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AUTHOR   Lenn, Peter D.; Maser, Thomas F.
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ABSTRACT
              Four programed instruction courses were developed in
the form of printed texts. They covered the California Penal Code,
the laws of arrest, search and seizure, evidence, and dangerous
weapons control laws. The programed courses were used as self-study
instructional material for recruit training and for in-service
training for policemen. The courses proved to be effective and
economical. The presentation of the programed lessons at a computer
terminal was evaluated and found to be equally effective as the
printed material. However, the computer was found to be less
efficient in terms of student time and to be more costly than the
workbook format. (JY)

FINAL REPORT

June 30, 1971

Development and Evaluation of

COMPUTER ASSISTED/PROGRAMMED INSTRUCTION ON THE LAW

Prepared for
State of California
California Council on Criminal Justice
1108 - 14th Street
Sacramento, California 95814

Attention:

Robert H. Larson
Executive Director

Sponsored under

CCCJ Grant, #0195 Dated May 1970

Prepared by:

Peter D. Lenn
Thomas F. Maser

APPROVED:

Peter D. Lenn
Peter D. Lenn
Project Director

C. R. Gain
C. R. Gain
Chief of Police .
City of Oakland, California

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1. SUMMARY

1.1 Results

The following results were achieved in Project 0195, Computer
Assisted/Programmed Instruction on the Law.

1.1.1. Four programmed instruction (PI) courses were developed
in the form of printed texts covering the following
subjects: The California Penal Code; The Laws of Arrest,
Search and Seizure; Evidence; and Dangerous Weapons
Control Laws. These texts are appended as part of this report.

1.1.2. The self-study PI texts were used as a regular part of
recruit academy courses for both home study and as a
primary activity during supervised study hall periods in
class. The self-study materials, which replaced formal
lectures as the primary instructional format, were found
to be effective and efficient in reaching training goals, in
reducing overall study time, in streamlining scheduling of
the recruit academy, in reducing instructor work load, and
in increasing the instructor time available for attention to
the individual learning problems of students. Two experienced
officers, each of whom lacked prior formal training as
teachers, were able to present the courses on criminal law
(Penal Code) and on the laws of arrest, search and seizure
with minimal preparation. Student achievement was as high
as in previous recruit schools. Anecdotal evidence indicates
that student achievement was actually improved, but no data
could be obtained to verify this statistically.

An opinion questionnaire, completed by the recruits, showed
that 97% felt the materials were effective in teaching course
objectives and 71% preferred PI texts to other forms of
instruction which they had in the academy. 85% expressed a
desire to have programmed instruction in additional subjects.

1.1.3. A limited sample suggests that the self-study materials
are effective in reducing the academic failure rate,
particularly of recruits with poor academic backgrounds
and skills. In the past, such recruits have had particular
difficulty with the course on the Penal Code. In the 62nd
Recruit School, two recruits were dismissed for academic
failure. They had passing scores of 72% and 78% on the Penal
Code final examination, and failed because of grades below
70% in courses taught by conventional means.

1.1.4.   The PI lessons on the Penal Code were used in a pilot
in-service training program. Each member of the 450
man Patrol Division was given a lesson per week and
allotted fifteen minutes of each regular, daily, 30 minute
roll call period for individual study.

1.1.4.1 An opinion poll was devised by the Oakland Police Department
to evaluate the response of experienced officers to this form of
in-service training. 91% indicated that they felt their
knowledge had improved. 78% of the responding officers
indicated a preference for programmed instruction over the
lecture format which typified previous training programs.
58% of the officers voluntarily worked on the materials on
their own time despite the fact that they were not to be
tested on the materials or held accountable for them in any
way. 54% of the officers expressed a desire for more on-duty
time to study the materials. 77% thought the level of the
Penal Code course was satisfactory, even though it was
designed specifically to meet the needs of inexperienced
officers. It is expected that the course on the laws of arrest,
search and seizure will be even more suitable for this type
of in-service training of experienced officers.

1.1.4.2 A small control group of experienced officers was given
pre-tests and post-tests in conjunction with the PI materials.
The group as a whole showed a 19% improvement in test scores.
The ease and economy of providing training by means of
programmed instruction coupled with the major improvement
in student acceptance of this program over earlier lineup
and in-service training programs suggest that the method is
useful for training experienced officers.

1.1.5   The PI lessons on the Penal Code were used successfully
for the training of civilian dispatchers employed by the
Oakland Police Department. The Commander of Communications
Section in which the dispatchers are employed found the
training to be effective and convenient and to be of
significant help to the dispatchers in their work.

1.1.6   The presentation of PI lessons at a computer terminal was
evaluated and found to be equally effective as the printed
material. However, the computer was found to be less
efficient in terms of student time and to be more costly
than the workbook format. Computer presentation of
instruction was workable and favorably impressed students
but does not appear to be economical or advantageous.

1.1.7   A diagnostic test on homicide laws was administered at
        a computer terminal. The computer analyzed the results
        and returned to the student a study prescription keyed to
        the PI materials. The method satisfactorily identified student
        needs but offered no advantages over written tests sufficient
        to justify the costs for continued use.

1.1.8   Analyses of the development and use costs of PI materials
        and of computer presentation of instruction were made and
        are included in this report.

1.1.9   The PI materials on the law have been adopted for continuing
        use by the Oakland Police Department. Presentation of the
        materials and methods developed in this project will be a
        major portion of the program of the third annual Institute
        on Teaching Law to the Police Officer at the University of
        California at Davis in August, 1971. Articles on the results
        of the program are in preparation by the project personnel
        and will be submitted to appropriate journals for publication.

1.2 Conclusions and Recommendations

The results of this project support the following conclusions:

1.2.1   Programmed, self-study instructional materials can and should be used for recruit training and in-service training in the police training environment to achieve higher levels of proficiency in less time, to reduce scheduling problems of both students and instructors, and to reduce instructor preparation time.

1.2.2   Computer presentation of programmed instruction material on legal subjects is more costly and somewhat less efficient than printed presentation of the same programmed material. These disadvantages appear to outweigh the motivational novelty, the automatic record keeping, and the ease of updating which are advantages of computer-assisted instruction.

1.2.3   The instructional materials developed under this project are ready to use and can be adopted immediately by any law enforcement agency in California. These materials permit the individualization of classroom instruction without changing teacher-student ratios. The materials permit the student to proceed at his own pace, they contain intermittent testing which identifies student needs and evaluates progress during the learning process. and they free the instructor to work with students who have special needs, interests, or problems. Detailed instructions and suggestions for use of these materials for recruit and for in-service training are given in Section 2.2 of this report.

1.2.4   The programmed instruction courses developed under this project are appropriate to the training needs of many civilian employees of police agencies. Jailers and dispatchers are typically most in need of such training. Because of the economy of packaged PI materials and the ease of scheduling packaged instruction on an individual basis, the materials create a means to provide training which has often been denied in the past.

1.2.5   There exists a need for professionally developed, individualized training materials emphasizing active student responses in the areas of report writing, criminal investigation, and patrol procedures. Such materials would be different in form

but similar in educational concepts to the materials developed under this program. A grant application for the development of such individualized and packaged training courses is being prepared by the Oakland Police Department for submission to the California Council on Criminal Justice.

1.2.6 The following two letters discussing the results of use of the PI texts developed under this project are from the Commandersof the Training Division and the Records and Communications Division of the Oakland Police Department.

POLICE ADMINISTRATION BUILDING · 455-7TH STREET · OAKLAND, CALIFORNIA 94607

Police Department

July 12, 1971

American Analysis Corporation
420 Market Street
San Francisco, California

Attention: Dr. Peter Lenn

Dear Dr. Lenn:

We have completed tabulating preliminary returns of the questionnaire
which was issued to all personnel who participated in the recent Penal
Code programmed instruction course. The following information, although
not complete, will perhaps serve as a barometer of the efficacy of this
type of training for police officers.

Although 450 personnel participated in the course, only 141
questionnaires have thus far been returned. This is attrib-
utable to two factors; (1) no control on questionnaire return
was implemented via signatures, checkoff lists, etc., in order
to obtain the most impartial information, and (2) random quest-
ioning of groups of personnel who participated in the program
as to the relatively small return indicates a substantial num-
ber of personnel had not completed the programmed workbooks
and did not wish to fill out the questionnaire until they had
done so. This latter factor, in my opinion, is important and
is discussed more fully below.

Of the 141 questionnaires received, a high percentage (78%)
indicated a preference for programmed instruction over the
lecture format previously employed. Most of the officers who
responded (77%) indicated that they thought the teaching level
of the material was satisfactory, even though the course was
originally designed for recruit officers. This is significant
and indicates that performance objectives of the course were
realistically designed around understanding of on-the-street
situations. More than half (54%) of the respondents indicated
a preference for more time to complete the workbooks than was
provided during line-up training sessions.

A factor which is significant by itself and which reaffirms
the rationale for not completing the questionnaires is the
relatively high number of persons (58%) who indicated that they
devoted additional hours of off-duty study towards completion
of the programmed workbooks. The workbooks were completed by
officers in recruit school during a total time allocation of
26 hours and, in retrospect, I feel that it was generally an
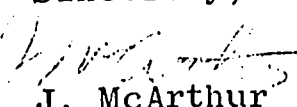impossible task put upon personnel to complete the workbooks

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as line-up training in only nine hours of fifteen-minute
training periods, which time was fraught with interruptions.
However, it is particularly impressive to me that personnel
voluntarily devoted substantial amounts of their off-duty
hours to complete the workbooks, with no benefit to them ex-
cept a greater knowledge of the Penal Code. This would seem
to demonstrate two things; (1) a strong desire on the part
of line personnel for in-service training and (2) a reaffirm-
ation in my mind of the minute-by-minute "challenge to contin-
ue" this kind of instruction, based on its unique teaching
method.

Ninety-one percent (91%) of the personnel who returned quest-
ionnaires indicated that their knowledge of the Penal Code
improved as a result of their participation in the programmed
instruction course.

Lastly, it is interesting to note the suggestions for addition-
al subject material which were made in the questionnaire re-
turns, especially since a substantial number of persons indicated
a wish for instructional material in Search and Seizure (a course
which was also designed under your project grant). Other sub-
jects suggested were Patrol Procedures and Report Writing.

In summary, the responses to the questionnaire indicated a high degree
of acceptance and effectiveness of the program and a desire for addition-
al subjects by this teaching technique. I hope that you will find the
questionnaire results gratifying and you may be assured that I find
them indicative of the quality and versatility of the product which
you have prepared.

Sincerely,

J. McArthur
Lieutenant of Police
Training Division

CITY OF OAKLAND

POLICE ADMINISTRATION BUILDING · 455-7TH STREET · OAKLAND, CALIFORNIA 94607

Police Department

July 2, 1971

Mr. Peter D. Lenn, President
American Analysis Corporation
420 Market Street
San Francisco, California   94111
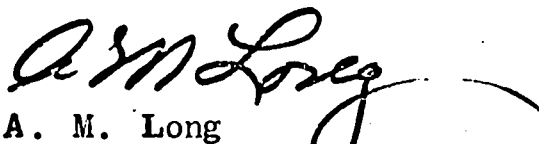
Dear Mr. Lenn:

I feel I should convey my impression of the programmed
instruction on the California Penal Code prepared by
your firm. When it was first presented to my
Communications Dispatchers in April of this year, it
was my first opportunity to observe its effects.

Few of the employees had prior knowledge of the subject
but they seem to have gotten more lasting information
from this course than any other. All comments made
were favorable and those taking this course preferred
this method over lecturing.

Since the dispatchers have been working in the Radio
Room, they have had fewer problems with the Penal Code
than in any other area. In my opinion, the programmed
instruction provided by your firm is both convenient
and effective.

Sincerely yours,

A. M. Long
Lieutenant of Police
Records & Communications
        Division

AML:je

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DESCRIPTION AND DISCUSSION OF PROJECT

2.1   Programmed Instruction Materials Development

2.1.1   Concepts of Programmed Instruction

The methods of programmed instruction are based upon the following concepts:

1. The curriculum is designed to achieve specific educational objectives which are formulated in terms of operational competence of the student.

2. Instructional materials are planned for individual use thereby permitting scheduling flexibility and self-paced progress by the student.

3. Immediate re-enforcement of learning by requiring its application in question and answer situations, problem solving or case study.

4. Refinement of instruction materials through extensive trial on sutdents until the curriculum in fact meets the educational objectives.

2.1.2   Instructional Objectives

The objectives listed below were established to guide the current development of instructional materials on the law related aspects of the California Penal Code, investigation, arrest, evidence, search and seizure and the administration of justice. Other training experiences, including outside reading, lectures, role playing and supervised field assignments will lead to the attainment of additional objectives of police training and will contribute to the attainment of the following objectives.

At the conclusion of the course, the recruit will:

1. be able to identify the roles and describe the operating procedures of the governmental bodies involved in law enforcement, criminal justice and the maintenance of order.

2. (a) be able to identify the elements of a crime as presented in a fact situation and be able to list the elements that must be present to establish the commission of a crime.

(b) be able to classify crimes as felonies and/or misdemeanors.

(c) be able to consult the penal code to identify uncommon crimes and their elements or to clarify any point of procedure.

(d) be able to apply the procedural sections of the penal code as a basis for police action in case study situations.

3. be able to decide in case studies when to detain, arrest, cite, warn or seek a warrant for arrest, and be able to discuss the basis for such decisions.

4. be able to choose reasonable courses of action and appropriate levels of force in case studies or dramatized situations, having taken into consideration laws, ordinances, policies and procedures.

5. **(a)** be able to identify proper and improper searches and seizures from case studies.

   (b) be able to identify situations in which search warrants should be sought from those in which a valid search may be made without a warrant.

6. be able to write reports in conformance with departmental instructions.

7. be able to testify properly in court.

8. be able to read independently and to apply information in departmental training bulletins.

9. be able to answer questions of law such as might arise in explaining his actions and informing citizens of their rights and obligations under the law.

10. be able to distinguish situations in which the patrolman has the legal and/or departmental authorization to exercise his own discretion. The cultivation of good judgement is an overall objective that cannot be attained only by the materials being developed in this project. Other training approaches including lectures, reading, role playing and field training will be used concurrently and will be directed at development of good judgement.

On the basis of these general objectives, specific
objectives were formulated for each portion of the course.
These objectives are described in each of the four courses,
so that the students and their instructors can determine
what is to be learned and whether it has in fact been
learned.

In the case of the course on the Laws of Arrest, Search
and Seizure and the course on Evidence, the specific
objectives were originally formulated as a set of test
questions covering all the skills to be taught. These
"Criterion Tests" appear as the last section of the text
on the Laws of Arrest, Search and Seizure and in the form
of "Progress Check" tests at the end of each of the four
lessons of the Evidence text. For the Penal Code and
Dangerous Weapons courses, the objectives were originally
in narrative form and the criterion tests were developed
subsequently. The narrative objectives used to design the
Dangerous Weapons course are included below to illustrate
the form of the narrative objectives and to permit comparison
between these objectives and the Criterion Test at the end of that
course.

OBJECTIVES - Dangerous Weapon Control Laws

At the completion of this lesson the student will be able to perform the following tasks:

1. Determine whether a potentially dangerous implement is a dangerous weapon according to the California Penal Code.

2. Classify dangerous weapons according to type.

3. Identify those weapons, the mere possession of which is unlawful.

S. 12020	a.	blackjacks, slungshot, billy, sandclub, sandbag, metal knuckles
S. 12420	b.	teargas weapons
S. 12020	c.	sawed-off rifles, sawed-off shotguns
S. 12220	d.	machine guns

4. Identify those weapons which are unlawful to be concealed on the person or in a vehicle.

S. 12025	a.	handguns, concealable firearms (without a license)
S. 2006 F&G	b.	rifles or shotguns with cartridge in chamber
S. 653k	c.	switchblade over 2" in blade length

5. S. 12031 Identify those special situations in which it is a misdemeanor to carry loaded firearm.

6. S. 171c Identify those special situations in which it is a felony to carry loaded firearms (Mulford Act)

7. Identify the classes of persons whose privilege to bear firearms is specially restricted.

S. 12021	a.	any person who is not a citizen
"	b.	any person who has been convicted of a felony
"	c.	any person who is addicted to the use of a dangerous drug
S. 12021.5	d.	minors lacking parental consent

8. Identify unlawful explosive devices as defined by the Penal Code

9. S. 12022 Recognize the occurrence of a separate punishable offense during the commission of a felony while armed with a concealable weapon.

10a. S. 12027 Consult the Penal Code to identify the following exceptions to weapon control laws.

    a. clubs and organizations who use target ranges, transportation to and from.
    b. clubs, which collect and display guns, antiques, etc.
    c. clubs, civil and military organizations, while parading, transportation to and from.

11. Identify crimes involving tampering with serial marks on firearms.

    S. 12090   a. tampering with serial number
    S. 12093   b. falsifying identification number
    S. 12094   c. purchase or sale of weapon lacking identifying number

12. Determine whether violations of weapons control laws are misdemeanors or felonies.

2.1.3   Developmental Testing

All of the instructional materials prepared were subjected
to repeated cycles of trial usage by typical students
followed by revision. This testing process is accomplished
by having the student work through a course without help
while being observed by an educational technologist.   The
observer notes any incorrect responses and the student's
reaction upon comparing his response to the correct response.

To observe a student working on PI materials is a fascinating
experience for an educator. One immediately observes
that the student is motivated by his success in making
correct responses. When a student makes a wrong response,
whether it was due to his own carelessness or to a defect
in the materials, he loses enthusiasm and concentration.
In order to obtain an accurate evaluation of the materials,
the observer must avoid tutoring the student on the material
before it has been presented in the PI text. On the other
hand, it is necessary to assist the student over weak points
in the materials. In this way the entire course can be tested
without interference by correctable deficiencies.

The function of testing of programmed instruction materials
is to determine their educational shortcomings. Each lesson
is intended to enable the student to acquire demonstratable
behavior which he was unable to exhibit before taking the
lesson. Behavioral goals can range from an ability to spell
"corpus delicti" to being able to determine from a case history
what crime, if any, has occurred. Testing with typical
students provides an indication of which training goals have
been met, which were simply not met, and where the student
has been trained to behave in an incorrect or undesired manner.
Initial testing with one or two students is sufficient to determine
major shortcomings. Later, after several cycles of testing and
revision, it is necessary to test the materials on a larger
number of students to "validate" the fact that the materials do
enable the entire target population to reach the training
objectives.

Testing of the programmed instruction materials also provides
the data necessary to develop efficient lessons. By determining
those places in the lessons where students become confused or
respond incorrectly, it is possible to repair these shortcomings,
so that later students will not encounter difficulty and will
therefore be able to learn more quickly. It is an important

concept of education that the learning process not be considered a test. One may test before the lessons begin to select students and after the lessons have ended to determine whether the students can do those tasks for which they have been trained. But, during the lessons, a student's learning is facilitated by active participation in the lessons, by continuous success and by lack of confusion.

Programmed instruction lessons are designed to take advantage of these concepts of promoting efficient learning. The lessons require the student to respond actively at each step of the way. It is the responding that is important to learning, not the fact that there is a possibility that the student may make an incorrect response. Therefore, it is a goal in the development of programmed instruction materials that all the students make correct responses to all the questions in each lesson. Though every student will respond incorrectly occasionally, and some students may make a large number of incorrect responses, the testing process enables us to develop PI lessons that minimize student confusion and provide him with the motivation that comes from succeeding in his task of learning. A student learns faster if he can be led to making the right response to every problem presented to him.

Unlike conventional texts and lectures, the burden of success or failure is assumed to be the responsibility of the programmed materials. During the testing and revision process, what appears to be student failure identifies flaws in the materials under development. The result is an instructional package in which student success in terms of predefined educational objectives is predictable for target student populations.

2.1.4   Validation Testing

The purpose of validation testing is to determine whether the PI materials are actually successful in enabling all of the students to achieve the educational objectives. Of the four courses developed, the Penal Code text was most extensively tested and the course on Laws of Arrest, Search and Seizure was used with one full recruit class. Though the Evidence and Dangerous Weapons texts were subjected to trial usage during development, neither has received sufficient use to be considered validated. However, these materials will be used in forthcoming recruit academies and it is expected that the results achieved will validate those courses.

2.1.4.1 First Validation Text of Penal Code Materials

In this first Validation Test of the Penal Code text, the
students were given 8 days to cover the material. During
this time they had five 3-hour study hall periods in which
they could work or not, as they chose. In the study hall
periods, they had access to a proctor who was able to
answer questions and discuss the subject matter knowledgeably.
Most students spent the study hall hours rather at leisure and
did the bulk of their studying at home. After the first day,
student questions were concentrated in the first hour of each
day's study hall period. This leads to the conclusion that
the study hall periods could be shortened to a daily 1-hour
discussion period, during which the problems which the
students encounter in their home study could be covered.
On the last of the 8 days allowed for studying the PI materials,
the students had a 3-hour lecture/discussion session with
the Penal Code instructor. The following day they were
given the same final examination on the Penal Code that
had been used in the recruit academy of the previous summer
(but omitting the last four questions on the laws of arrest).
A copy of that examination is included in the Appendix of this
report. A comparison of the results obtained in the previous
administration of this test to students who had been given
traditional instruction with those obtained by the students who
used the PI materials is shown in Table 1. In addition to
the numerical results shown in the table, there are numerous
points of comparison and evaluation that were made and are
discussed below.

TABLE 1

PENAL CODE

TEST SCORE DATA

Note that a different test was used in the 62nd OPD Academy.
The tests are included in the Appendix of this report.

	Conventional Instruction	Programmed Instruction	Revised Programmed Instruction
OPD Academy	59th	61st	62nd
Number of students	20	28	26
Elapsed days of course	13	8	6
Lecture hours	25	3	3
Number of questions rejected	8	16	0
Highest score	91	90	97
Lowest score	60	55	72
Class average	78.8	78.4	87

The students using the PI materials achieved esentially the
same class average as the earlier group and did so with 3
hours of lecture instead of 25, and approximately the same
20 hours of studying. There are only estimates of the
number of student hours previously spent in studying for the
Penal Code course, but anecdotal evidence indicates that
no more time was spent with the PI materials even including
the study hall hours which were poorly utilized.

Though the class average was the same, there was a slight
increase in the spread of the grades in the group using the PI
materials. Also, there were several more students having
grades below the "passing" grade of 70. It is believed that
these differences are due to some omissions in the topics
covered by the PI materials and to certain problems with
the test. Both of these issues are described more fully
below.

The test shown in Appendix 1 has certain peculiarities of style
that are unusual and require some getting used to. For example,
true-false questions are presented in pairs and the student must
first answer both questions and then combine the two answers to
match one of the four possible multiple-choice options presented.
27 of the 49 questions are of this type. See questions 5 and 6
for examples. It would seem that when first confronted with
this unusual method of halving the weight of each true-false
item and of putting on a one for one guessing penalty, the
student would be confused and do less well. Prior to the
earlier administration of this particular examination, the
students had been warmed up for the instructor's style by
25 hours of lecture and 3 mid-course quizzes prepared by him.

A further difficulty in analysing the results arises from the
instructor's policy of disregarding those questions which are
missed by more than 50% of the class. Based on an intention
to be fair, this policy would be even better if it were used as
an indicator of the shortcomings of either the instruction or
the test. However, no record can be found of which 8
questions were disregarded in the earlier use of this test.
16 questions were missed by more than 50% of the students
in the present trail and were disregarded in computing the
class average. These were items:

> 2, 14, 15, 20, 21, 24, 25, 29, 31, 32, 37, 40, 42, 43, 45,
> and 49. Of these, ten covered topics which were intentionally
> or unintentionally omitted from the PI materials.

(The unintentional omissions are being corrected.)
The six questions remaining are 15, 25, 31, 32, 40,
and 42. Except for #15, these are difficult pairs of
true-false questions.

The second half of item 25, for example, requires the
student to notice that:

"Paying a person who provides a woman for the purpose
of engaging in sexual intercourse establishes the crime
of pimping."

is a false statement because "receiving" rather than "paying"
is needed to establish the action of pimping. The question
could cover the same concept more clearly if the student were
asked whether the payer or the receiver was the pimp.

It is difficult to establish a correct assignment of the cause
of these rejections to either the PI materials or the test.
However, the questions did indicate that strengthening the PI
coverage of attempts and proximate cause would be helpful.
This is being done.

While the results in Table 1 indicate success of the PI materials
in helping students achieve the same class average in less time,
this does not give a full picture of the real effectiveness of
the PI materials because the PI materials and the test have
different emphasis. Before having available the tool of
educational objectives, teachers typically make up tests
which penalize insufficient effort on home assignments and
insufficient attention in class. The alternative approach,
which is generally considered a better measure of the
effectiveness of an educational activity, is to test whether
the student has achieved the ability to do those things which
he was to be taught to do. With the former emphasis, it is
considered reasonable to hold the students responsible
for any major item of information mentioned in a lecture.
The latter approach would not allow such a test question
unless "remembering in lecture" or "remembering that point"
had been an objective of the course. A specific example in
the present case is the following. The PI materials were to
train the student to:

1. charge suspects in homicide cases with homicide and
   not to make a distinction between murder and manslaughter,
   nor the degrees of those crimes at the time of arrest.

2. investigate for the types of facts that would relate
to establishing or disproving the elements of murder,
manslaughter, and their various degrees.

In view of this objective, questions 16, 17, and perhaps 30,
which ask the student to choose between the types of homicide
and their degrees, test a capability which was not an
objective and was not specifically taught by the PI materials.
The content of those questions was however used for examples
in the earlier course, so the students had a better chance to
know the right answer even without an increased ability to
make such distinctions in general.

Another problem with the test as a full measure of the PI
materials was the lack of emphasis on those capabilities
which were emphasized in the PI materials and in which the
students might be expected to do better than those who had
not had the PI materials. This applies to such topics as
deciding which facts in a case establish particular elements
of a crime, establishing the capacity to commit a crime, and
establishing the mental element in crimes where criminal intent
may not be inferred just from the commission of a prohibited
act. Though the test called for the identification of crimes, a
process which seems to include matching facts to elements as a
necessary step toward a correct answer, this is really not an
adequate test of the desired behavior. The evidence of this
is that a large number of arrests for properly identified crimes
do not lead to prosecution because the peace officer did not
do an adequate job of identifying and then describing which facts
he used to establish each element of the corpus delicti. It is
hoped, but not yet proved, that the PI materials have provided
the students with a better capability in these areas than was
previously the case.

The PI materials as used in this trial did not cover riots,
disturbing the peace and conspiracies, but these topics were
involved in several of the test items. These shortcomings
of the PI test have been remedied. Both the lack of
familiarity with the instructor's testing methods and the
fact that some topics were simply not covered in the existing
version of the PI materials would account for the increased
spread in the students' grades. This is because variability
in the students' initial knowledge and general test-taking
abilities would have a greater effect in this situation than will
be the case when the coverage deficiencies of the PI materials
are corrected and when a test more closely atuned to the
defined behavioral objectives is used.

2.1.4.2 Second Validation Test of Penal Code Materials

The PI materials on the Penal Code were expanded following the first usage to cover those areas previously omitted but considered necessary by the subject matter expert who reviewed the results of the first trial. In the second validation test, the students again were given three hours of lecture and discussion. Twelve hours of supervised study hall time was provided in class and the students completed their studying as a home assignment. The elapsed time of the course was shortened to six days, so that it could be completed before the course on the laws of arrest was begun.

This schedule permitted only one week-end for slower students to catch-up and complete the lessons. However, the final examination on the Penal Code course was not held until a week later to allow additional study time, particularly for memorizing the elements of the crimes listed in the appendix of the course. During the intervening week, the students' time was occupied with the PI materials on the Laws of Arrest, Search and Seizure and with the beginning of the course on report writing.

The final examination on the Penal Code administered to this 62nd Recruit Academy is included in the Appendix of this report. A comparison of this test with that used in both the 59th (Control Group) and 61st (First Validation) indicates that the test is more intelligible, less tricky, and attempts to cover the same material with greater relevance to job performance.

It should be noted that none of the examinations contained in the Appendix to this report should be considered ideal examinations. Validation of the materials required use of existing test questions. It is strongly recommended that local agencies draft their own examinations by modifying the criterion tests contained in the PI texts to suit their own individual needs.

Scores on the final examination given to the 62nd Recruit School may be considered a better indication of the effectiveness of the PI materials than the earlier test described in Section 2.1.4.1 of this report. The grades of the recruits in the 62nd Academy are also shown in Table 1.

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2.1.4.3 Effectiveness in Meeting Minimum Objectives

Among other requirements of the Oakland Police
Department Recruit Academy, all recruit officers
must achieve a passing score of 70% or better on the
Penal Code final and for the recruit school as a whole.
To date, no recruit has failed an examination on
material offered through programmed instruction.
Traditionally, the Penal Code course has been the most
difficult course offered in the school. Two recruits in
the 62nd Academy were terminated because of academic
failure. However, the men passed the Penal Code final
examination with scores of 72% and 78%, and failed as a
result of performance in other aspects of the school. This
limited evidence, observations of instructors in the academy,
and the range of scores in the validation tests indicate
that the PI materials effectively reduce the rate of
academic failure. While the materials, supplemented by
the informal assistance of an experienced officer, were
found to satisfy the needs of all students, they also tended
to minimize the difference in achievement between the
most successful and least successful students. The
orderly presentation of information in the programmed
instruction texts tends to lower those barriers to learning
which block students disadvantaged by poor academic
backgrounds or a lack of refined study skills from
achieving the minimum academic performance required
by the Recruit School. The programmed instruction texts
also identify and faciliatate individualized attention to
specific learning problems of particular students before
the moment of the final examination.

2.1.4.4 Validation Testing of the Laws of Arrest, Search and
Seizure Course

After developmental testing, the course on the Laws of
Arrest, Search and Seizure was used with the entire 62nd
Recruit School class. The twenty-six hours of class time
available for the course were devoted to ten hours of lecture
and discussion, ten hours of supervised study hall, and
six hours of role playing. Two examinations were given and
are included in the Appendix of this report. The "quiz"
covering the Laws of Arrest, Search and Seizure resulted
in a class average of 89%. No official final examination is
given in this course, but questions on the course were
included in a general mid-term examination. Of the twelve
questions pertaining to the course included on this mid-term,
no student missed more than two. The class average was 93%
on those 12 questions. These results indicate that the materials
were successful with this group of students.

2.2 Programmed Instruction Materials Applications

2.2.1 Recruit Training Application

During the validation testing, most the time previously scheduled for each course was retained in the Recruit School schedule. This provided for the possibility that failure of the PI materials might necessitate a return to the conventional instructional approach in order to bring the recruits to the required level of proficiency in each course. As that did not become necessary, the bulk of class time was devoted to study hall sessions, in which the students worked informally and individually on the PI lessons. A police officer or instructor was present throughout these periods to answer questions and to discuss particular points with individual students.

This study hall arrangement was found to provide a number of important advantages, though the amount of time allotted was excessive and could be reduced in the future. Providing the students an opportunity to have directed, yet informal, discussions with a working officer enhanced the relevance of the course and provided teaching at an operational rather than academic level. Further, because the teacher must only relate police actions to the law, he has no need to prepare an academically-styled course. It was suggested that the instructors assume the attitudes about legal questions which they would ordinarily take when performing a police function. They were to answer questions, if possible, in terms of what they would do if faced with an actual incident. They were to research or seek legal advice on any questionable points and report back to the student. In this way, the artificiality of classroom training was reduced. Recruits were not expected to solve problems in the classroom which an experienced officer could not and need not solve on the street. Recruits also obtained practice in choosing a course of action in the absence of complete information.

The study hall environment enables students to talk in small groups with instructors and with each other. Students may pursue those aspects of the course which specially interest them and get help on any concepts that are bothering them. Since the PI materials call for active responses from the student, his inability to respond

correctly to just a few frames in succession signals
that he has taken a wrong mental turn or missed a key
concept. In the individualized format made possible by
the PI, the student can stop when he needs help and get
it. He can do so without disrupting the progress of others
or the performance of a lecturer. Lecturers often feel
that it is their role to present material to the whole class.
Thus, in a conventional lecture course, the confused
student is viewed as a nuisance for whom the lecturer does
not have time to stop. Even the most skillful lecturer is
frequently faced with the problem of ignoring individual
problems or wasting the time of many students to help a few.

A most noticeable difference exists between individualized
in truction in a study hall setting and a conventional
lecture. On the one hand, lecturers often complain they
do not have time to do justice to the subject, let along
answer the questions of students who have particular
problems. On the other hand, one finds a signle instructor
able to provide individualized attention to 30 or more
students. This neglected advantage of the one room
schoolhouse allows the instructor to ensure that a student
has fully grasped a point before the student proceeds to
the next topic.

Lectures are particularly inefficient for presenting
course content. A conventional text is a better way to
present information. In the ideal learning situation,
a skilled tutor engages in a continual dialogue with the
student. PI materials are an attempt to package the
advantages of a tutor at the cost of a text.

The distinct and important role of the lecture in training
is to provide the students with a performance by a person
possessing the skills they are trying to achieve. The
lecturer should be presenting himself for scrutiny. Using
the course content as a vehicle, the lecturer demonstrates
how he behaves and thinks relative to the subject matter.
Thus, the lecturer is most effective when telling case
histories and least effective when reading from the notes
he hopes to convert into a textbook.

It is important to retain some time in each course for a
lecturer to present "war stories" about police work. As
the lecturer is no longer viewed as responsible for presenting

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the entire course content, he can select topics for his lectures that are most interesting, exciting, or illustrative. The atmosphere of the lectures can become more relaxed, and they can be successfully offered by persons previously considered to be poor showmen. Good lecturers have always been those individuals who measured their lectures by their personal performance. These are the lecturers who are willing to spend the time to tell a story that illustrates a point. All experienced police officers have anecdotes relating to police problems which derive from their own experience. Many can be good lecturers if they will abandon the attempt to be talking textbooks.

A few hours of lecture were retained in the Penal Code and Arrest, Search and Seizure courses to permit the recruits to hear and see a trained person address the same problems they must learn to handle themselves. Additional lecture time was devoted to guest lecturers, who provided a non-police view of the criminal justice system.

Both courses were also supplimented with role playing exercises. This excellent educational device is becoming increasingly widespread and should be of enormous benefit. The OPD has video taping equipment which is used to record, play back, and critique role playing incidents. Role playing is an excellent way to use the class time freed by the efficiency of the PI materials and is a good supplement to the courses on the Penal Code and on the Laws of Arrest, Search and Seizure.

During the course on the Laws of Arrest, Search and Seizure, two of the training films produced by the Los Angeles District Attorney's Office were shown and discussed. This series, which includes over 20 films, is an excellent and inexpensive source of dramatized incidents for analysis by the students. The films were not designed to elicit active student responses, but that defect can be remedied by stopping the film frequently to allow time for students to reach their own evaluations of specific incidents.

The PI texts on the law made available as a result of this program, free the instructor in a beginning peace officer training program from the need to lecture on all the specific points of course content. This reduces his preparation time. By replacing lecture and undirected home study with individualized, self-paced programmed instruction lessons, the student learns more easily and more quickly. The student time made available by these efficiencies should be devoted to enriching the course of study through more discussions, more guest

lectures, and more role playing exercises or to providing
more time for other courses in the curriculum. Though
the PI materials could be used exclusively for homework
assignments, instructors are urged to try the supervised
study hall approach. It gives them time to tutor individual
students without wasting the time of the remainder of the
class and provides the students with a chance to talk over
the material as they are learning it. If used in this way,
the PI materials allow the instructor to lecture about
the proper application of the information instead of on the
information itself. Thus, lectures are used to their best
advantage to cover the vital and interesting aspect of
how an experienced officer actually applies the law in
specific cases.

Each instructor should review any PI text that he will use
to find those points in which his department's policies or his
own opinions differ from those presented by the authors.
These points should be handled during lecture periods. For
example, there are differences in policy concerning the
adviseability of taking a drunk home rather than arresting
him. Once the students learn the law from the PI text, they
will readily understand local policies intended to provide
police service meeting the needs of their community. Thus,
it is hoped that a few specific comments by the instructor
on policy and discretionary points will easily correct any
differences between the views in the PI texts and those of
any agency in California.

2.2.2   In-Service Training Applications

The self-study format of PI texts makes them particularly
flexible for in-service training, where manpower shortages
make it difficult to free men from their assignments for
training purposes. A whole range of possibilities exist,
ranging from unmonitored use of the PI materials for home study
to their use in conjunction with a regular training course.
Within the Oakland Police Department, a pilot program of
in-service training during roll call, that did not require
removing men from their regular assignments, was
implemented, as described in the following departmental
order.

OFFICE OF CHIEF OF POLICE
OAKLAND POLICE DEPARTMENT

SPECIAL ORDER NO. 1567

TO: All members, Bureau of Field   DATE: 13 Apr 71
     Operations and Community Relations
     and Youth Division

SUBJECT: Lineup Training in Criminal Law

EXPIRATION DATE: 6 Jun 71

I. General Information

    For the past eight months, the Department has been in-
    volved in a federally-funded grant project to develop
    programmed instruction training materials on Criminal
    Law. Considerable effort has been expended to prepare
    study guides and course workbooks by Lieutenant Joseph
    Colletti of Preventive Services Division, in conjunction
    with educational specialists working under contract to
    the Department.

    Seven programmed lessons and a test covering the entire
    Penal Code have been developed and are presently being
    used to streamline the teaching of this subject to inex-
    perienced officers undergoing recruit training. The
    next step in the development and testing of the program-
    med instruction method is use of the materials for in-ser-
    vice refresher training of experienced officers.

II. Method of Conducting In-Service Training

    During a seven week period beginning 19 Apr 71, sergeants
    and patrolmen of the Bureau of Field Operations and the
    Youth Section will be given self-instruction lessons on
    the Penal Code, to be completed during regular line-up
    training periods. Completion of the lessons will provide
    both a review and updating of personal knowledge of the
    Penal Code and an evaluation of the effectiveness of the
    materials and of programmed instruction as a method of
    in-service training.

    Approximately forty officers will be selected at random
    and tested on their knowledge of the Penal Code before and
    after the programmed instruction lessons are administered
    to sergeants and patrolmen of these organizational units

in order to measure the value of the training program.
Since the tests will be designed strictly as an eval-
uative tool of the training material, individual scores
will be held in confidence.

III. Training Division Responsibilities

A member of the Training Division will attend all line-
ups on 19, 20 and 21 Apr 71 to distribute self-instruction
workbooks containing the first programmed lesson to all
sergeants and patrolmen of the aforementioned organizational
units, and to explain procedures for completing the work-
books and documenting time devoted to the project. The
Training Division will provide organizational unit command-
ers with copies of the Penal Code to be used in conjunction
with the lessons and Labor Distribution Cards to document
time spent by participating members.

IV. Responsibilities of Participating Members

A. Completing Programmed Instruction Lessons

Specific instructions for using the programmed materials
will be included as a part of the lessons or provided
when the lessons are distributed. Each of the seven
lessons which will be provided are designed for self-
study to enable participants to work at their own speed.
Students will be able to move quickly over topics with
which they are familiar and to spend more time on new
laws or legal points which are not frequently encounter-
ed on the job. The programmed lessons have been design-
ed so that one lesson should be completed each week.

Because of the variance of line-up training time avail-
able for the project, members assigned to Patrol shall
devote five one-quarter-hour line-up training sessions
per week to programmed instruction. Members assigned
to Traffic, Preventive Services and Youth Section shall
devote three one-half-hour sessions per week to program-
med instruction.

B. Labor Distribution Cards

1. Documentation of Time Spent

Each member who has been issued a programmed work-
book will be given a pre-printed labor distribution
card in duplicate on which will be shown his name,
city employee number and other data. Participating
members will sign each card on the line above the
words "Submitted By." The actual number of hours

expended will be computed by the Training Division.

2. Absences from Line-up

If a member participating in the program is absent for any reason (e.g., O.T.A., illness, vacation) from line-up training sessions during the week for which the labor distribution card is provided, he shall sign both copies of that week's card on the line above the words "Submitted By" and shall also indicate on the same line the number of line-up training sessions he actually attended that week. The actual number of hours expended will be computed by the Training Division.

C. Responsibilities of Sergeants

Sergeants in attendance at line-ups shall distribute to each member the current week's programmed lesson and ensure that each member (including themselves) sign a labor distribution card in duplicate, to document time spent at line-up training during the previous week. Bureau of Field Operations sergeants will deposit the signed cards in a box provided for that purpose.

V. Organizational Unit Responsibilities

Organizational unit commanders will be responsible for distributing subsequent lessons and collecting labor distribution cards from members under their command.

A. Bureau of Field Operations Responsibilities

The Bureau of Field Operations commander shall ensure, on a weekly basis, that each sergeant and patrolman who was shown to be in an on-duty status by the daily watch detail signs a labor distribution card. The Bureau commander shall ensure that all signed time cards are forwarded to the Training Division within three days following completion of the preceeding week's lesson.

B. Youth Section Responsibilities

The Youth Section commanding officer shall ensure that all sergeants, patrolmen and policewomen under his command sign the labor distribution cards at the conclusion of each week's lesson. The commander shall ensure that all signed time cards are forwarded to the Training

Division within three days following completion of the
preceeding week's lesson.

The materials may be retained after they have been completed
for future reference or study, with the exception of the Penal
Codes, which shall be returned to the Training Division by or-
ganizational unit commanders.

Questions regarding the program or critical comments after it
has been completed should be directed to Lieutenant J. McArthur,
Training Division.

By order of

C. R. Gain
Chief of Police

There was a wide variation in response to the pilot
roll call training program using PI materials. Some
watch commanders were energetic in seeing that the
allotted 15 minutes were as free of interruptions as
routine business would allow. Others were less co-
operative with the program. Officers interested in
study for promotional exams were eager students.
Others thought that this training was a waste of their
time. In this pilot program, there was no attempt to
require the officers to complete the lessons or to
concentrate on the task. The results of the pilot
program were evaluated in two ways.

Twenty officers were given a pre-test on the Penal Code.
At the end of the training program, a second exam
covering the same material was administered. The two
exams are included in the appendix to this report. Only
14 of the original 20 officers were available for the post-
text. For this group of 14, the results were:

<center>

Pre-test average	71.4%
Post-test average	85.0%

</center>

This represents a gain in knowledge as measured by testing
of 19%. No penalty for wrong answers was applied as a
guessing factor. If that had been done, the improvement
in test scores would have been greater. The pre-test
average for the 20 officers taking that test was 73.3%.
Sixteen officers took the post-test, including two who had
not taken the pre-test. The 16 officers had an average
score of 84.6% on the post-test. This mixed grouping
showed a test score improvement of 15.5%.

A score improvement percentage is computed as:

$$\frac{100 \times (\text{Post-test score} - \text{Pre-test score})}{\text{Pre-test score}}$$

For the 14 officers who took both tests, their improvements
as computed with this formula were 4%, 5%, 6%, 8%, 8%,
9%, 16%, 19%, 26%, 29%, 31%, 34%, and 39%. The average
of these gains is 18%. It should be noted that every member
of the group showed some improvement and that some showed
great change. In fact, seven men receiving the lowest grades
on the pre-test had an average improvement of 26%. Three of

the men in the lower half of the class on the pre-test
moved into the upper half on the post-test. These results
indicate that the PI materials were particularly helpful
to those needing the most help. A claim which cannot
usually be made by conventional instructional techniques
but which is common for PI materials. This is most
appropriate for vocational training, where the organization
wishes to ensure at least a specified level of competence
on the part of every employee.

Since officers are best informed about laws involved in the
cases they handle most frequently, these test scores do
not correspond directly to the percentage of cases which
an officer is prepared to handle properly. Still, it is felt
that in a significant number of cases these officers will
have a sounder grounding in the law as a starting point
for proper police action.

An interesting feature of the errors made on the post-test
was that they were almost entirely on material covered by
the last 3 lessons of the PI text. On the pre-test the errors
were more uniform over material on all topics. One might
suppose that this was the result of the men having completed
only the first 4 lessons but not the last 3. Such an occurrence
could correspond to either a loss of interest or to the fact
that insufficient time had been provided for studying during
the 7 weeks of the roll call training program.

Depending upon the reason for the observed text results,
it might be expected that the effectiveness of the program
could be increased by either allowing more time than 7 weeks
for the project or by providing some monitoring of progress
as a stimulus for increased effort. Perhaps both would be
useful. Merely, the administration and grading of pre- and
post-tests would tend to motivate student efforts.

The second measure of the in-service training program was
an opinion poll conducted by the Department's Training
Division. The opinion questionaire is included in the appendix
of this report. The results of the poll are presented in the
Training Commander's letter which appears in section 1.2.6
of this report.

The pilot program using PI materials for in-service training
was conducted with the lessons of the text on the Penal Code.

Though specifically developed to meet the needs of
recruits, 77% of the experienced officers polled stated
that they thought the level of the material was satisfactory.
The level of the text on arrest, search, and seizure will
probably be even more acceptable to experienced officers
than the Penal Code course, because it contains a large
number of realistic practice cases and deals with an
area of practical importance which has undergone significant
changes in recent years. The Arrest, Search and Seizure
text will be used in a forthcoming in-service training program
by the Oakland Police Department following the model of the
pilot program on the Penal Code. The text on Dangerous
Weapons Control Laws would also be suitable for such use.
The course on Evidence is intended to provide an adequate
orientation to the procedures of prosecution to enable
the recruit to begin to perform as a peace officer. Once
an officer has been involved in a trial, he may find this
course too simple. The course contains a test on each
chapter, which enables the student to determine whether
he has mastered the contents of each chapter. Thus, an
experienced officer could move quickly through the Evidence
text without wasting time. But, of the four, the Evidence
text has the least to offer the experienced officer.

As a result of the experience gained from the pilot program
of in-service training, it appears that PI materials can be
used effectively even during 15 minute sessions under the
less the ideal study environment of the roll call period.
Experienced officers, more than recruits, are able to handle
the materials almost entirely on their own and have established
channels for getting answers to legal questions that they may
have. It is suggested that officers receiving such in-service
training be given a pre-test and a post-test, primarily as a
mechanism for showing official concern for their improvement.
If the pre-test papers are collected and the students are not
forewarned, there is no particular reason that the same
questions cannot be used on both the pre- and post-tests
(though different exams were used in this study).

2.3 Computer Assisted Instruction

2.3.1 Presentation of Instruction by Computer

In this project, the use of a computer as an automated tutor was investigated. Two modes of operation were tested. One is described in this section and one in section 2.3.3. In the first, the programmed instruction materials originally developed in written form were "programmed" into the computer for presentation to the student at a TV style terminal such as is shown in Figures 1 and 2. The material appears in written form on the screen and the student answers by typing his response on the keyboard of the terminal. The student's response is automatically compared to "correct" response and he is informed by printed message whether his response was correct or incorrect. Depending upon his answer, the next occurance will be either to move on to next portion of the course, to go back to an earlier part of the course, to receive a remedial comment before one of the first two options, or to be given another chance to make the correct response. These choices are pre-determined by the educational programmer when he prepares the PI materials for insertion into the computer.

In this project, the word "program" is used in two different ways. Instructional materials are "programmed" as described in earlier sections by developing a sequence of information presentation which requires active participation by the student. Such PI materials can be presented in the form of texts, films, or audiotapes. In the type of computer assisted instruction used in this project, the written PI materials are printed at a computer terminal each time a sutdent goes through the lesson. In order to control the operation of the computer, a computer program must be prepared by a computer programmer. The computer program consists of instructions which the computer executes in presenting the PI materials to the student. Both the computer program and the PI materials are stored in the computer memory.

Instructions on the use of the computer program used in this project for computer presentation of PI materials is described in the appended set of CAI Documents. That program can present any PI materials on any subject. The computer program
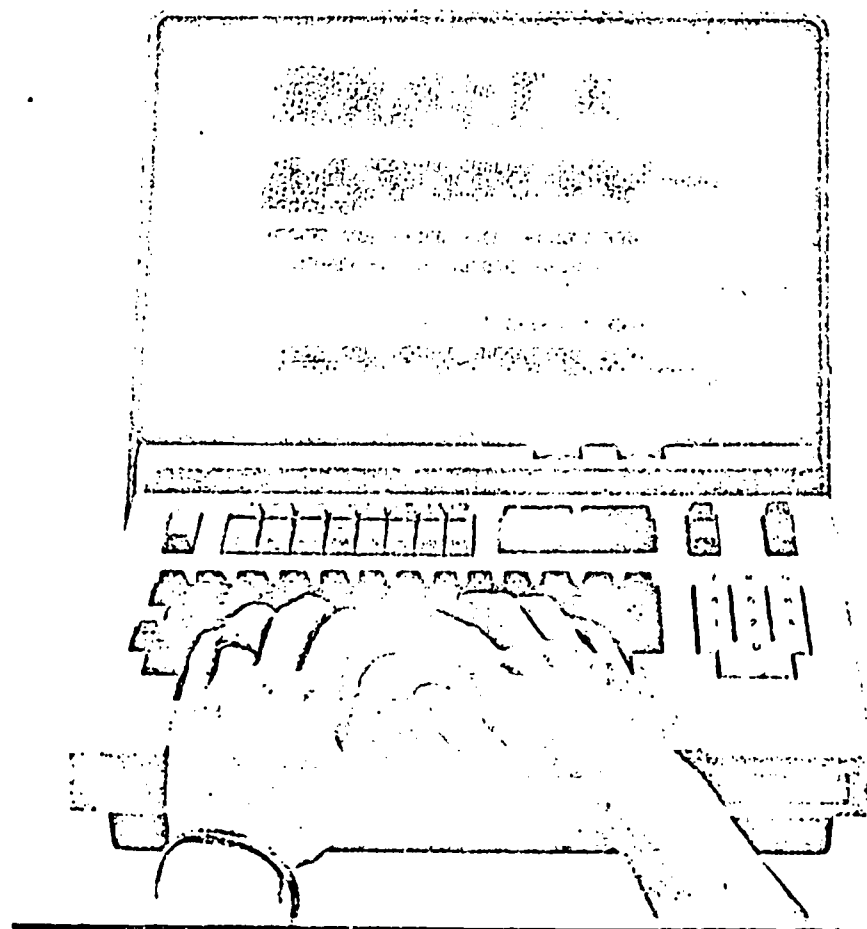
Figure 1 Photograph of a computer time sharing terminal.
The Bunker-Ramo terminal pictured is typical of
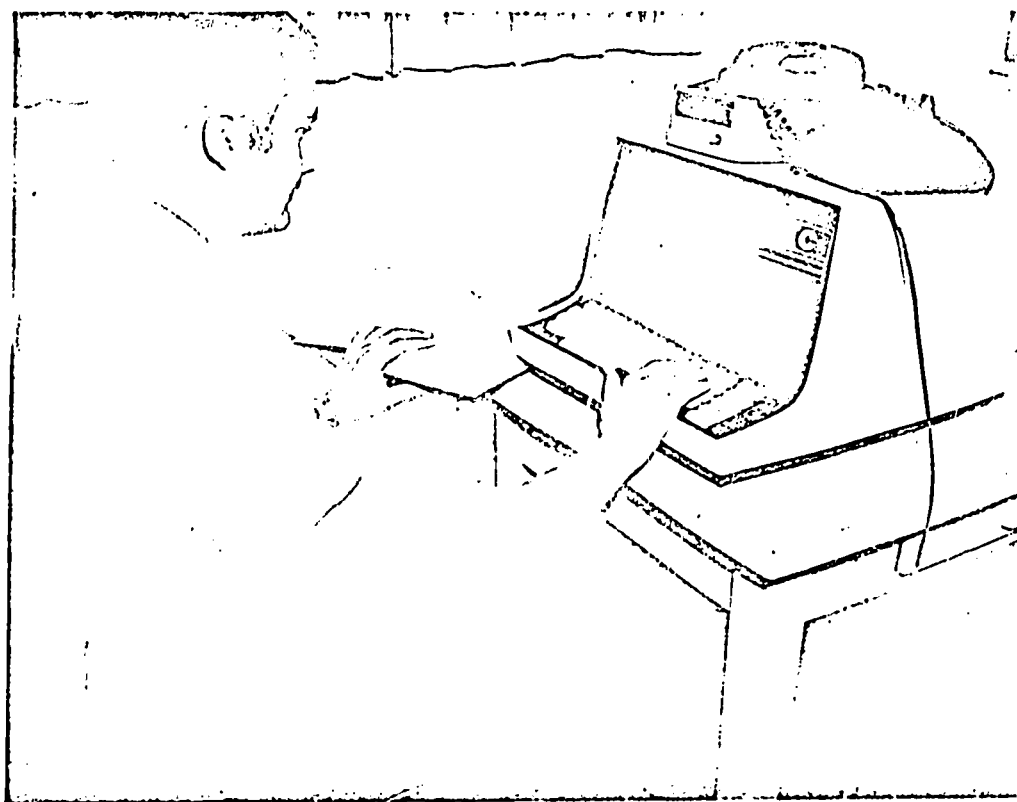the type of terminal which will be used for this
program.

Figure 2   Photograph of a police officer engaged in
computer assisted instruction at a computer
terminal. The terminal communicates with
the computer by audible beeps transmitted
by ordinary telephone. The computer displays
written messages on the television screen
(see Figure 1) and the student responds by
typing on the electrified keyboard. Operation
of the terminal is silent. The student is shown
referring to the Penal Code as instructed by
a message from the computer.

is separate and distinct from the PI materials. To
prepare printed PI materials for CAI, it is necessary
to follow the instructions just mentioned. This is done
by an educational technologist who makes educational
decisions about the sequence of steps to be followed by
the computer. The third lesson of the Penal Code course
(covering Homocide) was prepared for computer presentation.
It is shown in the form ready for storage in the computer
memory in the appended set of computer documents. Each
line of the course is identified by a two letter code which
indicates to the computer the nature of the text on that
line, such as a question or an answer. Once the educational
technologist gets the PI materials into this form, following
the instructions mentioned above, the PI material is
keypunched and fed into the computer for storage.

Many of the responses required of the student in the PI
materials are just short answer, such as "YES" or "TRUE"
or a letter indicating the correct item on a multiple choice
question. However, some of the educational objectives
required could only be met by "constructed" responses, in
which the student writes out his answer. Since the computer
can only identify correct answers if they exactly match the
answer originally specified by the educational technologist,
a constructed response of "malicious and willful" would be
marked wrong if the correct answer were "willful and
malicious". Similarly, the computer would treat "willful
and malicious" as a wrong answer.

The following innovation was used to circumvent this inherent
limitation of CAI, in those cases which educationally called
for constructed responses. The student was instructed to
make his constructed response in writting on a piece of paper
and then to indicate to the computer that he was finished
answering by hitting the attention key on the terminal. At
that point, the computer displayed the stored correct answer
on the screen and asked the student if his answer were correct.
Our experience with self-study PI materials indicates that
students recognize that individualized study is not a test and
can therefore be trusted to play fair in grading their own
responses. In working with printed PI materials, the
student grades all of his own responses. It therefore seemed
reasonable to allow him to grade his own constructed
responses in the CAI situation. After the student indicates

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"YES" or "NO" to the question of whether his constructed response matches the stored correct answer, the computer proceeds by considering "YES" to be the correct answer to the original question and "NO" to be the wrong answer.

The above approach for handling constructed responses in CAI was found to work well. It eliminates both the difficulty of requiring the student to type out a long answer and the problem that arises because the computer cannot interpret answers (but only compares them, letter by letter, with a previously stored correct answer).

In the case of some concepts covered by the PI materials, the remedial steps to be taken if a student makes an incorrect response depend upon which wrong response is made. The computer program allows the educational programmer to specify different sequences of events for various, specific wrong answers. For example, if the correct answer for a multiple choice question is item "A", a different sequence of instruction can be specified for students who respond "B" from that specified for students who respond "C". While this elaboration is time consuming, and not generally worthwhile, it is very helpful on occasion to assure that the student who makes an error is getting pertinent remediation that reduces his confusion.

The computer system used had the capability of writing on the terminal screen at the rates of 10 letters per second and 30 letters per second. These rates correspond roughly to 100 words per minute and 300 words per minute. At the slower speed, the time required to print the material on the screen, exceeds the time required by the student to read it. Originally, it was speculated that the slow writing speed might advantageously slow the student down, forcing him to concentrate on every word. However, it was found that the slow speed was distracting and irritating. Most students reread the material once it was on the screen and many paid no attention to the material until it was all written out. Thus, the time lag created by the slow writing speed was lost time, in addition to being an irritation. Therefore, after a few initial trials, all CAI work was done at the faster speed of 300 words per minute. The slow speed of 100 words per minute is a standard speed of teletype networks.

The computer operation for CAI is done on a time-shared
basis, with the computer handling many users simultaneously.
During heavy computer usage hours in the late morning and
late afternoon, a student may have to wait a few seconds or
longer before the computer proceeds with the next step
in his course. To avoid delays, most CAI trials were
conducted in the evening. Of the seven students who were
subjects in this CAI trial, all but one spent an average of
between 5 and 6 minutes per page of material (based on the
page length of the original PI text). The one exception was
a trial at 100 words per minute, during a day when response
delays were particularly bad. In that trial, the subject
averaged 8 minutes per page. On the other hand, students
averaged between 2.5 and 4 minutes per page when working
from the printed text. The difference in speed seems to be
attributable to one or more of the following causes:

1. Waiting for the computer to proceed to the next step.

2. Waiting for the computer to write each segment of the
    course on the terminal screen.

3. Time spent in typing an answer on the keyboard rather
    than simply checking it off or saying it to yourself.

4. Possible distraction or confusion relating to the use
    of a computer and a terminal. The writing on the
    screen is light green on a dark greyish-green background,
    is entirely in capital letters, and is harder to read than
    a printed page.

It was found that officers quickly learned to use the terminal
and were able to teach other officers to do so. An introduction
to CAI was included in the course, so that the student could
become familiar with CAI before starting on his lessons. The
user instruction cards that were prepared are shown in
Figure 3. It took 15 to 20 minutes for one officer to show
the next officer how to handle the terminal and for that
second officer to go through the introductory lesson on CAI.

The opinions of the officers about the computer presentation
of PI material varied greatly. Some were excited by the
novelty of dealing with a computer and some recognized that
working with the printed texts was faster. Generally, the
response to the computer did not seem significantly better

INSTRUCTIONS FOR USING THE COMPUTER TERMINAL
WHEN YOU ARE READY TO START
1. Set the terminal switches to ON and REMOTE. Turn the coupler switch on (so the red light is on).
2. Dial the computer (Oakland phone number is 835-3562) and set the phone in the coupler.
3. Watch for the flashing light to go on at the front of the coupler. If it does not go on, replace the phone and then repeat Step 2.
4. When the computer asks for user code type PAAC101 and hit the return key.
5. When the computer asks for the password type OPD and hit the return key.
6. At the next pause, type RUN TEACH/RCC and hit the return key.
7. If the computer asks DO YOU KNOW HOW I WORK? type YES (or 1) and hit the return key. (Note: Sometimes this step is skipped.)
8. When the computer asks for the course name type CHAP3/PAAC101 and hit the return key.

/ (See Step 6 and 8) is on the same key as ? (last key - bottom row)
1 is always number 1 - not the letter L as on the typewriter
O in OPD is letter O; in PAAC101 is the number zero

INSTRUCTIONS FOR USING THE COMPUTER TERMINAL
WHEN YOU ARE READY TO STOP
1. If you want to stop at a point where the computer asks if you want to continue or to stop, follow the instructions on the screen and you will get to the end of the lesson. Then go to Step 3.
2. If you want to stop in the middle of a lesson, type STOP as the answer to any question that requires a typed answer. Then go to Step 3.
3. After getting to a stopping point (either from Step 1 or from Step 2 or from the end of the course) type BYE and hit the return key. Be sure to note page number where you stopped.
4. After the computer has said goodbye and finished typing the time used, turn the terminal switch to OFF, turn the coupler switch off (the red light will go off), remove the phone from the coupler and place back on the phone base.

Special Reminders
Type 1 to answer true or yes -- type 0 (zero) to answer false or no
Type page number in following form..PAGE8..to skip to a certain page
Type STOP to get off the computer if you are not at a regular stopping point,

Figure 3.   Two sides of the instruction card enabling the student to use the computer terminal on his own.

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than to the printed PI materials, but this may not be significant in view of the small population tested with CAI.

The material presented by CAI was the same as that in the printed PI text. The major advantage that might have been expected was that the novelty and liveliness of computer presentation would hold the student's attention better than printed materials. This was not found to be the case. All the students tested found working with the computer tiring and frequently requested breaks. It also seemed that the ability to score one's own responses that is inherent in the PI text is more appealing and provides better motivation than the automatic scoring of responses done by the computer.

Another point, is that the student is able to look back in the text but is unable to "leaf through" the lesson at the computer terminal. Thus, the self-pacing and self-managing aspects of a PI text are somewhat reduced in CAI. The computer does not rush the student; he has an unlimited time to make each response. Still, because of the psychological pressure that the machine is "waiting" and the limitation of being unable to glance back at earlier pages, CAI diminishes the self-pacing advantages of PI. This seems to show up as decreased motivation on the part of the students, though again the sample population is too small for a really reliable conclusion on this point.

2.3.2 The Costs of CAI

The starting point for CAI is the preparation of PI materials, so the costs of CAI are always in addition to the costs of PI materials development. Then there is the cost for preparing the PI materials for computer presentation and, finally, the cost during actual student usage.

In the current project, the development of the PI materials cost about $1,000 per student hour of instruction; a figure which is at the low end of prevailing industry standards. Preparation of the PI material for computer presentation cost about $500 in addition. These are one time costs and could be amortized over a large number of students if CAI were used on a continuing basis.

Operating costs for each student involved:

1. Terminal rental at $140 per month

2. Telephone charges at $0.80 per hour for local calls, and multiples of that rate if a toll call is required to reach the computer.

3. Computer usage charges. On the commercial service used for this project, these were over $16 per hour. Charges varied with the time of day and with the student's speed. These charges consisted of $11 per hour minimum charge, plus about $5 or more per hour based on the number of operations performed by the computer. An estimate is given below of projected costs if an agency acquired a computer solely for use in CAI.

4. Other computer costs, consisting of storage charges if a commercial service is used or of operating personnel costs in the event an owned computer is used for CAI. The storage costs during this project were $240 per month for maintaining the course and program files in computer storage.

Thus, the cost per student hour of CAI during the project were in excess of $20 per hour. This figure is not representative of the costs which would actually be incurred if a small scale, time-shared computer were leased or purchased and dedicated to the CAI application. There are a variety of ways of providing the hardware for CAI and of financing such hardware. The following figures are representative of the approach which currently seems most desireable and which can be used as a planning model for other ways of accomplishing the same purpose.

The hardware required for a small CAI application might consist of the following items:

Hardware	Purchase Price
4 student terminals	$10,000
Mini-computer with 12K memory and a control terminal	23,000

Disk drive and 256K fixed disk	$15,000
Magnetic Tape Input/Output Capability	14,000
Software for computer system	5,000
	$67,000

Such a system could be leased on a one-year basis for 40% of the purchase price ($ and a one-year full maintenance and service contract would cost about $3,000. Thus, the cost per year would be about $30,000. If each of the 4 terminals were in use for 500 hours per year, the cost per student hour would be about $15. This figure is comparable to that obtained by using a commercial time-sharing service.

Economies can be achieved in a number of ways. Use of a longer term lease or of outright purchase of the hardware would reduce the yearly cost below 40% of the purchase price. If the equipment were purchased and used for 5 years, the cost would be about 30% per year including 20% for initial purchase and 10% for the cost of money. A larger system with more terminals would provide lower cost per terminal. A system with 16 terminals would cost about $110,000, lowering the purchase price from $16,750 per terminal on the 4 terminal system to $6,875 per terminal on the 16 terminal system. Finally, one might project more than 500 hours of usage per year for each terminal. In a large department or in a region containing a number of moderately big departments, just a few hours per man per hour could keep the terminals occupied for a major fraction of the 8,700 hours in a year. For example, if a 16 terminal system were purchased for $110,000 and charged at 30% per year plus $6,000 a service contract and if each terminal were used 1,500 hours per year, CAI could be provided at a cost of $1.63 per student hour. This would provide an availability of 139,000 terminal hours, of which it is assumed that 24,000 will be used. Thus, 8 hours of terminal time could be provided for each 3,000 men at a cost of $1.63 per student hour. If even larger systems were used or if fuller utilization of the terminals were possible, the costs could be reduced even further.

It is estimated that large user groups, such as public
school systems, can obtain computer assisted instruction
at less than the $0.80 per student hour that it generally
costs for conventional public school education. In the
police environment where 24 hour scheduling is imaginable,
even lower projections are possible. These figures indicate
that CAI costs can be made relatively minor compared to
the salary paid the student in a vocational training setting,
so long as there is a large enough group of students to make
extensive use of the hardware and to offset the initial
development costs. Thus, the question of whether to adopt
CAI on a broad scale seems primarily answerable on the
basis of its merits rather than its cost. From the current
study, it appears that CAI offers no net advantage over
printed PI materials for the presentation of instructional
materials. The primary factors in this conclusion are
the faster learning rates and better portability of the
printed PI materials.

2.3.3 Computerized Diagnostic Testing

In the current project, the use of the automated grading
and branching capabilities of CAI for diagnostic testing of
students was investigated. A computer program was
written to present test questions at the terminal, to
compare student responses to correct answers stored
in the computer memory, and to finally print out a score
and the diagnostic messages which had been programmed
for each test item that was missed. The computer program
which was developed for this purpose is included in the
appended volume of computer documents. An 18 item test
on homicide was developed from the criterion test on
lesson 3 of the Penal Code PI text. Each question was keyed
to one or more pages of the PI study materials. Thus, for
each question on the test which the student missed, the
computer would write out a message indicating the pages
of PI material that should be studied to correct the deficiency
which caused the student to miss the test item. That test
is also presented in the attached compilation of CAI documents.

A number of recruits and experienced officers took the
18 item test on homicide. Each student spending between
15 and 20 minutes at the terminal to complete the test. All
of the test items were of the "objective" type, so a guessing
penalty equal to the percentage missed is probably appropriate
and will be referred to in the following discussion of the results.
The test was taken by 3 newly hired recruits without prior
police training. They achieved raw scores of 50%, 60%, and
65%. Applying a one for one guessing penalty, the adjusted

scores would be 0%, 20%, and 30%. Three experienced officers were given the test and achieved raw scores of 70%, 70%, and 75%. Again, applying the guessing penalty, these would be adjusted to 40%, 40%, and 50%. The recruit who scored 65% initially was retested after he had studied the first 3 lessons of the Penal Code text. At the second testing, his raw score was 90%. Applying the guessing penalty, his test grades improved from 30% to 80% (raw scores of 65% and 90%). Another recruit, who had not been pretested and whose only training was self-study from the Penal Code text while awaiting the start of the next recruit academy, scored 95% on the exam.

The above test results are interesting, but do not bear on the major issue of whether use of the computer as a testing machine has advantages over conventional testing procedures. Still, it should be noted that a diagnostic test has questions covering the initial concepts of the subject matter and the final application of all the information in the topic covered. Thus, in a diagnostic test on homocide, any citizen of sufficient knowledge to qualify as a police recruit could be expected to have enough information to make better than random guesses on many questions. At the other end of the scale, several quite difficult questions were included to diagnose any terminal confusion the student might have with the subject. Thus, it might be expected that experienced officers without recent training or exposure to homocide cases would miss a fair percentage of these harder questions.

The experience of using the computer as an aid in administering diagnostic tests seemed to indicate that the disadvantages of this approach outweigh the advantages for regular use in the police environment. The advantages are automatic grading and the novelty which might tend to impress officers with the sophistication and, by inference, the value of the training which they are to engage in after the diagnostic test is completed. Another potential advantage is that officers might be more likely to voluntarily test themselves if a computer terminal were continuously available to all. However, it is also possible that they will voluntariiy make use of the criterion tests included in the PI texts, once these are in their hands. Of course, there is no evidence to believe that an officer who is attracted to a computer administered diagnostic test will carry out the study prescribed as a result of the test.

The students given the computerized diagnostic test covered the 18 test items in 15 to 20 minutes. The pre-test on the Penal Code was also administered to experienced officers and was of similar difficulty. It consisted of 37 items and occupied 30 to 40 minutes of student time. Though the population was quite small, it appears that computerized testing is about as fast as conventional testing. This is different from the rates for PI presentation, where CAI was slower than printed presentation. One possible explanation is that in computerized testing, the student was unable to go back to check his work. If students in fact spent about 25% of their time looking back over their answers on the printed test, the rates of completing test items would be comparable to the rates of completing instructional frames, with the faster rates being achieved with printed materials. The desireability of eliminating review of a test is difficult to decide because students are generally conditioned to checking over their answers. Also, it is a tenuous argument to say that not looking back is more analogous to actual job performance, in view of the many artifacts in the test environment.

All of the officers used as subjects for the computerized testing were attracted by the concept. One student commented that the fact that you could not go back to an earlier question to change an answer made the test a better measure of one's actual ability. This feature enables one to ask a sequence of questions of successive levels of difficulty to determine just where the student's ability lies, without having to avoid phrasing in one question that would prompt the correct answer to another question.

The disadvantages of computer administered tests are mainly questions of cost and convenience. It is more difficult to prepare a test for computer presentation and one is essentially forced to use only "objective" type questions. Where training materials, once programmed into the computer, will require only occasional and minor updating, test questions must be continually changed if the test is to continue to be useful to the users. Secondly, the amount of usage that can be projected for computerized testing will be significantly less than for CAI. Therefore, the economies expected from full utilization of computer hardware will not be realizable where the computer is used

solely as a testing machine.

The extra steps involved in putting a given examination on the computer and in arranging access to the terminal for the officers will in all but the largest departments, outweigh the effort needed to grade the exams and to prepare the study prescriptions manually. Computerized grading of answer sheets can be arranged economically, possibly through a local college or high school, eliminating the paperwork of grading even though the exam is presented in printed form. Also, the study prescription will more likely result in study if coupled with a little live exhortation and personalized advice on how to proceed.

The results of this trial usage of computerized diagnostic testing suggest that it should probably be considered a workable frill that could be used to dress-up an in-service training program. A short test on a single topic, such as homicide, might require 15 to 20 minutes of terminal time. In all but the largest departments, terminals could not be kept busy just for testing. Thus, the costs would be $10 to $15 per terminal hour or $2.50 to $3.75 per student tested on a single topic. Since one might want to have each student tested on a number of topics, the computer costs would make computerized testing expensive without achieving sufficient offsetting benefits to justify the cost. Therefore, the computer presentation of examinations seems impractical for the police training environment. Computerized grading of exams, on the other hand, can generally be obtained very inexpensively and should be considered whenever the number of students being tested exceeds 50.

3. Financial Note

Financial reports on the project will be submitted separately by financial officers of the City of Oakland. The project was completed within the estimated budget.

Appendix

None of the test instruments included in this appendix are
recommended for use. They were designed to parallel
previously administered tests, so that comparisons could
be made between students using the PI materials and those
who had previously received conventional instruction. It
is recommended that instructors prepare their own tests, using
the criterion tests included in the PI texts for guidance.