis and construction of those complex behavior repertories usually known as 'subject-matter mastery,' 'knowledge,' and 'skill.'"[1] (It should be pointed out that, as programming has come of age, there appear to be more similarities than differences in the various programming techniques.)

The gc l of every matheticist, an analyst-writer of mathetical lessons, is to work toward a genuine technology of education by combining in his programs the concepts of behavioral science with the effective practices and procedures that have always been used by good teachers.

Perhaps the easiest way to understand how these behavioral science concepts may be combined with effective instructional practices and procedures is to describe the mathetical system which our unit uses in developing programmed lessons.

Practices and Procedures of the MDU

The MDU uses an exacting and systematic process to develop and to improve existing materials so that they are student-oriented and student-proved.

[1]Gilbert, Thomas E., "Mathetics: The Technology of Education," Journal of Mathetics, Vol. 1, No. 1, January, 1962, p. 8.

The mathetical approach involved functions requiring participation of specialists as well as staff. Skilled technicians in each vocational area decide what subjects should be programmed. They also serve as subject-matter specialists by choosing for the writers the appropriate practices and procedures within the selected areas. Our vocational instructors act as specialists or experts. In addition, we usually ask other technicians or professionals in the same vocational area to verify the content of the training lesson.

Recently, a committee made up of vocational educators in Alabama met together to discuss the topics we should program this year. After much discussion the group selected "Communication Skills for the Auto Mechanic" as an area where training materials are much needed. The staff of the MDU is now in the process of reviewing literature and interviewing the experts in this field.

In order to produce programs, the MDU performs certain functions which fall under the following general headings:

1. Subject Matter Selection
2. Specification of Operational Deficiency
3. Performance Requirements
4. Performance Analysis and Programming
5. Editing and Evaluation

Forgive me if I use technical terminology or fail to explain fully as I discuss these functions. The subject is a complicated one, and time is short. After all, it takes approximately six months to train a programmer!

1. Subject-Matter Selection

The first function, subject-matter selection, proved to be very tedious, time consuming, and costly in the initial stages. However, when we failed to give this function adequate consideration, we ended up with some lessons that did not fit into every instructor's course outline. When subject matter is properly selected, the cost of the programming is justifiable in terms of the learning time saved, and the programs have high standards and broad application to training. To make sure that subject matter is properly selected, it is necessary to first determine the extent to which a particular performance deficiency is a widespread and significant problem. In other words, there should be a large audience with a real need for the program. As a rule of thumb, we say that if over 50% of the target population knows over 50% of the material the area does not require programming. The area selected should also be one that presents teaching or learning difficulties. In short, programs are not written to replace existing materials which already do an adequate job. They are written if materials are non-existent, or if what is available does not teach well, or to supplement--to make teaching and learning easier and more effective. There are areas which are better taught by other methods, such as demonstrations or group discussion. All I am saying is that there must be a valid reason for developing a program--we do not program in a vacuum.

2. Specification of Operational Deficiency - (What do we need to teach?)

Since the only justification for a program is that it can correct an operational deficiency, the training needs and standards of effectiveness are determined on the operational level. If the student does not know how to do something, or if he is not doing something correctly, the writer states these deficiencies so clearly that there is no doubt about the extent to which they can be overcome by subsequent training in the form of a program. The formula for assessing knowledge or skill deficiency is M - I = D. M is the master's or expert's performance; I is the initiate's or trainee's performance; D is the deficiency, the difference in the performance of the expert and the novice.

Once the operational deficiency is determined, it is translated into terms of tentative training objectives. These objectives form the guidelines for writing a detailed description of the subject matter practices and procedures. The analysis of the subject matter and the format design of the program are based on the objectives, too.

The training objectives are stated in behavioral terms--concise, measureable terms of what the trainee should be able to do after completing the program. Such ambiguous terms as "to understand," "to know," or "to appreciate" are avoided. Instead, specific behaviors are listed, such as "to write," "to identify," "to solve," or "to list."

For example, "When the student has completed the program, he should be able to mix mortar"...

or

"to identify electrical circuit symbols used by an industrial electrician"...

or

"to use a scale ruler"...

The objectives also state the conditions under which trainees are expected to perform after taking the programmed lesson.

For example: "Given the necessary materials this student will be able to mix mortar to be used in laying a brick wall"...Negative or delimiting requirements would be included also, that is, "This lesson does not teach how to estimate the amount of mortar needed."

Finally, the objectives specify criteria of acceptable post-program performance of the trainee, that is, the level of competence at which the student should be able to perform. These criteria are usually expressed in terms of time, percentage of correct answers on an examination, or actual demonstration of ability before a supervisor or examiner.

Training objectives are prepared with the prospective trainee population in mind. Most of our materials are designed for the disadvantaged trainee; however, the programs proved to be even more successful with other groups who were not necessarily deprived or handicapped. Regardless of our success, we always describe the design population in terms of educational levels and general background and knowledge in the areas to be covered by the program. Since it is not always possible to uncover individual deficiencies of the target population before a program is developed, it is sometimes necessary to develop remedial programs which will provide the prerequisite knowledge needed to complete a particular program. For example, our fractions laboratory is being developed because the bricklayer trainees were unable to solve problems requiring the use of fractions in a series of lessons on estimating materials. Individual and field tryouts quickly uncover the remedial areas that need to be programmed.

3. Performance Requirements

Once the operational deficiency is determined (stated as training objectives) and the feasibility of a program is confirmed, the correct performance (reflecting current, standard subject-matter practices and procedures) is determined. This is the "job analysis." Its importance can hardly be overstated, for a program can be no better than the analysis upon which it is based. Correct performance is determined by observing the actions of an expert practitioner and by questioning him about his covert actions, since covert performance is just as significant as overt. (The Material Development Unit's personnel had to be trained to ferret out obscure behaviors.) To ensure accuracy, someone considered to be even more "knowledgeable" than the practitioner checks the analysis to see that the behaviors described are actually those behaviors the trainee should learn. As you would perhaps guess, the subject matter experts sometimes disagree as to what procedures or practices are correct! In such cases, the writers consult with other experts, and they also refer to the most up-to-date reference materials available. The procedures or practices used are those on which most of the experts are in agreement.

4. Performance Analysis and Programming

Actually, this function and the previous one (Performance Requirements) overlap considerably. The first phase of this function consists of delimiting and organizing into behavioral terms the content of the course or program. This step is very important because it defines the initial deficit in the capability of prospective students with respect to subject-matter competency. The analysis also helps to determine the maximum "operant span" or step-size by which the student can effectively learn--that is, how much can be absorbed at one time. The notational system used in this initial analysis is called a "prescription." In the prescription the subject matter for the program is first broken down into statements of what the trainee is to learn to do (the response, or R) and when he is to do it (the stimulus, or S). This technique reveals discrepancies which may be found in standard job analyses, and it highlights the overall behavior patterns.

After the "prescription" is completed, a final check is made for technical accuracy. It is possible at this time to determine what the program in its final form will accomplish, that is, final training objectives are formulated.

The second phase of the Performance Analysis and Programming includes a systematic analysis of the "prescribed" behavior deficit for those generalization and competition components that cause the primary learning problems for the student. This analysis anwers such questions as:

1. Are there similar stimuli which may not appear similar to the student but which require the same response? For example, having learned the sound of "B," will the student know that "b" and "𝒷" have the same sound? If your answer is "No," the generalization must be made for him.
2. Are there stimuli in the prescription which may <u>appear</u> similar to the student but which require different responses? For example, the scales on the Volt-Ohm-Milliammeter (VOM) almost always appear as concentric arcs which are read with the same pointer. Yet, the ohms scale is read from right to left while the scales for volts and amperes are read from left to right. Teaching strategies must be devised that will treat for such competition.

3. Is there a similar stimulus situation outside the specific behavior being taught, but in the student's experience, which may be confusing? Most household light switches are installed so that one turns the light on by moving the switch up. Suppose that a machine which the student is learning to operate is turned on by moving the switch down. He may attempt to turn the machine on in the same way he has learned to turn a light on. Again, competition must be overcome.

The second phase also includes the development of outlines or "lesson plans" which show the precise teaching strategies that will be used to produce the actual "exercises"--the term used to describe a teaching unit in a mathetical program.

The teaching strategies used in these exercises are characteristic of mathetical lessons. There is a great deal of flexibility in the layout and response requirements since mathetics is not a format system. Function determines the format. Notice the lack of uniformity of style or appearance from lesson to lesson or page to page. An exercise uses whatever is best depending on the characteristics of the behavior to be taught and the abilities of the student population. Some exercises look much like a linear frame while some may resemble a double page spread with all the design appeal of a good magazine advertisement.

All types of responses are called for in mathetical lessons. They vary from a paper and pencil type response to those involving the use of tools or simulator kits. The response is not always overt.

Because the learning situation should duplicate an actual situation as nearly as possible, extensive use of illustrations and simulations characterizes mathetical lessons. We find that it is effective to represent a particular stimulus by using illustrations to teach the student the correct response. Illustrations and simulators assist the student in transferring his knowledge from the learning situation to the job. Our program, "Soldering Leads," is a lesson in which illustrations and simulations were used very effectively in a program. Boys were able to transfer their knowledge very easily without any help from an instructor.

In most cases, a lesser degree of simulation will work well. For example, our series on using the VOM actually has a drawing of the instrument to guide a student in its proper use. By marking on a drawing at key points or in a certain sequence a student is able to apply the knowledge to actual job performance.

The model teaching exercise presents a stimulus-response relationship at least three times: once in a "demonstration," then in a "prompt," when the student responds with assistance, and finally in a "release," when he responds without help of any cues. Students like these lessons because they are able to learn without being bored to distraction by repetition that they dislike intensely.

5. Editing and Evaluation

The first phase of this function consists of editing procedures that are generally standard; however, there are some exceptions which I shall explain.

First-draft exercises are submitted for review to the subject-matter specialist who checks the technical accuracy of each program. Any suggested changes are usually limited to minor points such as technical terminology, and do not include changes entailing extensive reanalysis and rewriting. After these changes are made, an individual tryout is conducted with a student in the design population. In tryouts and field tests, a pretest on information covered by the lesson is administered. The student (or students) then takes the lesson. A posttest is then administered. The difference in pre- and posttest scores tells us how well the lesson taught. A student's failure on certain parts of a lesson may point up needed changes. Samples of such changes may be decreasing step size, changing layout to eliminate confusion, rewording, etc. If changes are made after individual tryout, the program is resubmitted to the subject matter persons for review. The most critical phase is the evaluation which is based on the individual and field tryouts. In the individual tryout a student takes the program under the close observation of a staff member of the Unit. Depending upon the heterogeneity of the prospective design population, from one to six such tryouts are conducted; one tryout may suffice for a highly homogeneous population. Revisions are made to correct inadequacies in the program. The cycle of tryout revision-tryout continues until the student's performance reached an acceptable level which is normally 85% or above on the posttest. It is this tryout procedure we refer to when we say that our programs are <u>student-proved</u>.

Finally, the program is submitted to field testing, meaning that a representative sample from the prospective training population uses the program under operational conditions as close as possible to conditions of actual performance. (The results of our field tryouts are included in the specifications of each program when it is published. A report of the field test results is included in the Programmed Lessons brochure which may be obtained from the Rehabilitation Research Foundation, P. O. Box 1107, Elmore, Alabama. The back of each lesson cover in the brochure gives the specifications for the lesson.)

Use of the Programs

Although it was impractical to fit the programmed lessons to the curricular schedule of the various field-test classes, it was possible to install the lessons in the precise place for which they were designed in the curriculum of the courses at Draper. The following data give an exact picture of some of the lessons used in the appropriate place in the training schedule.

Results of Programs used in Draper's Courses

Lesson	Pretest	Posttest	Net Gain
Mixing Mortar	28%	97%	69%
Tools & Areas of a Haircut	35%	98%	63%

Most important of all is the fact that these lessons tend to motivate the trainee to continue working. Trainees and instructors are definitely in favor of using programmed materials whenever they are available.

The flexibility of these mathetical lessons makes them ideal for training needs of vocational schools and industry where transfer of skills to actual job performance is critical. Because of their flexibility, their value is not limited to individualized instruction. We plan to use the mathetical system in programming group instruction, which could be presented through films, slides, role-playing, or other techniques.

One of the most frequent criticisms leveled at programmed instruction, particularly mathetical lessons, is that it is expensive to produce. Admittedly, the cost of production is greater than that of traditional training materials. We believe that the advantages of programmed materials far outweigh the costs. I will not list the advantages again, but will summarize them all by stating that we have demonstrated that programmed instruction provides both learning and instructional efficiency. Thus, we have achieved one of our major aims. If you would like to improve your training program, we highly recommend that your instructors be trained to use programs properly.

Selection and Evaluation of Programmed Instructional Materials[1]

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Whether one is evaluating programmed instruction (P.I.) to determine if it is the most efficient method for the teaching job at hand or to determine which of two or more programs best meets his needs, the method of evaluation is much the same. Once committed to the use of programmed instruction on either a limited or general basis, one must seek specific programs to meet specific needs. The wealth of P.I. materials available confuses even the veteran practitioner. Before considering any programmed lessons, the evaluator must know the answers to these questions: Are you going to use programmed materials to teach an entire course? Do you plan to use them to supplement or enrich the usual course of study--that is, will they be used to help slow learners over difficult spots and to allow fast learners to do further study while others master the required subject matter? Are there specific points in the curriculum at which you plan to use P.I.--points which traditionally have been instructional stumbling blocks? Will you use them to up-date and sharpen the skills and knowledge of your staff? In other words, to evaluate you should know exactly how you plan to use programmed instruction.

Behavioral Objectives--You should also formulate in writing the specific training objectives you plan to achieve with programmed instruction. These objectives should state in precise, measurable terms, exactly what the learner will be expected to do after he has completed the learning experience. A

[1]This paper was presented at the Draper Training Conference for 21 visitors from Hawaii, Montgomery, Alabama, November 21, 1967.

statement that the student will know how to do long division is not enough. A better objective would be: Given 50 problems in long division, the student will be able to set up and solve 45 of them. Preparation of "behavioral objectives" is sound teaching practice regardless of the method of instruction. Preparation of such objectives is essential when one begins to screen programmed materials for possible use. You use them to select P.I. materials which have approximately the same behavioral objectives as those you have designated. One programmed course may completely satisfy a particular training need while other deficiencies may require all or part of several P.I. lessons.

Sources - Just finding out what is available in P.I. materials is a major task. For this purpose, two resources appear to be indispensable: The Automated Education Handbook and the Hendershot Catalog. Both references list programs by subject matter. Each also contains information about grade level, price, and publisher. The Automated Education Handbook gives a better description of the materials available. In addition, it contains essays and discussions on the theory and use of programmed instruction. The Handbook is, however, an expensive volume; the Hendershot may suffice strictly for ordering purposes. To acquire programs to evaluate, one peruses these volumes and orders examination copies of programs which appear to cover the desired subject matter at the appropriate level and for a price which is within his means.

Now to evaluation.

Evaluation - The obvious way to evaluate a program is to try it out on the students with whom you plan to use it. Such tryouts may not always be possible; furthermore, you will not want to try out every program you receive.

For example, certain programs may prove to be totally inappropriate to your training needs. Your own training objectives will serve as a preliminary screening device. All good programs have definite objectives and they should be stated in the same terms as your own--in terms of performance--what can the student do upon completion of the program. If your objectives and those of the program seem to coincide, further examination is called for. Programs can be eliminated immediately if their objectives are not appropriate to your needs. As Susan Markle says, "A program takes shape with the specific audience in mind." Information about this target audience should be included with the teacher's guide or manual which should accompany a program. If this audience and your own students are somewhat similar, you are ready to subject the program to a searching, critical inspection. This inspection should be guided by the following key factors: Content, Construction, Level, and Pedagogy. These areas are discussed here separately for ease of presentation; you will not have to review a program four times. This writer believes that a reviewer can best accomplish his task by going through a program as a student.

Content - As you consider content, you will be seeking to answer several questions, keeping in mind your intended use of programmed instruction. First, does the program cover the topics you plan to teach? Titles can be misleading. I have on my desk a program entitled "Effective Writing." Promotional material led me to believe it would help me to write "clear, forceful prose." The program turned out to be a course in English grammar. Granted that a grasp of grammar, punctuation, and usage is essential to the production of good prose, I didn't anticipate that the "secrets of composition" would be quite so basic.

Second, what skills does the program develop? And, are these the skills you want your students to develop? For example, a program may teach a student to quote rules for the use of the comma. Is this what you want your students to be able to do, or do you want them to be able to use commas correctly? Here again, we see the importance of written objectives.

If you plan to teach a whole course with a program, you will want to see if it is in line with the prescribed course of study. And regardless of use, you will want to know if what it teaches is in agreement with what other "authorities" in the field teach. If you aren't sure, get the opinion of an expert, and check the author's qualifications and those of any consultants he lists as subject-matter experts. In short, the subject-matter content must be technically sound, and it must be appropriate to your general and specific training needs.

Construction - The second area you will be considering as you examine a program is its construction and fabrication; that is, the way it is put together. Format or construction may sifnificantly add to or subtract from the effectiveness and applicability of a programmed lesson. For example, you will want to determine whether or not the program is divided into distinct units or segments. This is particularly important if you are planning to assign a supplementary role to programmed instruction. If there are logical divisions, you can use parts of a program more readily. A particular deficiency may be limited in nature and, therefore, only certain portions of a programmed course may be required.

Another item of importance is the ease with which a program can be used. The sheer mechanics of a program can make it frustrating. The physical negotiations required (turning pages in an unorthodox manner, inverting the programmed text, etc.) often presuppose more aptitude than does the subject matter of the program. The ease with which a student can confirm his responses should also be considered. He should not have to expend undue effort to check his answer; yet it shouldn't be easy for him just to copy correct responses.

Some other questions you will want to answer are these: Are the directions easy to follow? Does the program require special equipment? If so, will such special equipment be available to you? Will there be enough of it for all of your students? Will this equipment be cumbersome or inconvenient to use?

You will also want to determine if the program is consumable or reusable. It isn't necessarily desirable to reuse a program; your instructional materials budget must dictate. Be aware, however, that the effectiveness of some programs would be altered significantly if students are not allowed to respond in the program itself. For other programs, having students to write responses on notebook paper will not change the effectiveness. To some extent, you can be guided by the publisher's recommendations here, but rely on your own judgment, too.

Level - Another factor in evaluating a program is determining its difficulty level. This determination must be more precise than simply saying, "Course X teaches English grammar at the 7th grade level." Such sweeping phrases are common in bibliographic descriptions of P.I. materials. Remember, your needs are determined by your "behavioral objectives;" you are looking for program context that will teach these specific objectives. In this context, the term "grade level" is not too meaningful. What is important is the reading level of the material. In many cases, the reading skills called for are at a much higher level than the subject-matter content. Is the program written in a style and with a vocabulary your students can understand? If there is technical terminology are your students familiar with it? Or is it taught by the program? In passing, let me say that it's probably better to err on the side of too low a level than one that is too high.

You must also identify the prerequisites for each course. A certain series of lessons on estimating materials requires the use of fractions in a problem-solving context. If the bricklaying trainees for whom this series was designed do not have these necessary skills the lesson is of no value. In an otherwise sound P.I. lesson, disregard for the prerequisite skills may render it totally ineffective. If the target population does not have the prerequisites, remedial material must be prescribed. Too many deficiencies might lead one to reassess his target population.

Pedagogy - The fourth and final area you consider as your inspect a program is pedagogy. Actually, what is needed here is in the nature of a warning. I am quoting from an article by Paul I. Jacobs in the Automated Handbook: "The way the subject matter is organized and presented in a program is likely to surprise you. The order in which topics are covered may be strikingly different from other presentations of the 'same' subject matter that you have seen in textbooks. The steps the student takes to master a given topic may seem too small or repetitious. Think twice before rejecting the program on these grounds alone. It may be just these features that make the program uniquely effective."

After you have completed your inspection of the programs, you should know which you want to try out, or at least have eliminated those you don't want to try. If you still are doubtful, review the research evidence which is furnished with the program. And beware the program which lacks such data. This information should tell you how the program was tried out by the author and/or publisher. It should state who the students were, how the program was used, conditions of testing, and what results were obtained. That is, pre- and posttest scores should be furnished, along with copies of the tests. It should tell you how long the tryout students took to complete the test. The attitude of the students toward the program and the method of ascertaining it should be reported. Even when a purely subjective judgement has been made, it may have some validity.

At last you are ready to try the program or programs which have survived your inspection. Administer the lesson to a small group and carefully observe their performance as they work. Administer pre- and posttests so that you will have a measure of how well the program taught. The results--test scores and your own observations--give you a basis for deciding whether or not a program can be used for your purposes.

Earlier it was suggested that you may not always be able to try a program out. For example, suppose you want to teach an entire course with programmed materials. The ideal way to determine the program's merit would be to administer it to a class, using as a control group a class being taught by conventional methods. Your two groups would be administered the same pre- and posttests. The results would tell you if your program is at least as good as conventional teaching. In a public school system this just isn't practical. You run the risk that the program does not teach as well, and you then have a group of students who have been short-changed for a semester or a year. This is the place where you must rely on the experience of others. It's better not to rely on the judgment of someone who has inspected a program and written a review. If at all possible, find out what someone who has actually used the program thinks of it. If inspection alone--others as well as your own--is your only criteria, another warning from Paul I. Jacobs is in order: "In our present state of knowledge, different 'inspectors' of a program may not agree on its teaching effectiveness, or, even if they do agree, they may not be right. If you nevertheless want to or if circumstances compel you to place primary weight in your decision on your inspection of the program, then you will find a book by Markle quite helpful." The book to which he refers is Susan Markle's <u>Good Frames and Bad: A Grammar of Frame Writing</u>.

Evaluation involves inspection, review of research evidence, tryout, and the opinions of others. Anyone who begins to evaluate programmed instruction will doubtless find other questions to ask, and he will doubtless discover that not all questions suggested here are apropos to all programs. This is an attempt to furnish guidelines based on our experience. The sum of that experience is this:

No programmed instructional material is intrinsically valuable. It must be considered in the context of target population, adaptability to curriculum, time, motivational characteristics, measurable outcomes, and budget.