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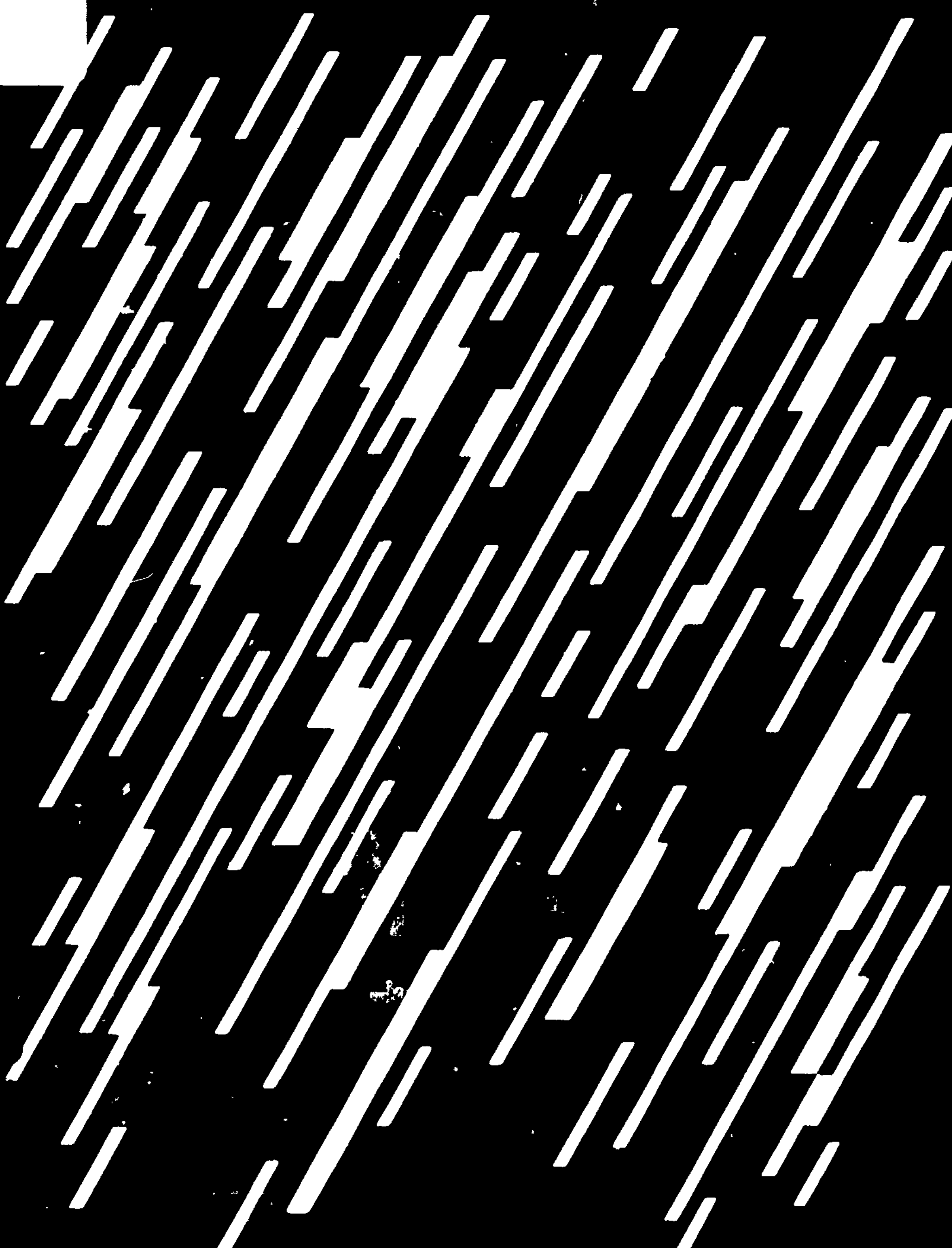
ABSTRACT

To convey to those who have had no experience with computer-assisted instruction an impression of the experience that students have in a CAI course, this report presents in print the sequence of instruction that one student received from one chapter of the course, Computer Assisted Remedial Education (CARE 1): Introduction to the Education of Exceptional Children. In addition to the content outlines, and pictures of the cathode ray tube throughout, comment is provided to make clear the flow of the course. (EM 011 037 through EM 011 043, EM 011 046, EM 011 047, and EM 011 049 through EM 011 058 are related documents.) (RH)



Note to accompany the Penn State Documents.

In order to have the entire collection of reports generated by the Computer Assisted Instruction Lab. at Penn State University included in the ERIC archives, the ERIC Clearinghouse on Educational Media and Technology was asked by Penn State to input the material. We are therefore including some documents which may be several years old. Also, so that our bibliographic information will conform with Penn State's, we have occasionally changed the title somewhat, or added information that may not be on the title page. Two of the documents in the CARE (Computer Assisted Remedial Education) collection were transferred to ERIC/EC to abstract. They are Report Number R-36 and Report Number R-50.

Jackie Powell: ERIC/EM

SAMPLE COMPUTER ASSISTED INSTRUCTION STUDENT INTERACTIONS

K. A. Hall, G. P. Cartwright, C. A. Cartwright,
H. E. Mitzel, and S. P. Wetcher

Report No. R-53

The Pennsylvania State University
Computer Assisted Instruction Laboratory

December, 1972

In November of 1970, the staff of the Pennsylvania State University inaugurated a new and sophisticated computer mediated instructional technology into its inservice continuing education program for teachers. The instructional program in special education is designed to assist regular classroom teachers in identifying the problems of handicapped children. The instructional program is given a wide audience by means of a specially designed Mobile Computer Assisted Instruction Laboratory. Since the beginning of the project, the Mobile CAI Laboratory has offered high quality college instruction to over 1,000 educators per year.[1] A continuing interest of the University is to convey to others, many of whom have had no experience with computer-assisted instruction (CAI), a description, a feeling, or a flavor of the experience that the students (inservice teachers) have when they take the program of instruction. This report attempts to meet this goal by presenting in print the sequence of instruction that one student received from one chapter of the course while seated at his student station. Some background "stage setting" information is included also to help the reader recreate the "experience."

CARE

Professors G. Phillip Cartwright and Carol A. Cartwright led a team of University faculty members in developing the graduate level course entitled, "Computer Assisted Remedial Education (CARE 1): Introduction to the Education of Exceptional Children." The purpose of the course is to give educational personnel the knowledge and skills necessary to deal effectively with children who have educational problems.

The CARE course is designed to prepare inservice preschool and primary level elementary teachers and other interested persons to know the characteristics of, and be able to identify, handicapped children. Handicapped children are defined, for purposes of this course, to be those children who have atypical conditions or characteristics which have relevance for educational programing. Handicapped children include children who display deviations from normal behavior in any of the following domains: a) cognitive, b) affective, and c) psychomotor.

The philosophy of the course is such that teachers are encouraged to look at children as individuals. The use of traditional categories or labels is minimal. However, certain terms and concepts related to handicapping conditions are taught so that persons who take this course are better able to communicate with other professionals in the field.

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[1] The Mobile CAI Laboratory is currently supported by The Pennsylvania State University, the Penn State Foundation, and a grant from the Bureau of Educational Personnel Development, U. S. Office of Education. The development of the CARE course for computer presentation was funded by a grant from the Bureau of Education for the Handicapped, U. S. Office of Education.

Upon completion of CARE 1, participants will have achieved the following major objectives. These overall objectives are, of course, broken down into a series of sub-objectives and tasks--over 1,100 in all. Participants will:

A. Know the characteristics of handicapped children and be aware of symptoms which are indicative of potential learning problems;

B. Be able to screen all children in regular classroom programs for deviations and determine the extent of the inter-individual differences;

C. Be able to select and use for those children with deviations appropriate commercial and teacher-constructed appraisal and diagnostic procedures in order to obtain more precise information as to the nature of the deviation;

D. Be able to synthesize information by preparing individual profiles of each child's strengths and weaknesses on educationally relevant variables;

E. Be able to evaluate the adequacy of the information available in order to make appropriate decisions about referral to specialists;

F. Be able to prepare adequate documentation for the case if the decision to refer is affirmative.

It is expected that the teachers who exhibit the competencies listed above will systematically evaluate children's learning potential and formulate appropriate educational plans.

Facilities

To implement this program, a custom-built expandable van was fitted with a small, stand-alone computer and fifteen student stations (IBM 1500 Instructional System). Each student station (Figure 1) is equipped with a small cathode ray tube (CRT) on which is displayed alphameric information plus a wide variety of graphics including animated illustrations. Student response components of the CRT include a typewriter-like keyboard with upper and lower case characters and a variety of special characters and a light-sensitive pen used by the learner in making responses to displayed material. In addition to the CRT, each student station has a rear screen image projector on which are displayed color photographic images. A 1,000-frame reel of microfilm, with each frame separately addressable by the computer, is used in the image projector. The third major display component is an audio device with separately addressable pre-recorded messages played through a headset for each individual student.

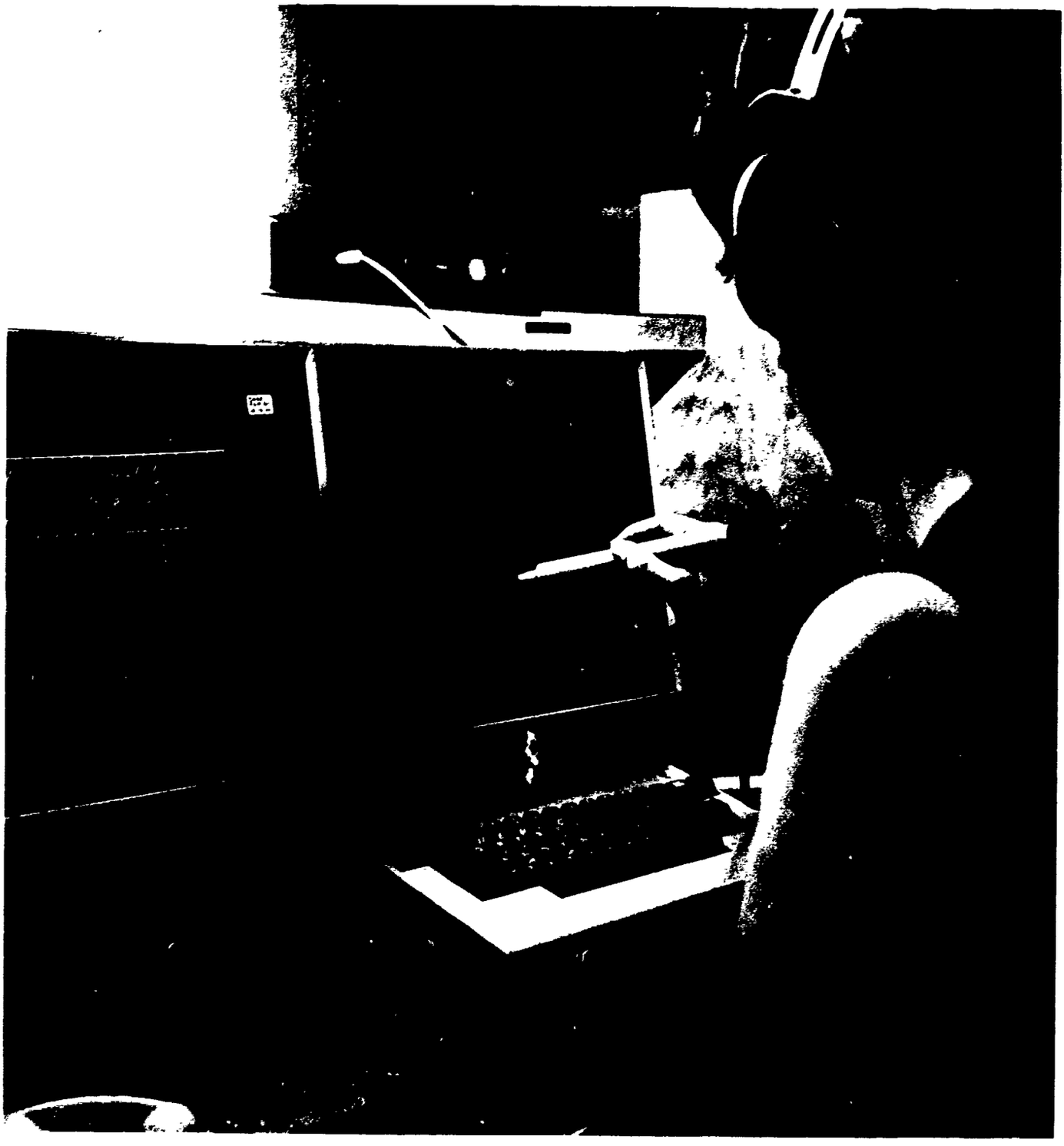


Figure 1.
Student at the Computer-Assisted Instruction Terminal.

Implementation

On a pre-arranged schedule, the Mobile CAI Laboratory is moved to a school in a rural community and connected to electric, telephone and water services. Over the next seven weeks, in late afternoon and evening hours, elementary teachers and their supervisors schedule themselves for one-to-three-hour sessions at computer student stations on flexible and irregular schedules to fit into the demands of their personal lives. During a seven week period the Mobile CAI Laboratory will accommodate approximately 125 to 150 learners who enroll for a typical three credit college level course. The students, of course, put in considerable time in home study of a 400 page textbook which accompanies the course. The Mobile Laboratory and this utilization plan are sufficient for providing instruction to more than 1,000 educators during a calendar year. However, the existing computer has sufficient power and capacity to support 15 additional student stations which would double the number of students served. Currently, the existing student stations and relocation scheduled every six weeks meet the needs of the target audience in a 25 mile radius.

Sample Instructional Sequence

A portion of Chapter 7, "Individual Differences and Normality," (written by Professor Harold E. Mitzel) was chosen for this presentation because of the wide variety of instructional strategies, presentation and response modes, and learning task complexities contained in the material. Chapter 7 develops teacher competencies in the area of educational measurement to enable the inservice teacher to properly interpret test scores which are commonly available to him in his school. Much of the content in Chapter 7 is intended to help teachers understand that a certain amount of deviation from the average is to be expected and that children should not be considered atypical if they deviate only slightly from the average.

For illustrative purposes, three components are presented for each section of instruction: 1. Content Outline, 2. Behavioral Objectives, and 3. Student Interactions. The content outline and the behavioral objectives are traditional in nature and are included to assist the reader of this document in understanding the student interactions. They are *not* presented to the student as he is taking the course.

The Student Interactions include material presented on the cathode ray tube, the image projector, and through the audio unit. Comments regarding the flow and sequence of the material are included. The key to the Student Interactions is presented in Table 1. In the live CAI situation, students need about two hours to complete the Chapter. For purposes of this document only, several portions of the chapter are excluded. Not all branches are shown and a number of sections are reduced in scope once the general format has been established.

Table 1
Key to Student Interactions

Item	Symbol	To the Student Working at the CAI Terminal	To the Reader of this Document
Cathode Ray Tube	*CRT*	Light blue figures on dark background	White figures on black background
		Animated – controlled by computer program	Static--animation depicted by time-lapse photography
			Photographs of cathode ray tube
Image Projector	*Image*	Full color, still photographs	Black-and-white still photographs of original art work
		Randomly available under program control	Reference is made to photograph through *Comment*
Audio	*Audio*	Recorded audio messages played through headset	Script of spoken messages
		Randomly available under program control	Appear in sequence created by the one student presented
		May be replayed at student option	May be re-read at reader option
	Comment		Directs reader through printed materials
			Describes steps performed by the computer
			Describes other alternatives used by the student

ORGANIZING AND REPRESENTING DATA

Content Outline

I. Bar Graphs
   - A. Present data about frequency or number of cases associated with labeled categories;
   - B. Frequency dimension or number scale; only dimensions essential in bar graph

Behavioral Objectives

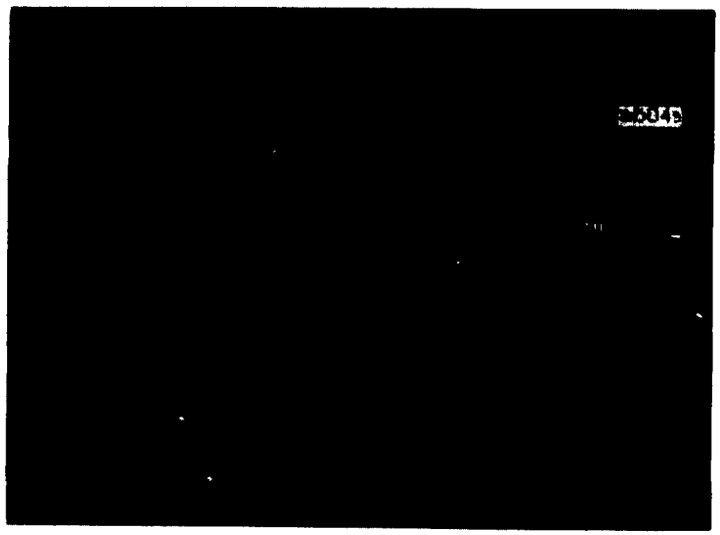
Given heights of children, indicate each child's position on bar graph (alternate choice).

Indicate that one dimension is shown on bar graph (alternate choice).

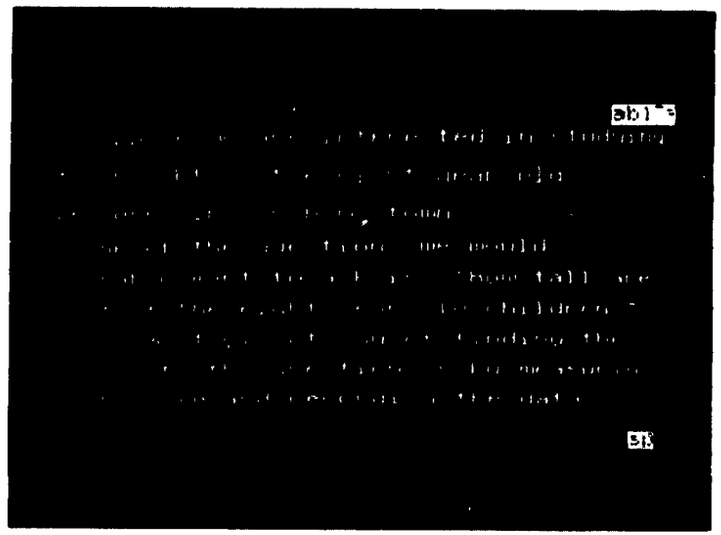
Recall bar graphs as type of data representation being discussed (completion).

Student Interactions

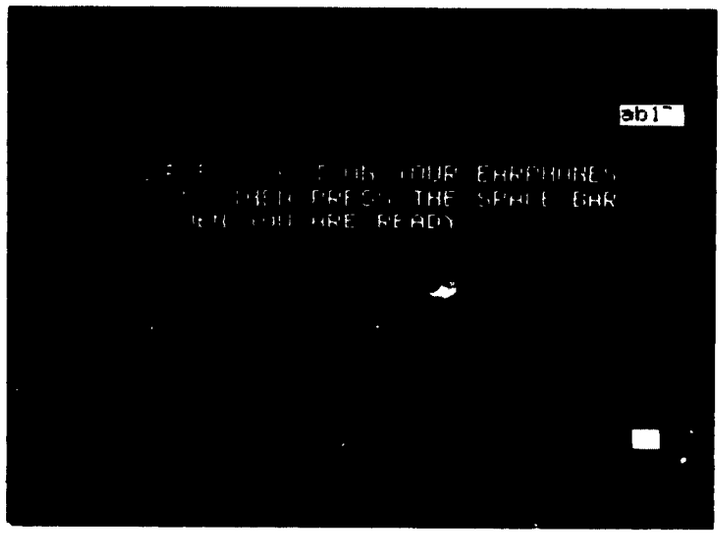
1-CRT



2-CRT



3-CRT

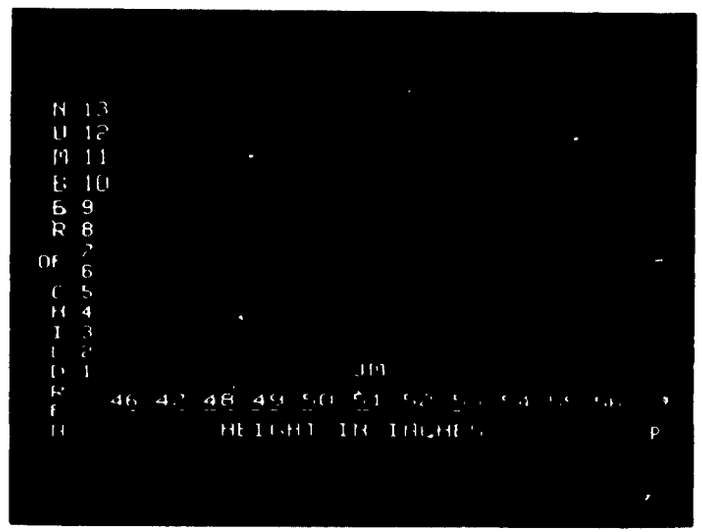


4-Image

5-Audio

The name of the child you see on your image projector is John Middleton. You see by his birth certificate that he is 8 years old. By having John stand beside a measuring chart, we determine his height to be 51 inches. Let us record this information on our Cathode Ray Tube. First of all, notice that on the left margin of our screen is NUMBER OF CHILDREN, and at the bottom of the screen is listed HEIGHT IN INCHES. We are going to enter John's height on the screen by placing his initials directly above the number representing his height in inches. Since John Middleton is 51 inches tall, the letters J M will now appear above the number 51.

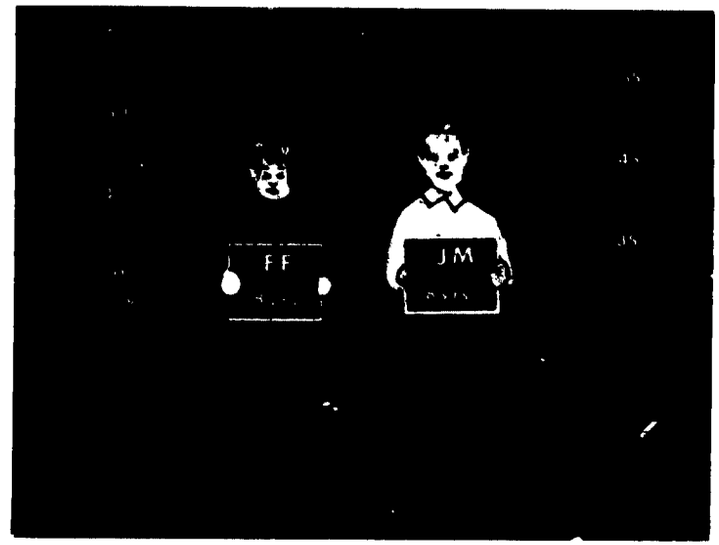
6-CRT



7-Audio

Joining John at the measuring chart is Fred Fox. Fred, as we can see by his birth certificate, is also eight years old. But he is not as tall as John. Fred is only 48 inches tall. You can record Fred Fox's height on the screen by placing your light pen on the number representing Fred's height in inches.

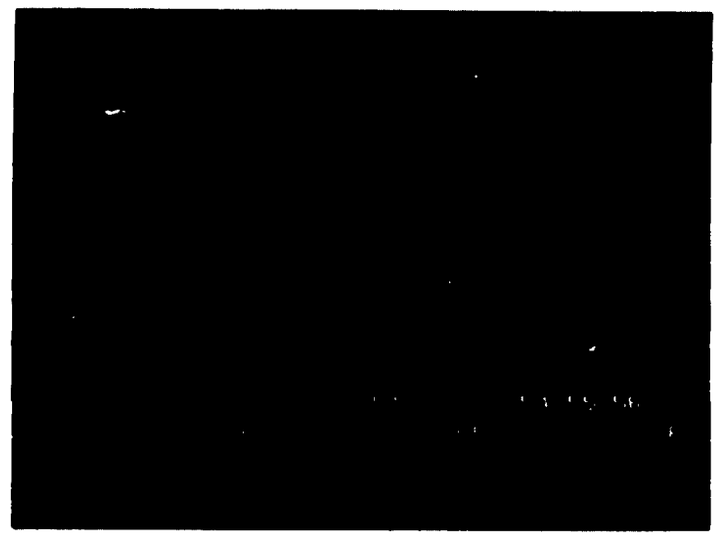
8-Image



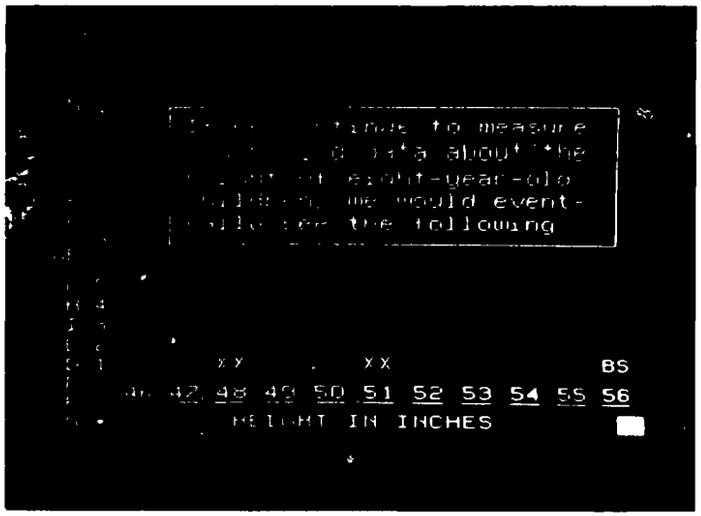
9-Comment

The P in the lower right corner of 10-CRT informs the student that he is required to make a light pen response. When the student touches "48" with the light pen, the computer places "FF" in the proper position to indicate to the student that he has correctly recorded the height of Fred Fox. The computer will then replace "FF" with "XX" as one step in building the bar chart shown completed in 13-CRT.

10-CRT



11-CRT



12-Comment

As the student watches, the program builds the bar graph illustrated in the completed stage in 13-CRT.

13-CRT

14-Audio

What we have constructed is essentially a vertical bar chart in which each pair of XX's represents one unit or one individual.

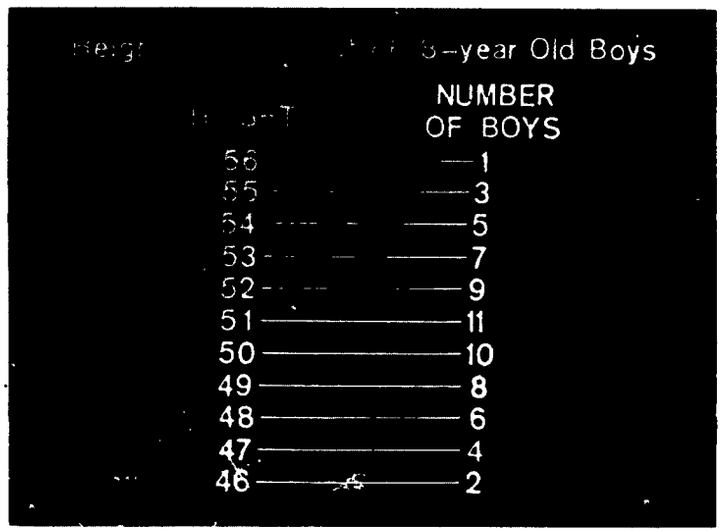
15-Comment

Several short-answer problems follow (not shown here) to provide the student with further tests of his acquisition of the important objectives.

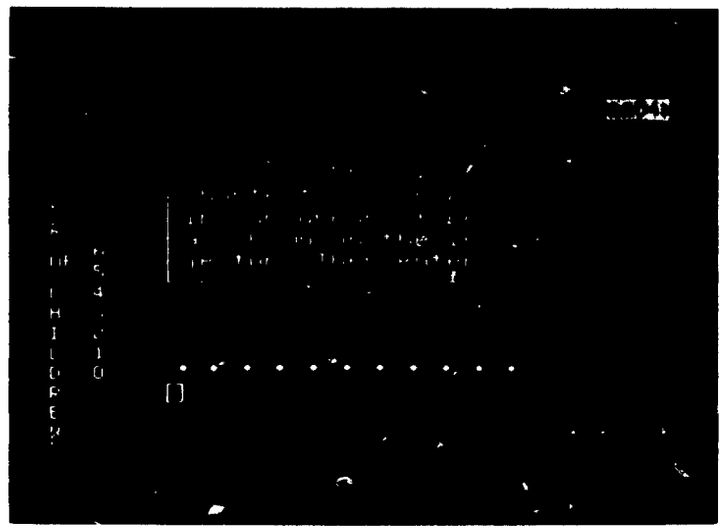
Content Outline	Behavioral Objectives
II. Histograms A. Two-dimensional frequency chart 1. Frequency represented by vertical bars 2. Unit of measurement represented on horizontal scale B. Continuous variation 1. Given measurement extends one-half unit below and one-half unit above measured value.	Type heights of children along horizontal axis of histogram (constructed response) Conclude that 3 units on bar of histogram represent frequency of 3 (constructed response) Conclude that the total number of units of a histogram represent the total frequency of the data (constructed response)

Student Interactions

16-Image



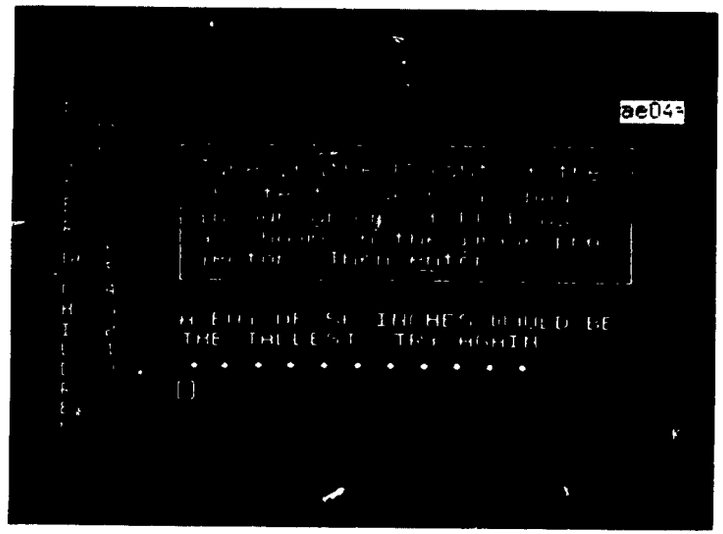
17-CRT



18-Comment

The student responded "56" which is incorrect (19-CRT). The response has been erased and appropriate feedback given. The cursor (small rectangular shape) and the "K" in the lower right corner of the screen indicate to the student that he is expected to respond again.

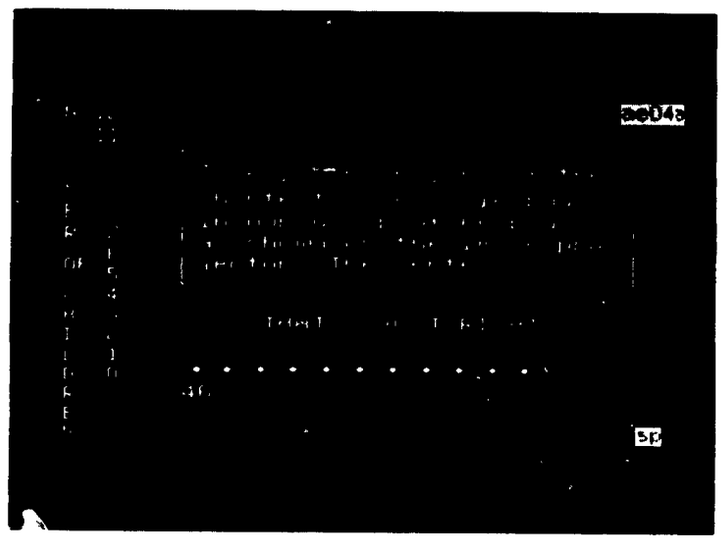
19-CRT



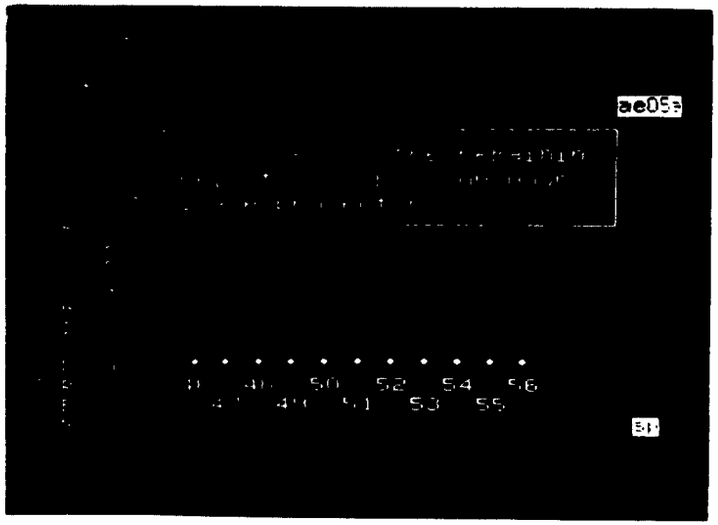
20-Comment

The student responded "46" and received the feedback, "THAT'S JUST RIGHT," as shown in illustration 21-CRT.

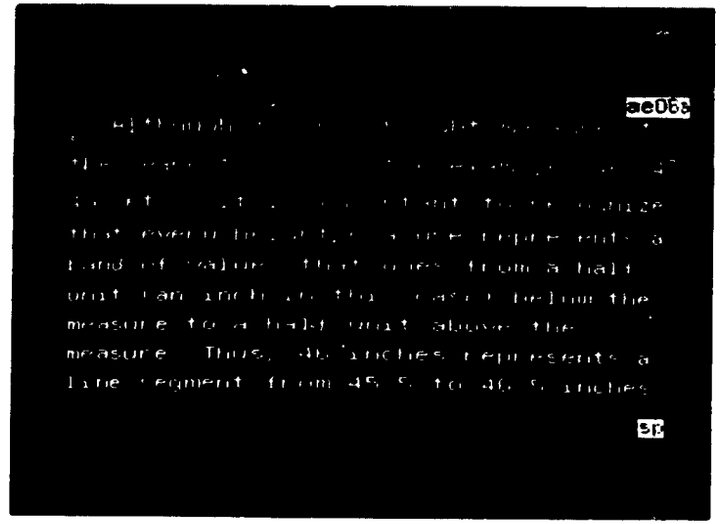
21-CRT



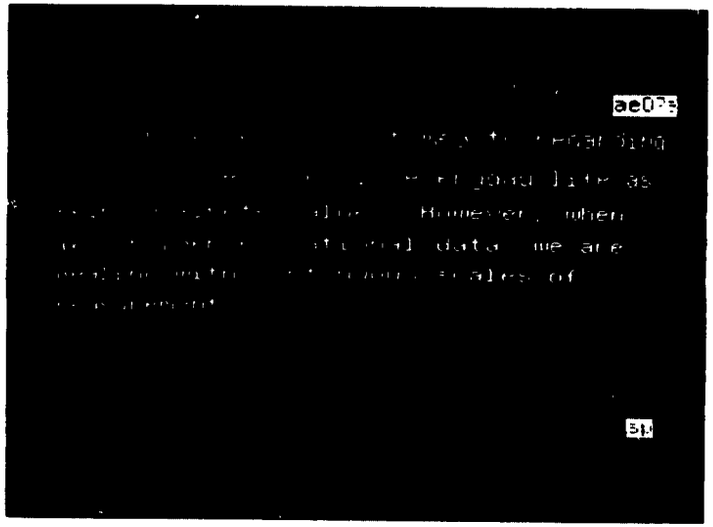
22-CRT



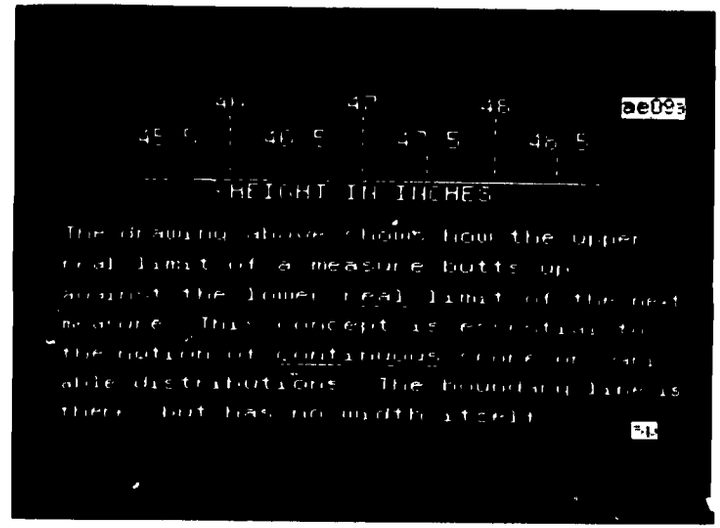
23-CRT



24-CRT



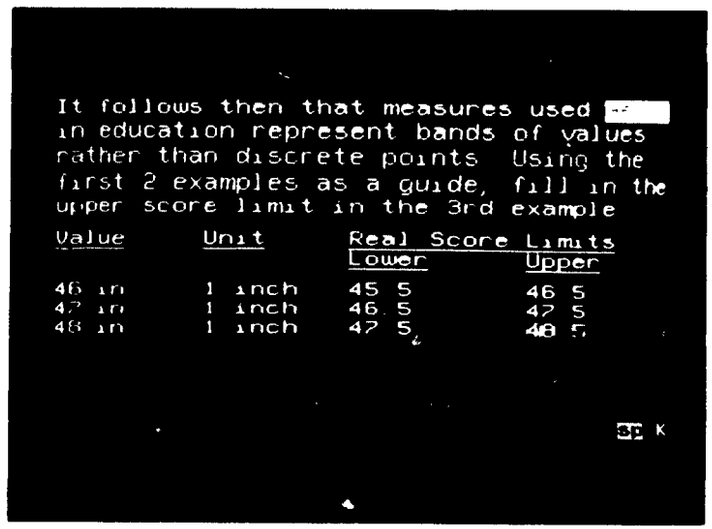
25-CRT



26-Comment

27-CRT shows that the student responded "48.5" and received feedback. The lines around "48.5" are the result of time-lapse photography and the movement of the cursor as the student responded.

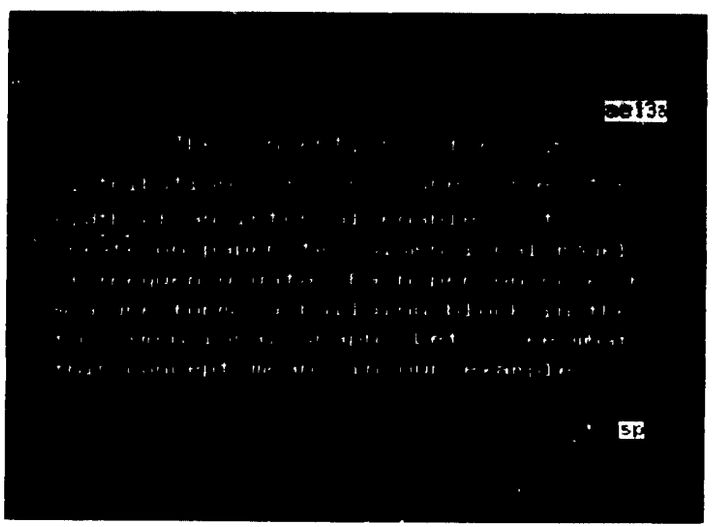
27-CRT



28-Comment

Additional practice problems (not shown here) are presented before the following text is presented.

29-CRT

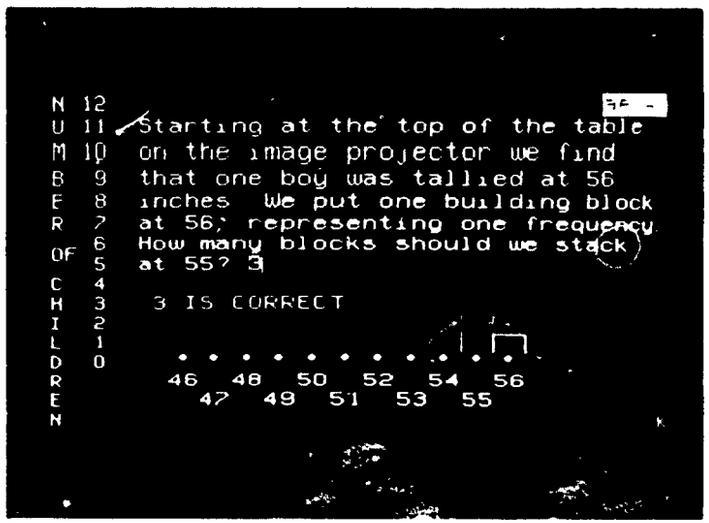


30-Comment

16-Image is still visible to the student on the image projector and is referred to in the following interactions.

Time-lapse photography (31-CRT) shows that the student responsed "3," received feedback, "IS CORRECT," and is shown how that quantity is represented on the graph.

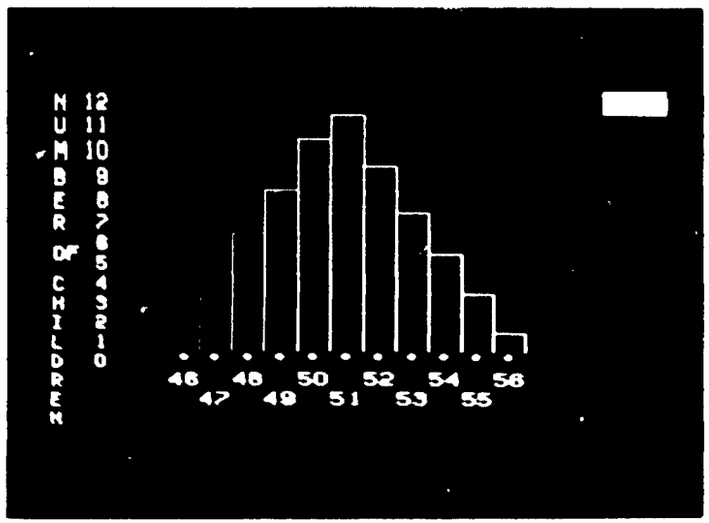
31-CRT



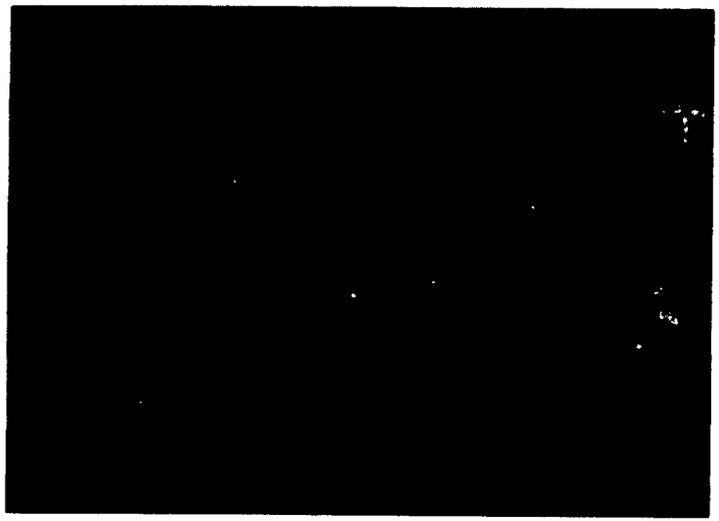
32-Comment

After the student has determined the total number of blocks in the graph by referring to 16-Image, the graph is constructed for the student in real time on the CRT.

33-CRT



34-CRT



35-CRT

FREQUENCY CURVE

Content Outline

I. Normal Curve of Error–Theory
   - A. Two dimensions: frequency and scale value
   - B. Elements of scale dimension bear relationship to one another
   - C. Formed by connecting top of each interval column of histogram
   - D. If unit of histogram, reduced to very small widths, smooth curve created which often has "bell shape"
     1. vertical dimension represents number of cases or frequencies
     2. horizontal dimension represents continuous scale or measure
     3. frequencies tend to pile up in middle of distribution and be extremely few at extremes
     4. total area under curve proportional to total frequency
        - a. curve is symmetrical–50% of area falls below exact center of distribution and 50% falls above
     5. curved line approaches but never quite touches base line
   - E. Characteristics of normal curve are described precisely by mathematical formula called "Incomplete Beta Function"

Behavioral Objectives

Recall frequency as term for the number of cases in a distribution (short answer)

Recognize that the horizontal dimension represents a continuous scale of measurement (multiple choice)

Recall that cases tend to pile up in the middle of a distribution (completion)

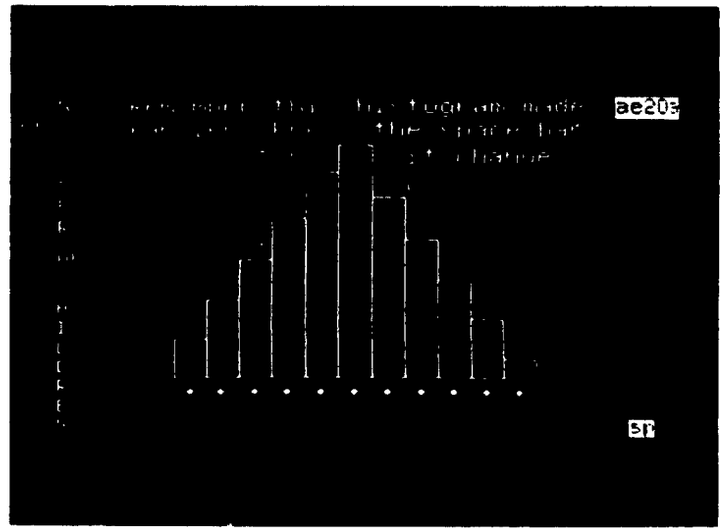
Conclude that 50% of the area falls in the left half of the distribution (short answer)

Conclude that the curved line never quite touches the base line because frequencies at the extremes of the distribution are rare (alternate response)

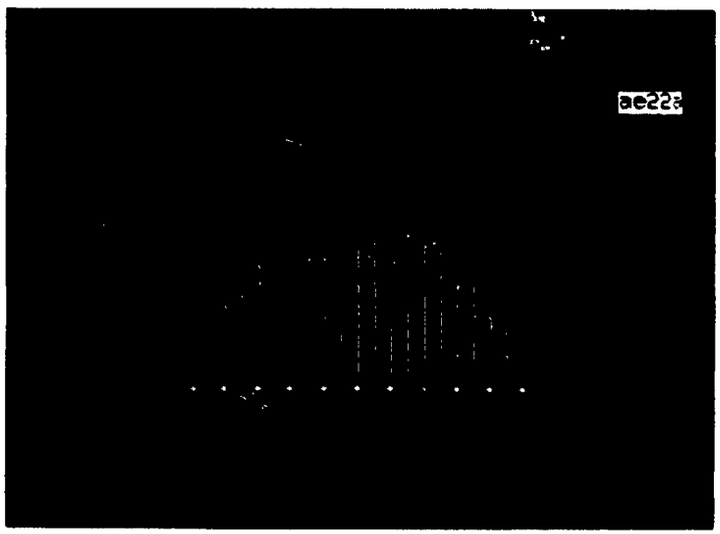
36-Audio

The histograms we have just constructed represent in a graphical way all of the information we have so far about the heights of 66 boys. It would, however, be difficult to manipulate this histogram in order to find a particular child's location in relation to all the other children or to compare the histogram of several groups. In short, histograms are awkward, so we need some other ways of looking at data.

37-CRT



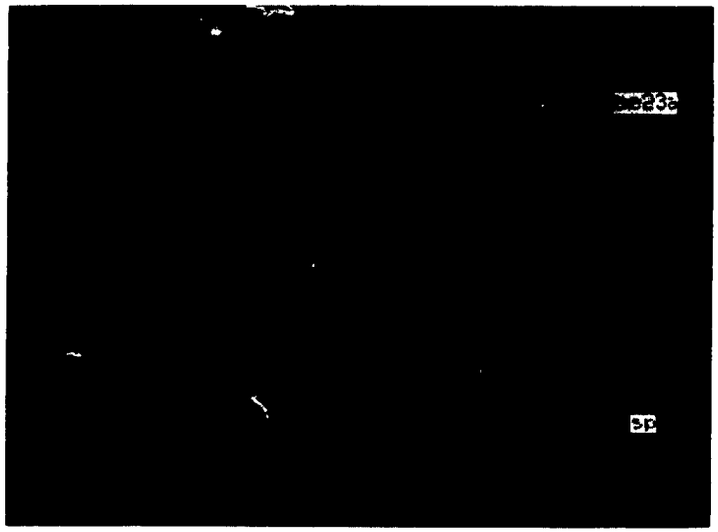
38-CRT



39-Audio

If our measures of boy's heights were accurate and recorded to the nearest half inch, the histogram of these measures would look like that shown on the screen now (38-CRT). Remember that the intervals in such an instance would extend one-quarter of an inch below the half-inch label and one-quarter of an inch above the label. If we extended the process to very, very narrow intervals, we would get the following:

40-CRT



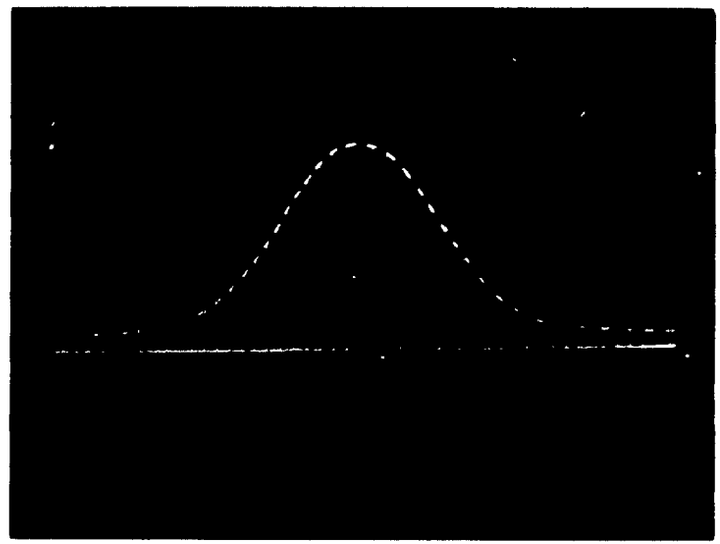
41-Audio

The shape of the histogram is partly a function of the number of cases on which measurements are taken. It is both intuitively and scientifically sound to expect small samples to show greater fluctuations or deviations from one another than large samples do.

42-Audio

In the instance of the heights of boys, we would anticipate a definite smoothing of the tops of the intervals. And, if we had a very large sample, the histogram of the heights of eight-year-old boys would look like that shown on the projector (43-Image). Note that a curved line has been passed through the tops of the histogram columns. For the remainder of this section, we will use the curved line to represent distributions and omit the mass of vertical lines.

43-Image

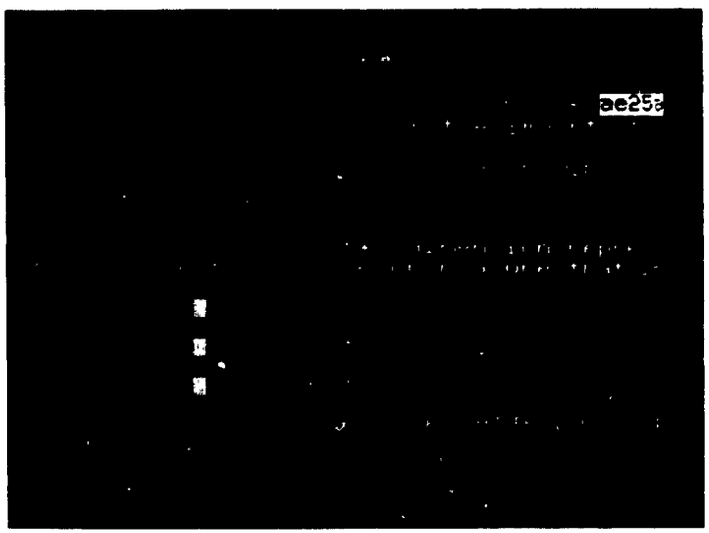


44-CRT

45-Comment

The student responded "frequency," received feedback "correct," and is ready to proceed to the next question in the review.

46-CRT



47-Comment

The correct answer (46-CRT) is "continuous." Had the student indicated either of the two wrong responses, the following feedback would have been presented to him

NO. REMEMBER THE BAR GRAPH WHEN THE COLUMNS WERE SEPARATED BY SPACES IN THAT INSTANCE, THE DISTRIBUTIONS WERE DISCONTINUOUS. LOOK AT THE IMAGE AND TRY AGAIN.

48-CRT

49-Comment

The correct response is "center" or "middle." Appropriate corrective feedback would be provided for the incorrect response "mode" or "mean."

Several more short-answer questions follow which review the important objectives, culminating with a description of the terms, "Incomplete Beta Function" and "Normal Curve of Error."

Students have the option to see a frame which contains the mathematical function defining the Normal Curve of Error.

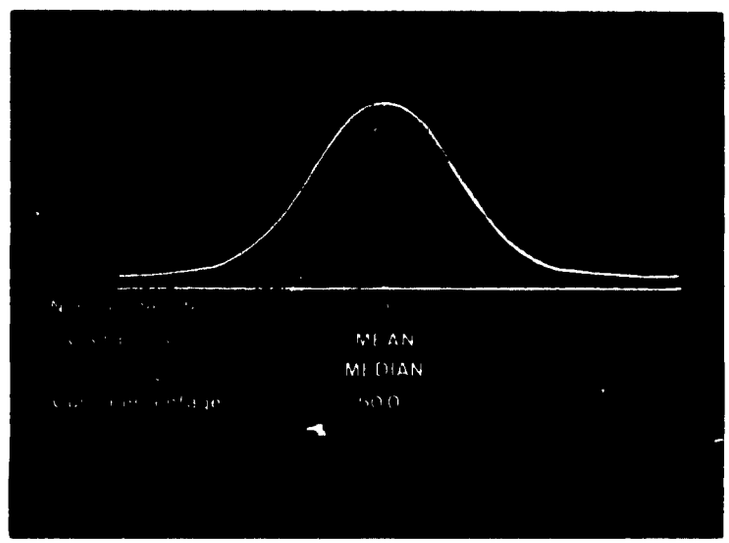
Content Outline	Behavioral Objectives
II. Normal Curve of Error--Application	
A. Normal curve serves as a model for handling and describing behavior variables and characteristics of children.	Recognize model as term which best describes normal curve (multiple choice)
B. Center point of normal curve located at:	Recall that cumulated percentage of frequencies at center of distribution is 50 (completion)
1. Arithmetic mean: sum of values in distribution divided by number of observations	Recognize symmetrical quality of model as the characteristic which makes the mean, median, and 50th percentage coincide (multiple choice)
2. Median: middle value in ordered distribution of values	
3. These points occur at same center point in normal curve because of its symmetrical quality	
C. If distribution of real data is close fit to normal curve model, relationships and locations attributed to model can be transferred to "real" data.	

Student Interactions

50-Comment

The student is brought to criterion on the first two objectives before proceeding to the next material.

51-Image



52-CRT

53-Comment

A light pen response is requested in 54-CRT The correct response is the fourth option Other options provide corrective feedback:

Response. First option

Feedback: NO. FREQUENCY CURVES HIGH ON THE ENDS AND LOW IN THE MIDDLE COULD QUALIFY. TRY AGAIN.

Response: Second option

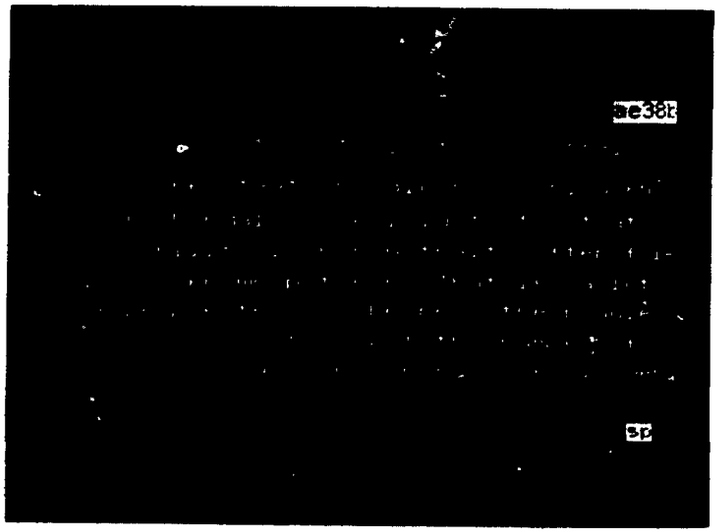
Feedback: FREQUENCY DISTRIBUTIONS WITHOUT TAILS COULD HAVE THE SAME CENTER POINT CHARACTERISTICS AS OUR MODEL. TRY AGAIN

Response: Third option

Feedback: NO. THIS CHARACTERISTIC WOULDN'T AFFECT THE CENTRAL TENDENCY. TRY AGAIN.

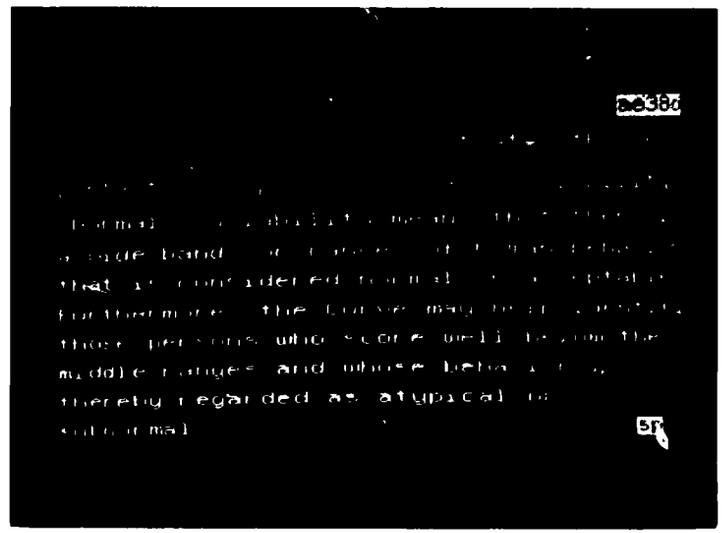
54-CRT

55-CRT



56-CRT

57-CRT



Content Outline

III. Normal Deviate
- A. Standard unit of width or distance on horizontal scale or normal curve model
- B. Measures distances from center point of normal curve model; center of distribution is zero point for normal curve
  1. values above mean have positive values
  2. values below mean have negative values
- C. Distances on normal deviate scale have kind of equal and relative quality; i.e., normal deviate value of +2.0 is twice as far from the mean as normal deviate of +1.0
- D. Six normal deviates (three on each side of the mean) encompass all but .25% of the area under the curve
- E. Normal deviate is termed "standard deviation" when referring to distribution of "live" data.

Behavioral Objectives

Recognize normal deviate as being an arbitrary but uniform measure (multiple choice)

Given example, compute size of a normal deviate in score values (short answer)

Conclude that normal deviates below the mean have negative values, and normal deviates above the mean have positive values (completion)

Conclude that the area under the curve between -1σ and 0σ and the area between 0σ and +1σ are the same (alternate choice response)

Recognize symmetry as the quality that makes an area under the curve equal to a corresponding area on the other side of the median (multiple choice)

Conclude that the area between -3σ and -1σ is not equal to the area between -2σ and +2σ (alternate choice response)

Given pairs of distances on the baseline of a normal distribution, indicate whether each pair is the same or different in area (alternate choice response)

Given partially completed table of normal deviate scale points, means, and standard deviations, complete the table with equivalent values

Find mean values of a distribution of scores (short answer)

Given partially completed table of raw scores and normal deviates, complete the table with equivalent values (constructed response)

Given a distribution with a mean of 30, recognize that 22 and 38 are equidistant from the mean (multiple choice)

Recognize that the area between -1σ and +1σ includes about 2/3 of the total distribution (multiple choice)

Given spans of normal deviate values, compute the percentages of area corresponding to each span (short answer)

Student Interactions

58-Comment

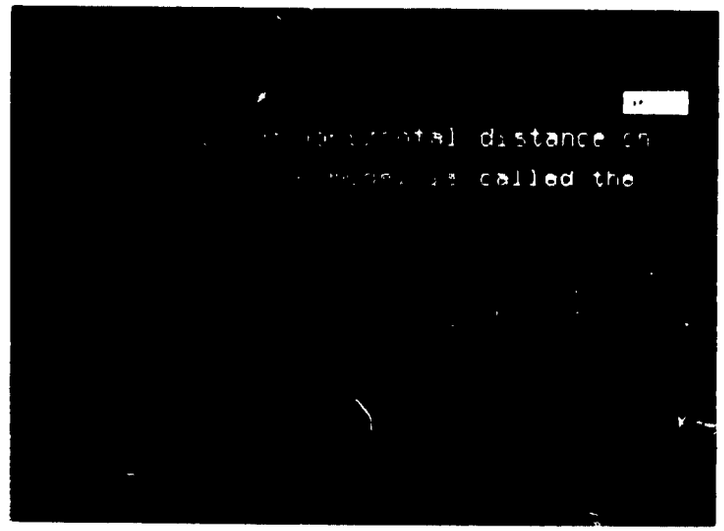
51-Image is still visible to the student on the image projector and is referred to in the following interactions.

59-CRT

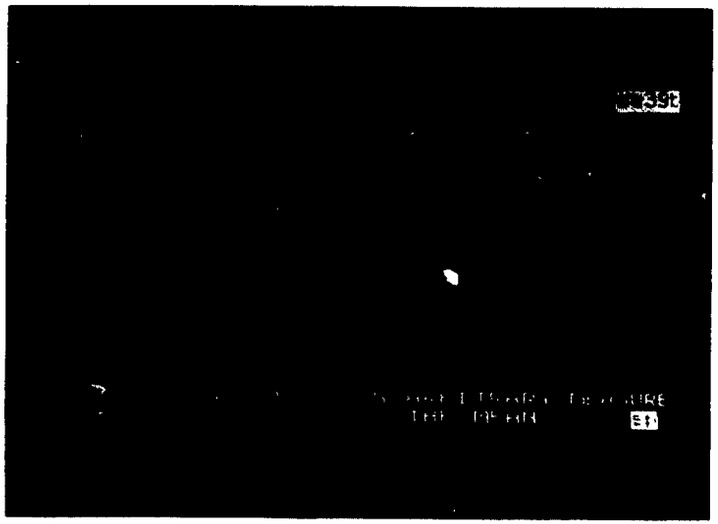
60-Comment

The student responded "distance" to the question in 61-CRT and received corrective feedback. Similar interactions follow.

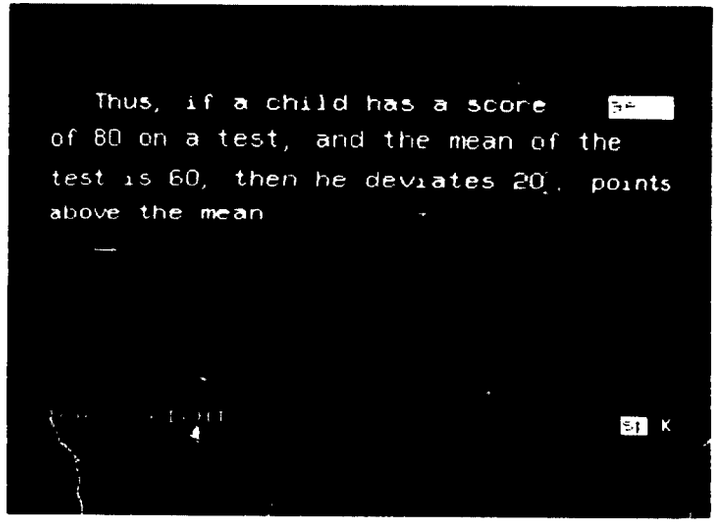
61-CRT



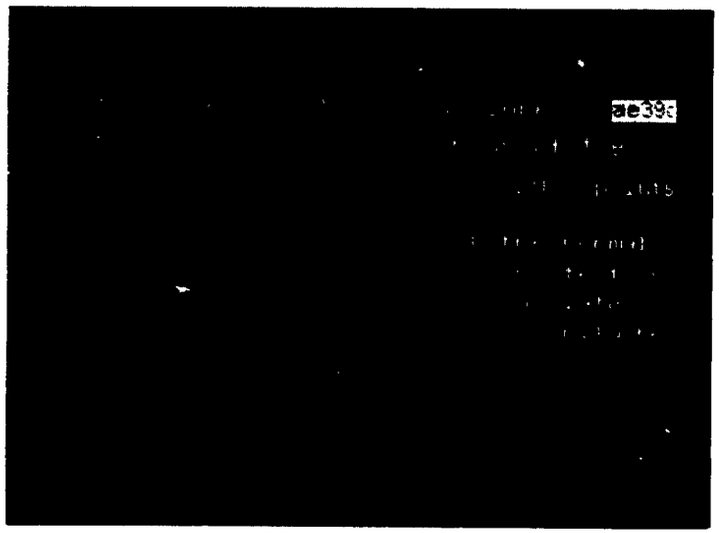
62-CRT



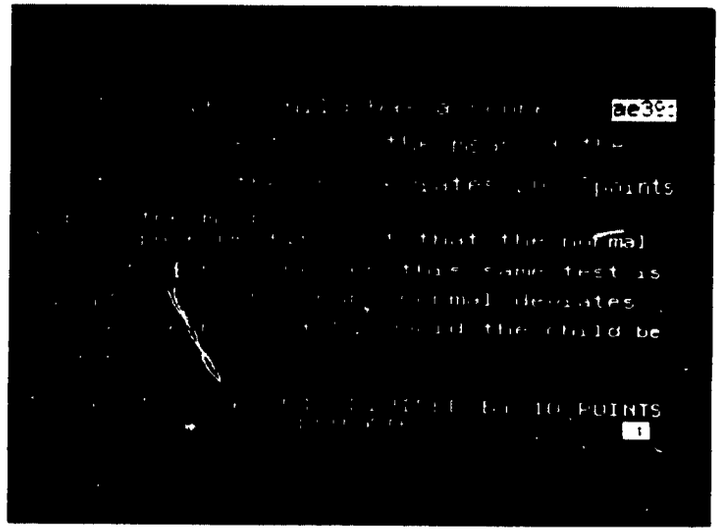
63-CRT



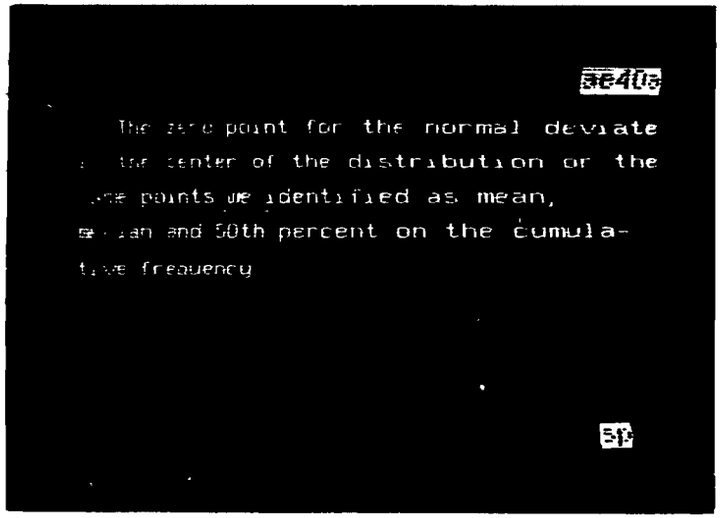
64-CRT



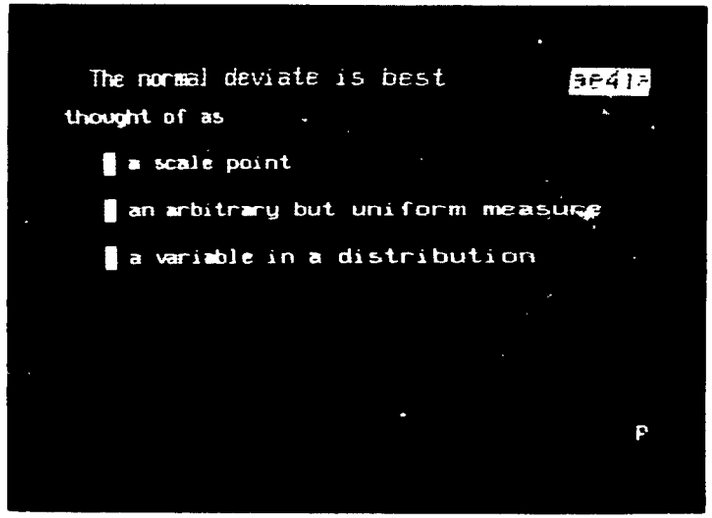
65-CRT



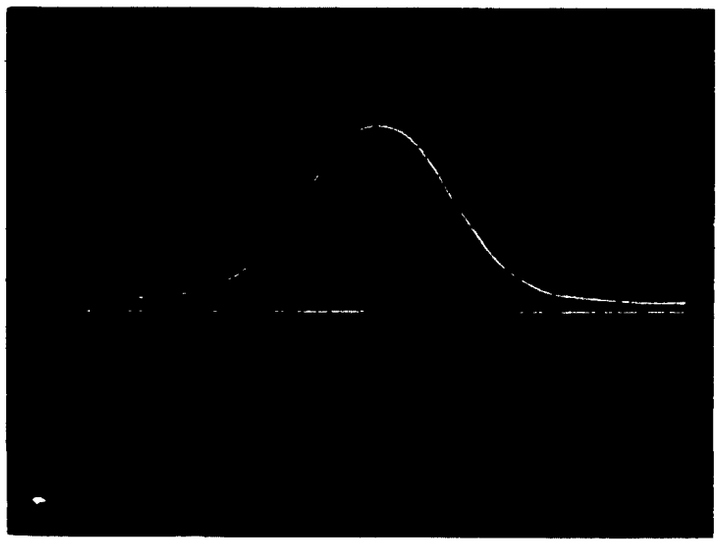
66-CRT



67-CRT



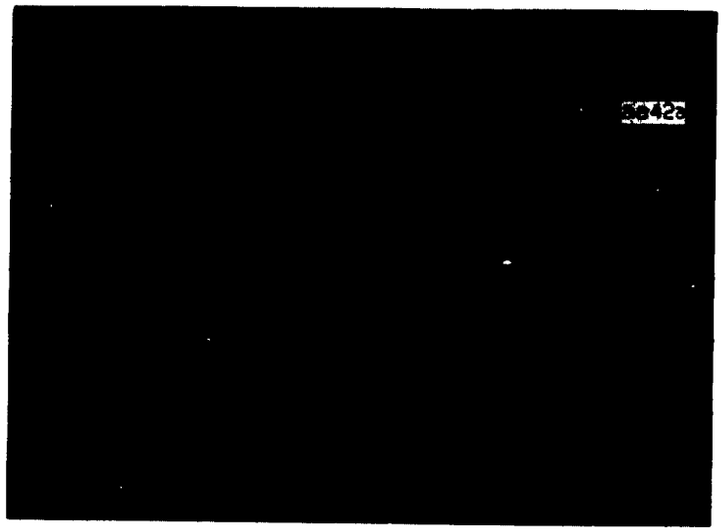
68-Image



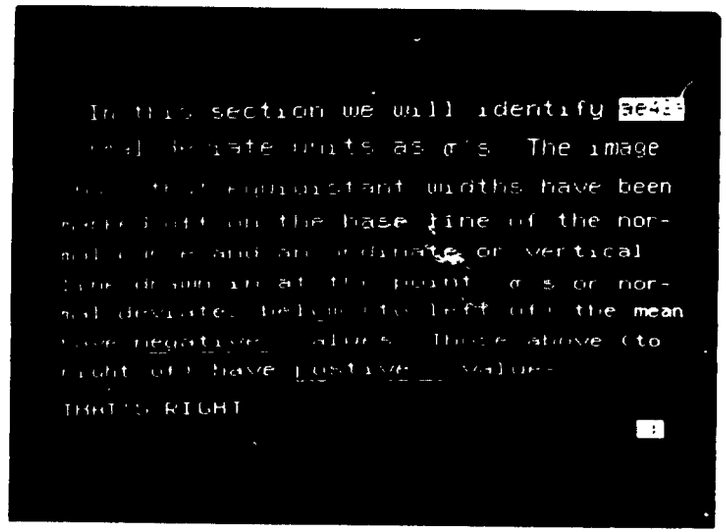
69-Comment

70-CRT and 71-CRT illustrate two stages of a 3-part completion question. The student has provided each underscored word to correctly complete the sentences and to demonstrate his competency with the concepts.

70-CRT



71-CRT

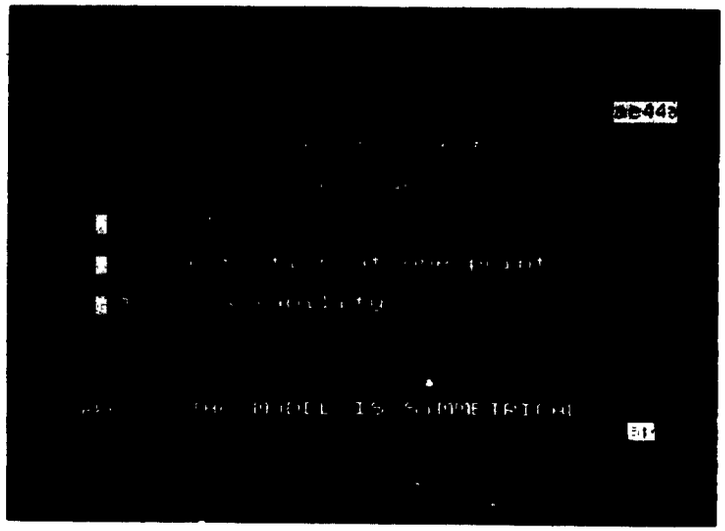


72-CRT

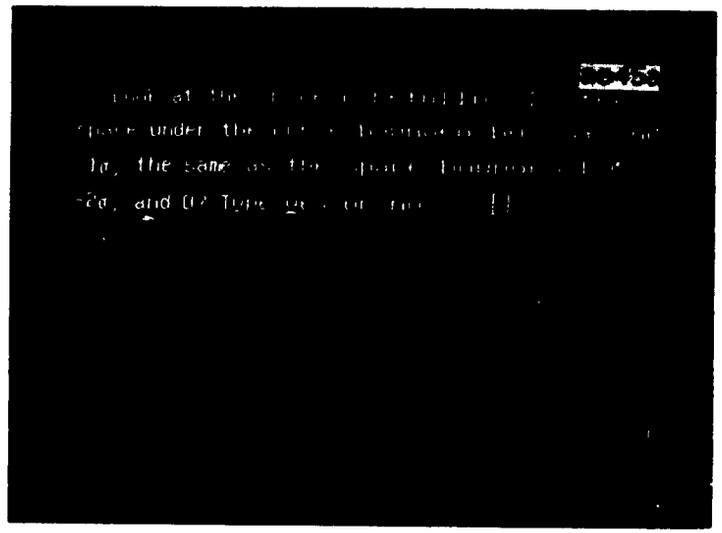
73-Comment

Using the light pen the student selected "same" (72-CRT) and "symmetry" (74-CRT) as his responses and received feedback.

74-CRT



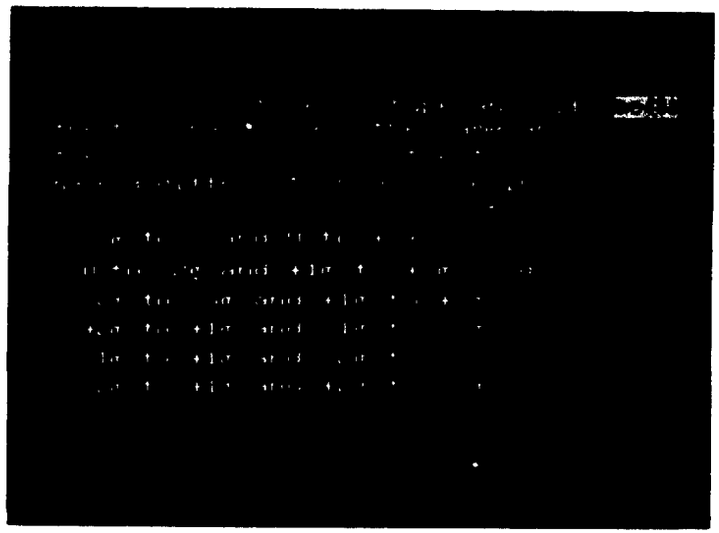
75-CRT



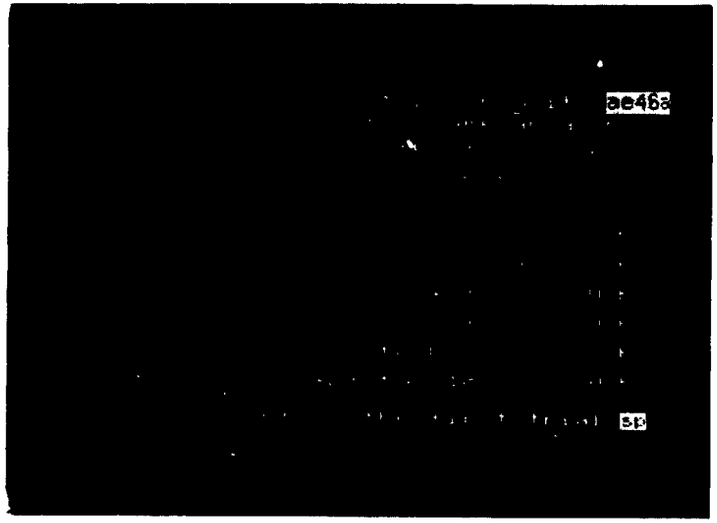
76-Comment

The student has responded correctly to the first four parts of this question (77-CRT). However, he erred on the fifth, as the feedback indicates. The incorrect response was immediately erased and the student was allowed to try again.

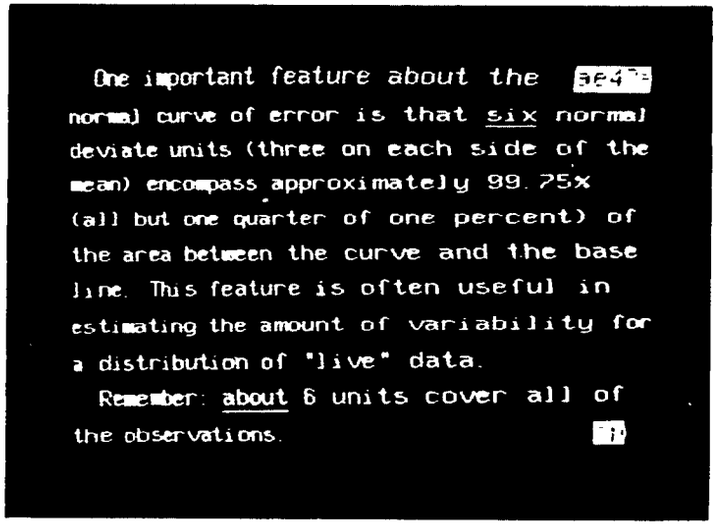
77-CRT



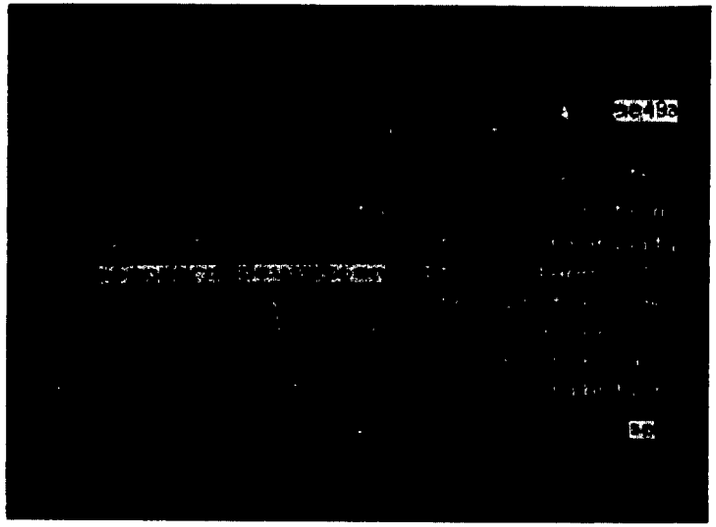
78-CRT



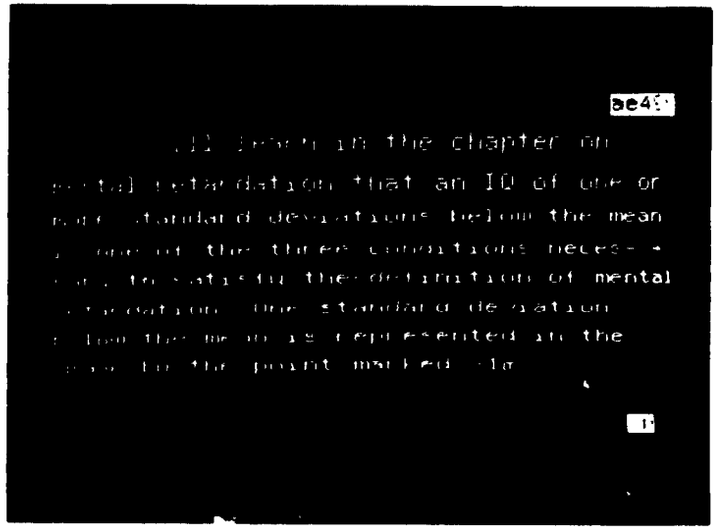
79-CRT



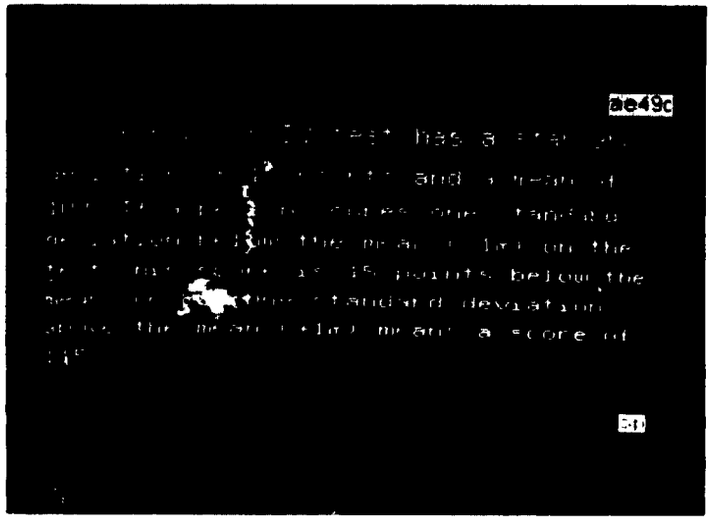
80-CRT



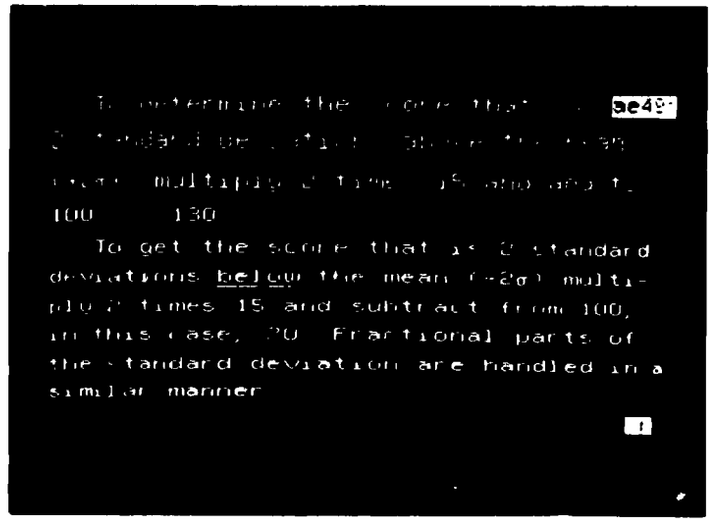
81-CRT



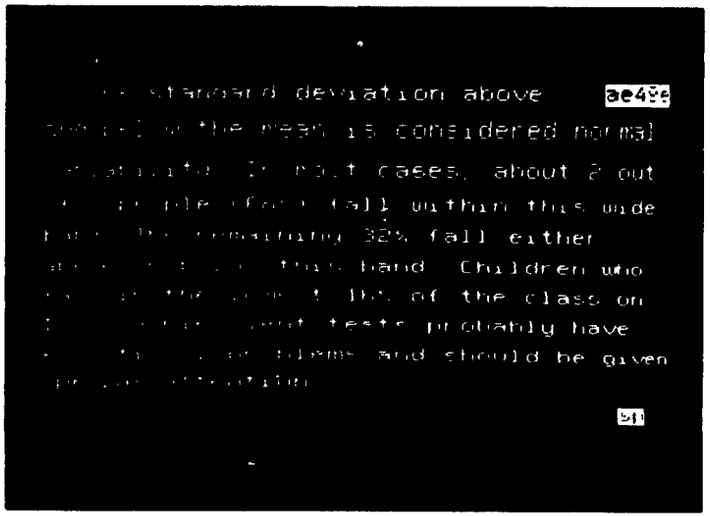
82-CRT



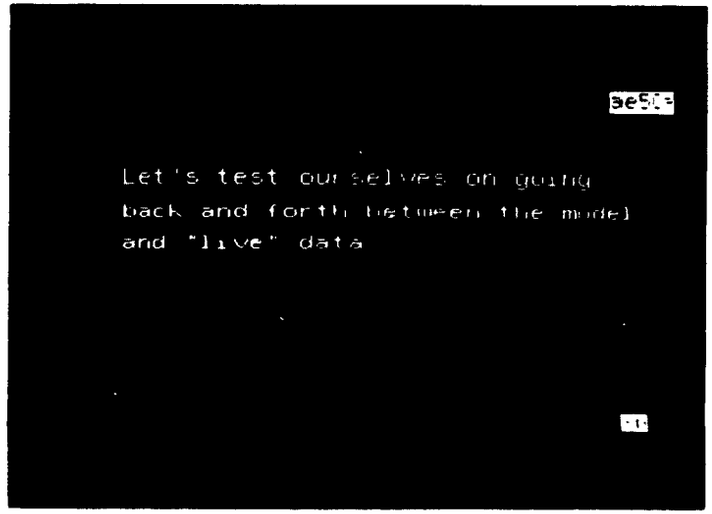
83-CRT



84-CRT



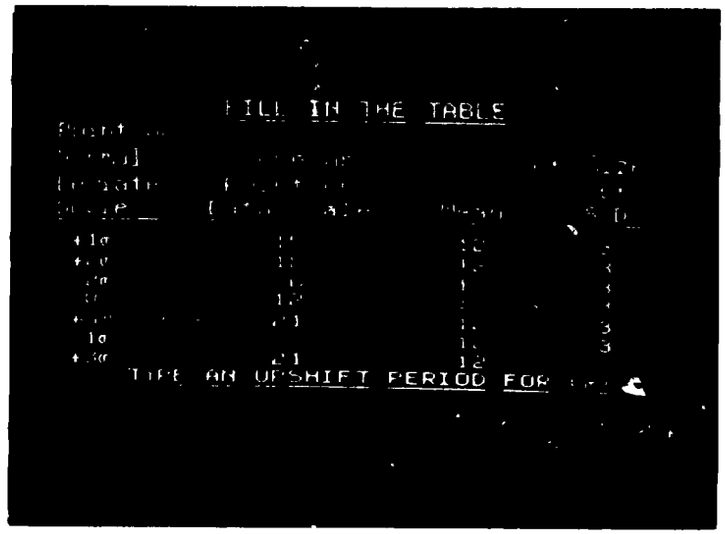
85-CRT



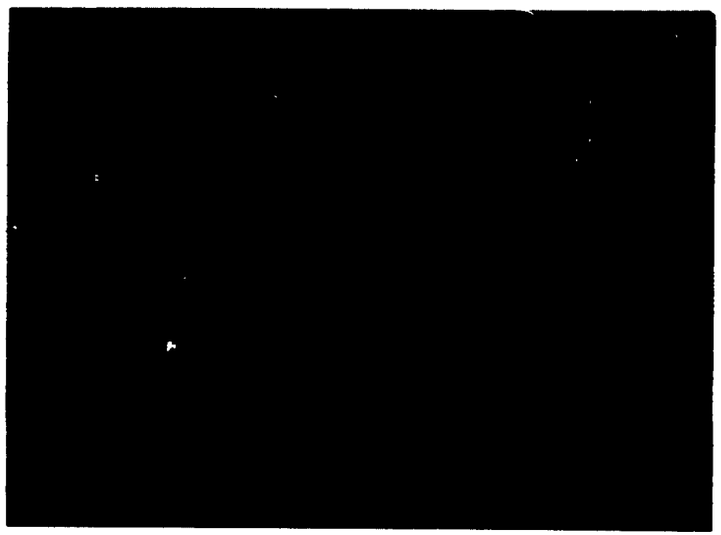
86-Comment

87-CRT and 88-CRT illustrate two stages of a three part completion question requiring the student to demonstrate his competency with certain concepts of normal deviates.

87-CRT



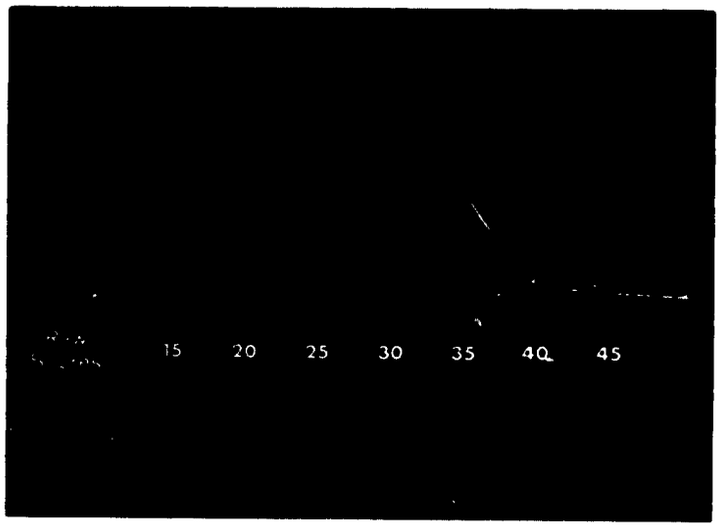
88-CRT



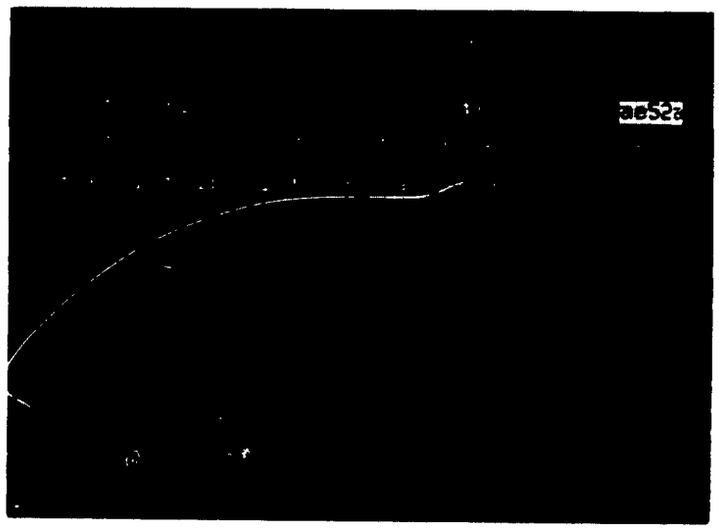
89-Comment

91-CRT through 95-CRT refer the student to 90-Image. Each student response causes the program to provide proper feedback—supportive for correct responses and remedial, corrective feedback for incorrect responses.

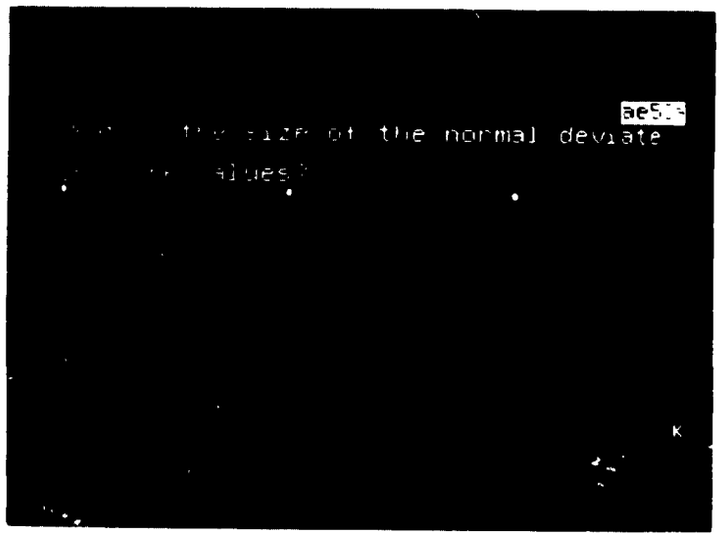
90-Image



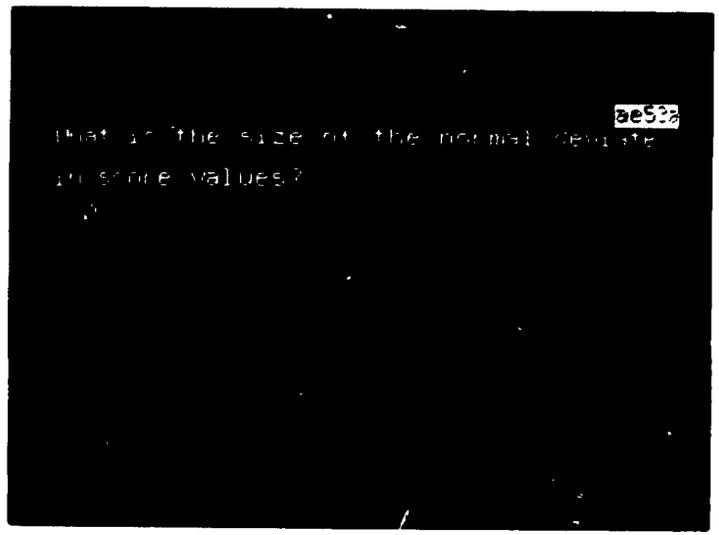
91-CRT



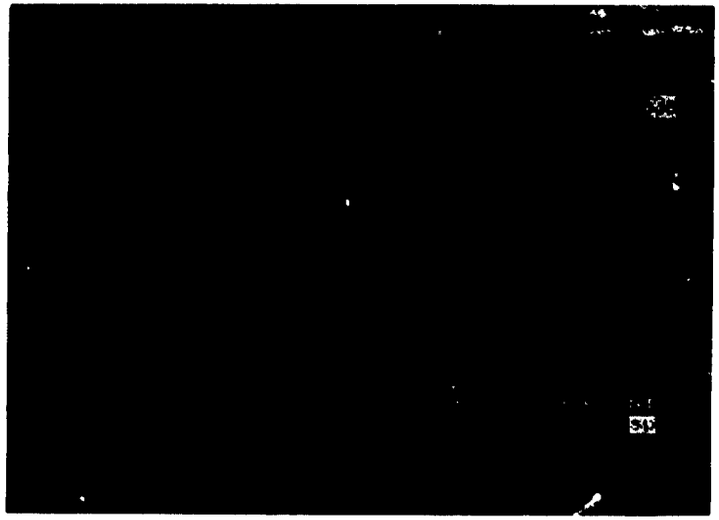
92-CRT



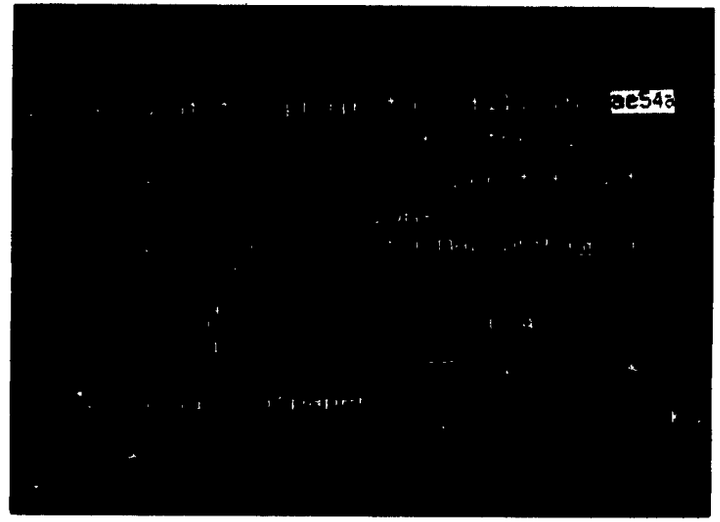
93-CRT



94-CRT



95-CRT



96-Comment

The correct response is "28" (95-CRT). Following is an illustration of incorrect responses and the associated feedback for each:

Response: 32

Feedback: NOPE, YOU FORGOT TO PAY ATTENTION TO THE MINUS SIGN.

Response: 26

Feedback: YOU MAY HAVE FORGOTTEN THAT 4/10 OF 5 IS ONLY 2, NOT 4. TRY AGAIN.

Response: First unrecognized or unanticipated response

Feedback: HINT: IF 4/10 OF 10 = 4, THEN 4/10 OF 5 = 2.

Response: Second unrecognized or unanticipated response

Feedback: HINT: IF 4/10 OF 5, THE NORMAL DEVIATE VALUE IS 2 SCORE POINTS, AND IF THE MINUS SIGN SAYS TO SUBTRACT IT FROM THE MEAN, WHAT IS 30 – 2?

Response: Third unrecognized or unanticipated response

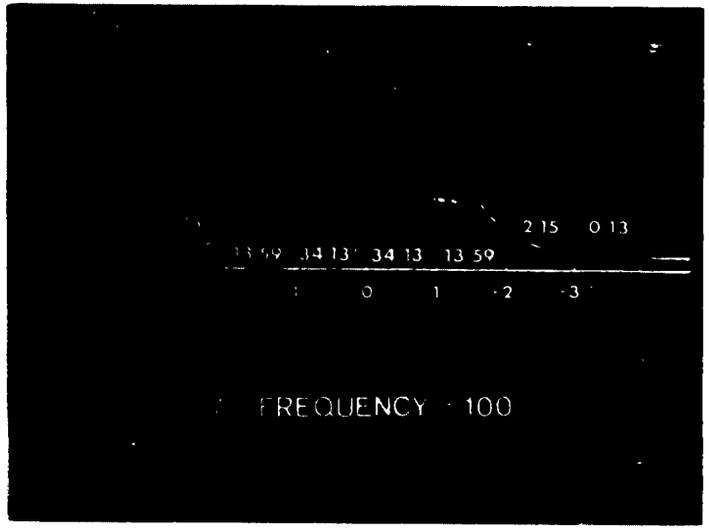
Feedback: THE MEAN IS 30 AND 0.4σ BELOW THE MEAN IS 2 SCORE POINTS. 30 – 2 = 28. ENTER 28.

97-CRT

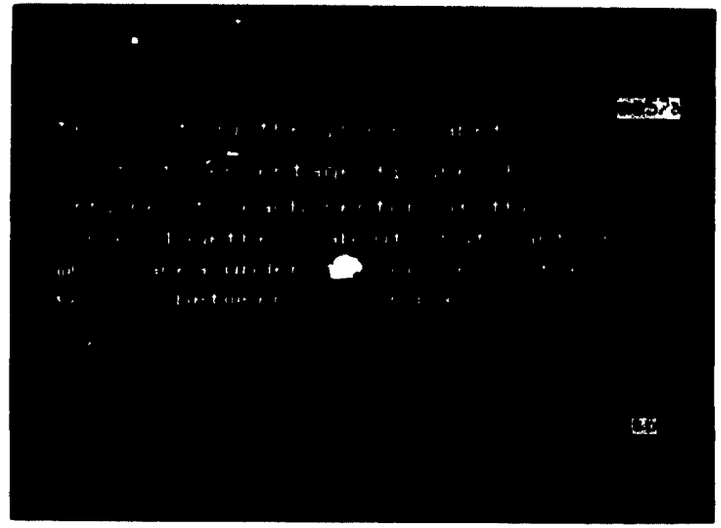
98-Comment

100-CRT, 101-CRT, and 103-CRT refer to 99-Image.

99-Image



100-CRT



101-CRT

103-CRT

102-Comment

103-CRT shows that the student has responded correctly to the first six problems. Following is an illustration of incorrect responses and the associated feedback for the sixth problem:

Response: 100%

Feedback: THE ANSWER COULD NOT BE 100 UNLESS WE INCLUDED ALL SEGMENTS. TRY AGAIN.

Response: 99.94%, 99.84%, 99.64%, 99.24%, or 99.75%

Feedback: YOU'RE VERY CLOSE. BETTER CHECK YOUR ARITHMETIC.

Response: 4.56%

Feedback: YOU'VE INCLUDED SEGMENTS ABOVE +2σ AND BELOW -2σ AND SUMMED THE FREQUENCIES. TRY AGAIN.

Response: 84.13%

Feedback: NO. YOU ADDED PROPORTIONAL FREQUENCIES EITHER BELOW +2σ OR ABOVE -2σ.

Remedial, tutorial instruction is provided as feedback for unanticipated and unrecognized responses.

Content Outline

IV. Normal Curve Table
- A. Convert areas to percentages by moving the decimal point two places to the right and adding a percent sign.
- B. Column 2 of the table gives the area from the mean to the normal deviate value.
- C. Column 3 of the table gives the area under the larger portion of the curve either above or below the normal deviate.
- D. Column 4 gives the area under the smaller portion of the curve either above or below the normal deviate.

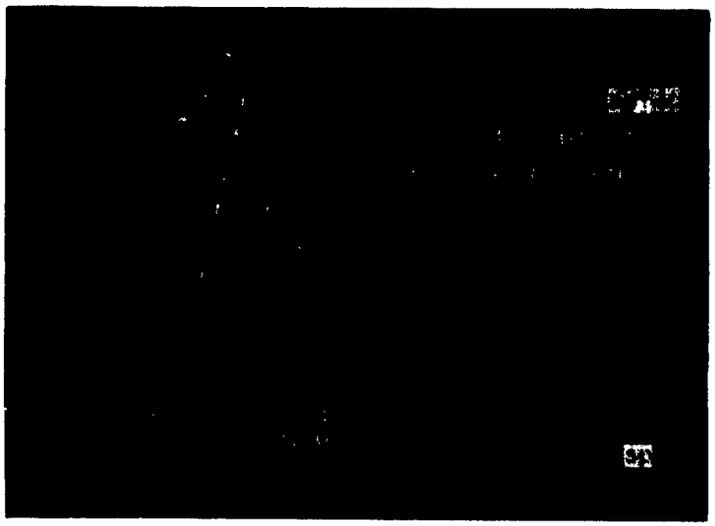
Behavioral Objectives

Given a table of Areas of Normal Curve, be able to interpret the table and use it to convert normal deviates to areas and areas to normal deviates (constructed responses)

Recognize that the areas under the normal curve can be thought of as percentages of the total frequency or area (constructed responses)

Student Interactions

104-CRT



105-Comment

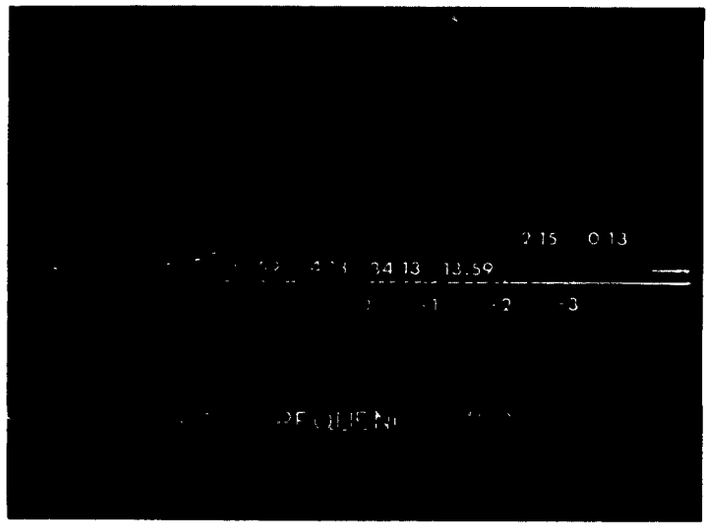
106-CRT refers the student to Plate 7.6 in the student reference handbook which accompanies the course. The table is included in this documentation inside the back cover.

106-CRT

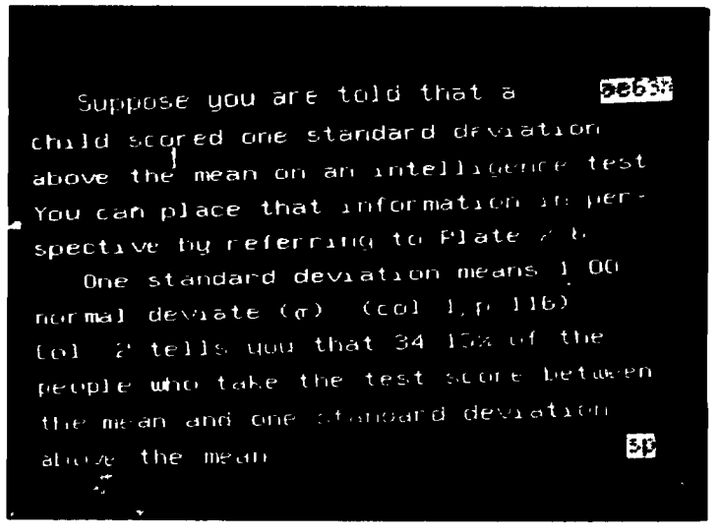
107-Comment

The relationship of tabular and graphic representation of the areas of the normal curve are developed through the coordinated use of the CRT for explanations, image projector for graphic displays, and the table for tabular data.

108-Image

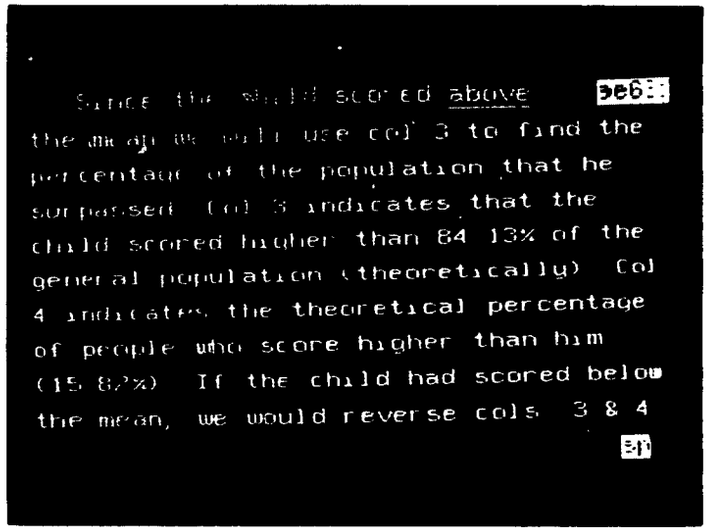


109-CRT

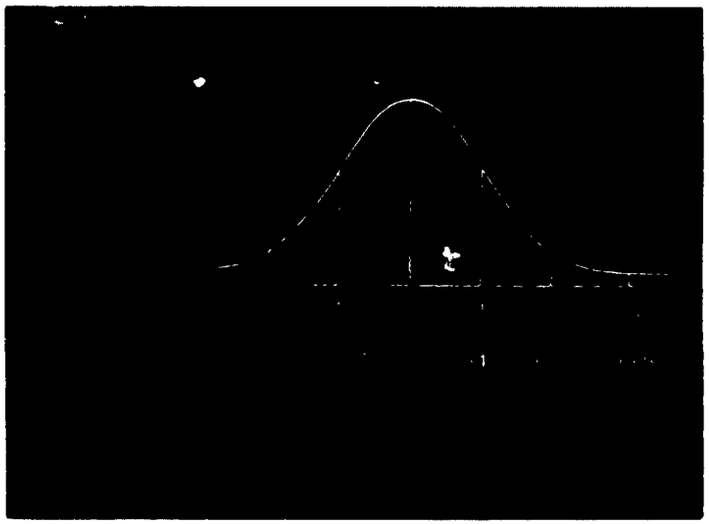


110-Image

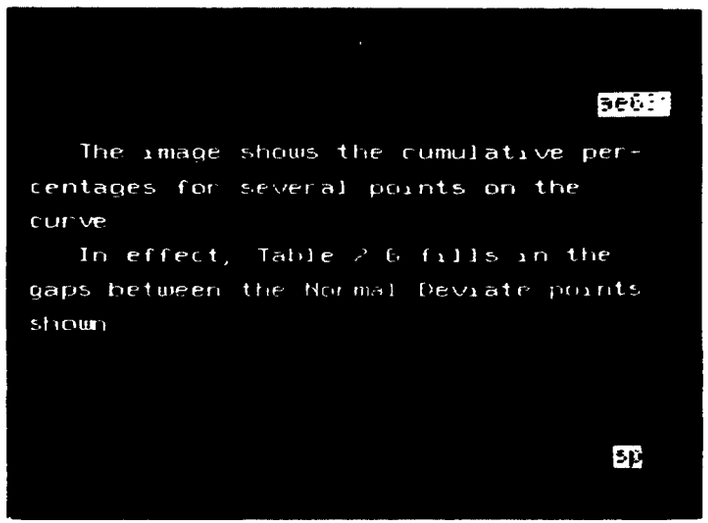
111-CRT



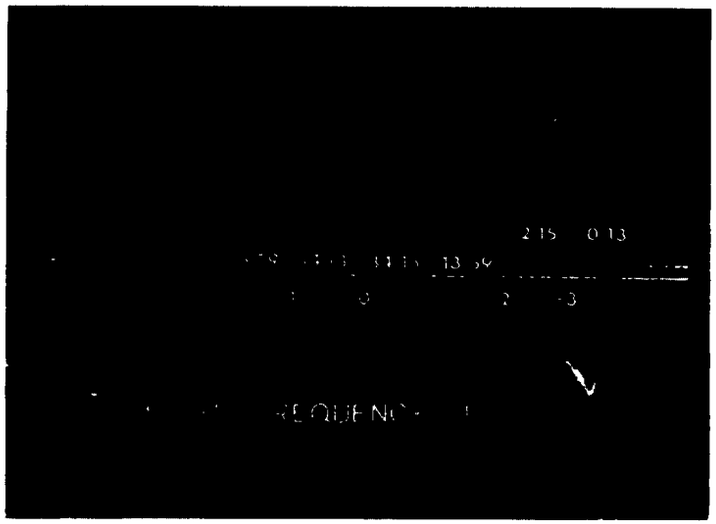
112-Image



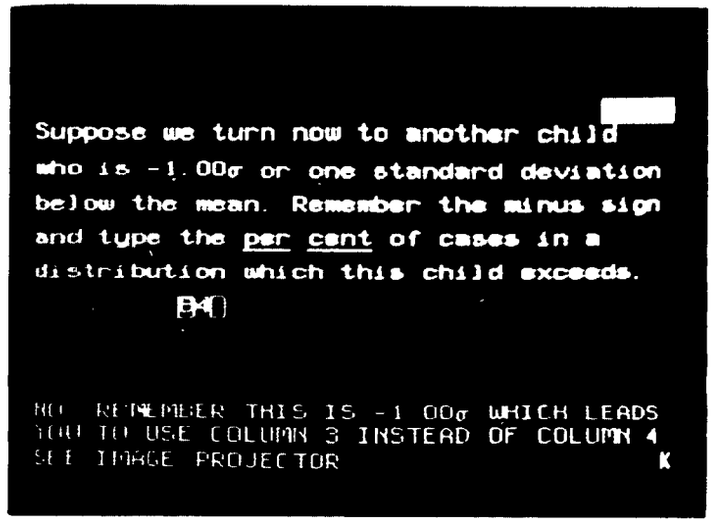
113-CRT



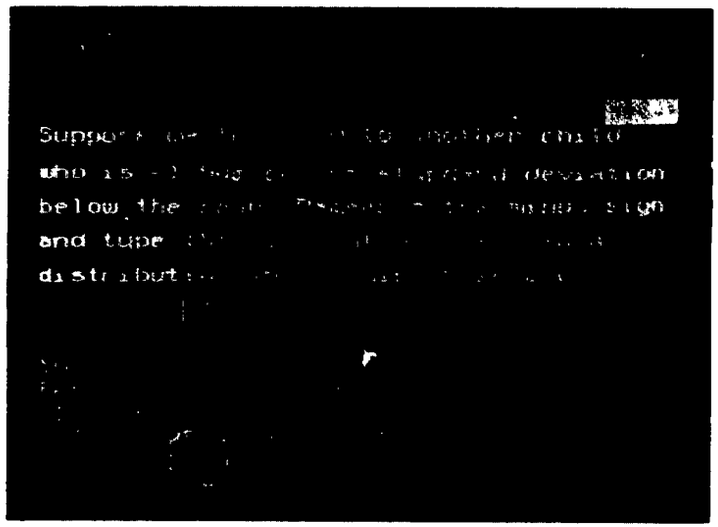
114-Image



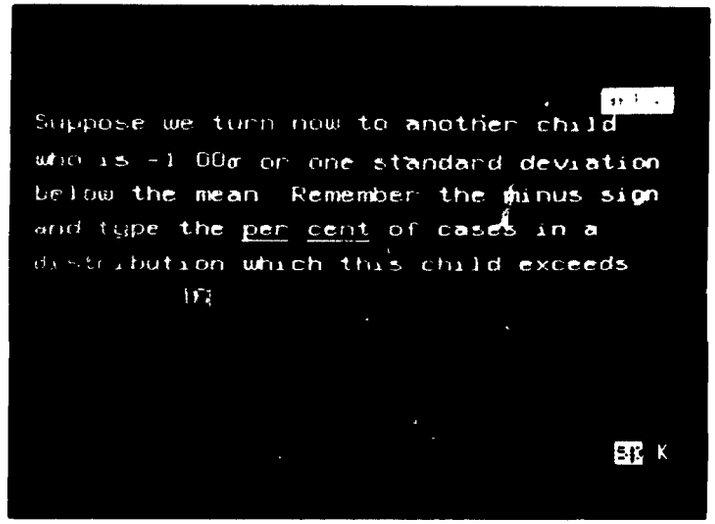
115-CRT



116-CRT



117-CRT



Content Outline

V. Measures of Relative Position
   A. Percentiles: divide distributions into 100 equal parts
      1. 50th percentile corresponds to normal deviate of 0
      2. 84th percentile corresponds to normal deviate of +1.0
   B. Quartiles: divide distributions into four equal parts
   C. Deciles: divide distributions into ten equal parts
   D. Quintiles: divide distributions into five equal parts
   E. Equal and relative quality are not associated with standard deviations

Behavioral Objectives

Conclude that quintiles represent five equal parts (short answer)

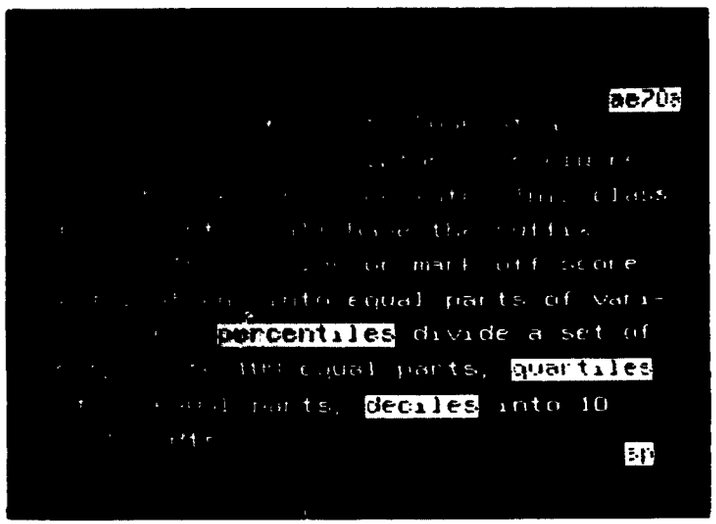
Given a partially completed table with percentiles, deciles, and quartiles, complete the table with the appropriate equivalent values (short answer)

Identify 84th PR as the PR corresponding to a normal deviate value of +1 (short answer)

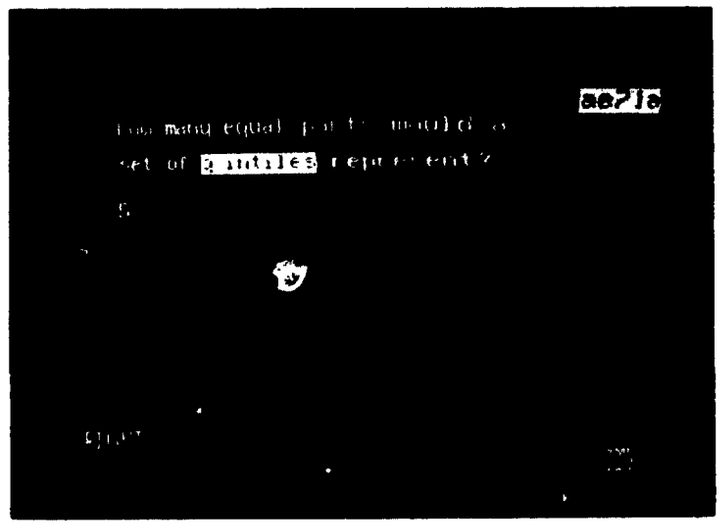
Given percentile ranks, determine the normal deviate values that correspond to each (short answer)

Student Interactions

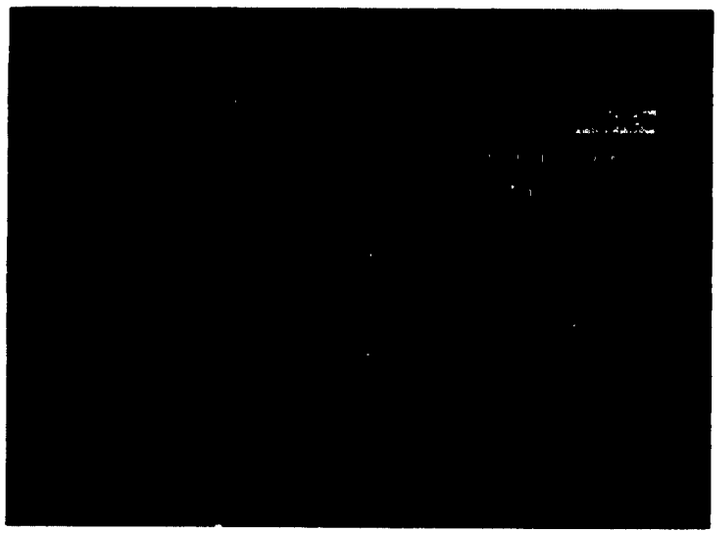
118-CRT



119-CRT



120-CRT



121-Comment

A series of exercises (not shown here) require the student to convert percentiles, quartiles, and deciles from one to another. He must convert the following:

3rd quartile to 75th percentile and 7-8th decile
50th percentile to 5th decile and 2nd quartile
1st quartile to 25th percentile and 2nd-3rd decile

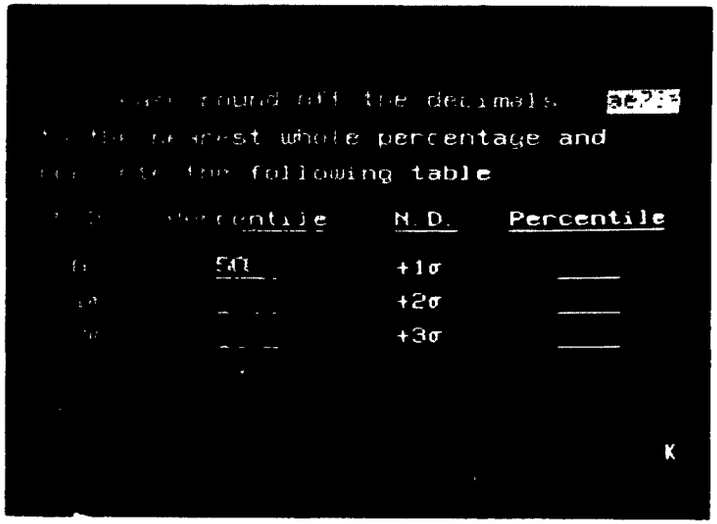
122-Audio

In using percentiles and quartiles to describe the relative position of pupils in some meaningful group, a pupil's score may be said to be at the 75th percentile or at the third quartile. It is incorrect to say that a pupil's score is in the third quartile. Because the quartiles are just score markers or points, a pupil's score cannot be in them. Many people make the mistake of confusing quartiles with quarters. It is, of course, permissible to refer to a given score as being in the third quarter of the distribution, but such a score will be below the third and above the second quartile or median.

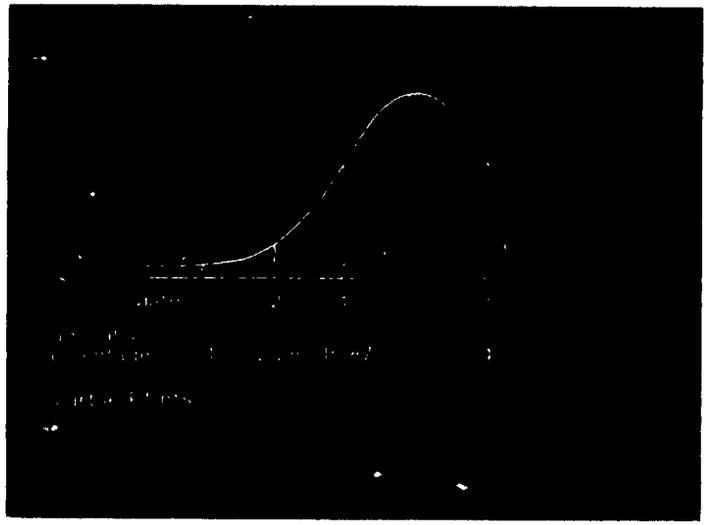
123-Comment

124-CRT refers the student to 125-Image for solving the problems. The student responded correctly to the first problem, received feedback and is ready to respond to the second problem (124-CRT).

124-CRT



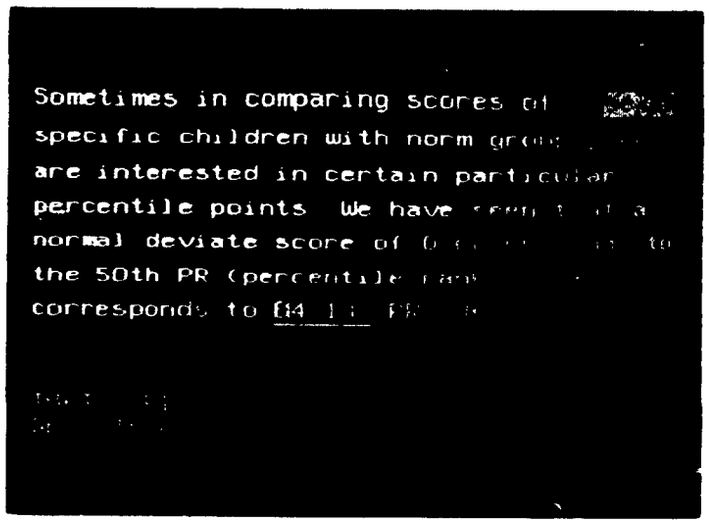
125-Image



126-Comment

127-CRT shows that the student responded correctly with "84.13" and received feedback.

127-CRT



128-Audio

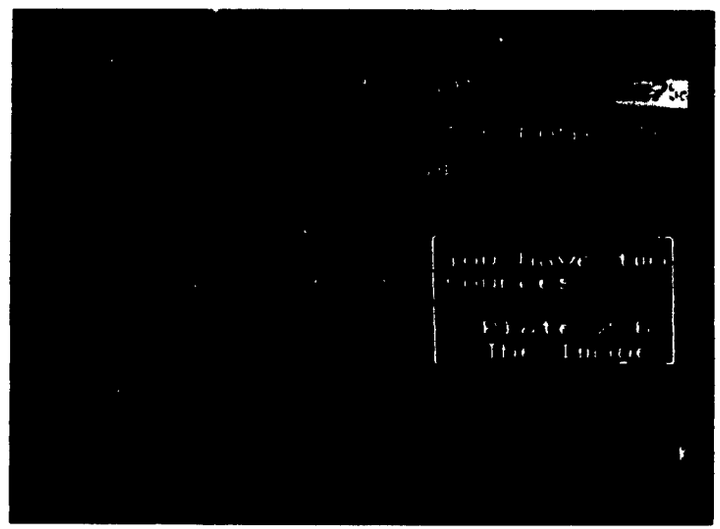
Now we want to learn how to convert percentile ranks (PR) in normally distributed data into their corresponding normal deviate values. Notice on the screen that we've chosen percentile rank 10 (that is PR 10) as an example. To find the corresponding normal deviate we first decide if the 10th percentile rank is above or below the mean. If it is above the mean, our corresponding normal deviate will have a plus sign; if below, the normal deviate will be minus. This decision also tells us which column of the table to use. Values in Column 3 begin at 50 percent and go up to 100 percent; consequently, they represent frequencies in the larger portion of a divided curve. Values in Column 4 begin at 50 percent and go down; consequently, they represent values in the smaller portions of a divided curve. Since 10 is below 50, the value we seek in the table will have a minus sign. And, we can locate it by looking for .10 in Column 4. Do this now.

In Column 4 on Page 4 of the table you will notice that the value closest to .10 is .1003. Read across to your left in the first column and you will find the normal deviate value of 1.28. We remembered the minus sign and entered -1.28 as our answer. Now you can try some table look-ups.

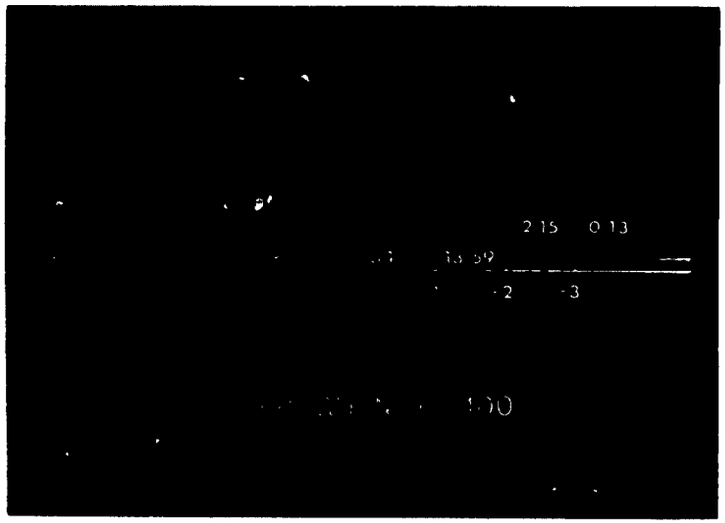
129-Comment

The student is shown the example (130-CRT) just presented by audio and is required to perform four table look-ups. 132-CRT shows that the student responded incorrectly to the first problem, received feedback, and is asked to try again. If he continues to do poorly on this exercise, he is presented with more problems of the same type before proceeding with the program.

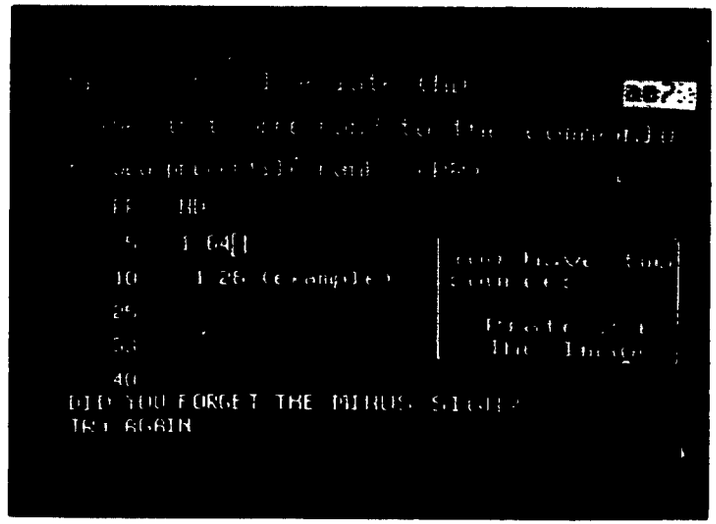
130-CRT



131-Image



132-CRT



Content Outline	Behavioral Objectives
VI. Derived Scores A. T-scores 1. distribution has a mean of 50 and a standard deviation of 10 2. alleviates awkwardness of negative values and decimals associated with normal deviates 3. percentile ranks can be converted into T-scores	Given normal deviate values, determine PR equivalent for each (short answer) Given T-score values, determine PR equivalent for each (short answer)

Student Interactions

133-Audio

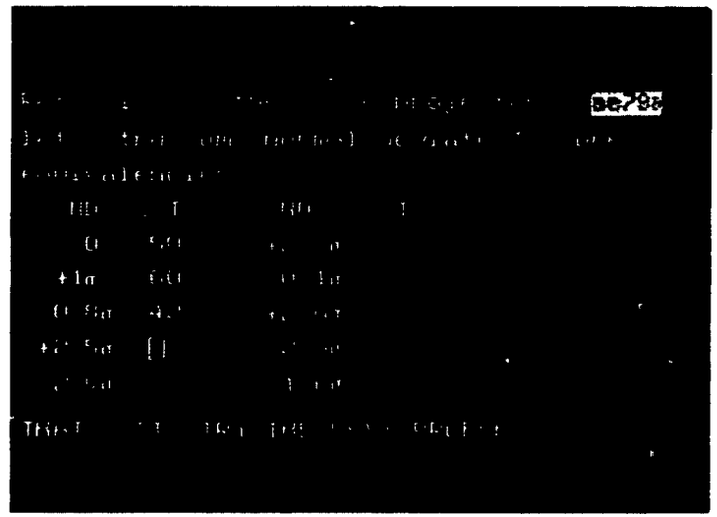
In the early days of educational measurement, teachers and other practitioners objected to the use of normal deviate scores for describing pupil test performances. They particularly didn't like the decimals and the necessity for keeping positive and negative signs straight. To overcome this hurdle, Ben Wood proposed a new type of standard score which he called T-scores in honor of two famous educational psychologists, Lewis M. Thurman and Edward L. Thorndike. T-scores are in practical use limited to two digits with a mean of 50 and a normal deviate unit of 10. On the image projector you can see how the T-scores correspond to normal deviate values and also eliminate decimals and negatives.

134-Comment

The student is referred to 135-Image and in 136-CRT is required to convert normal deviate scores to T-scores. He has responded correctly to the first three problems, received feedback each time, and is ready to attempt the fourth problem.

135-Image

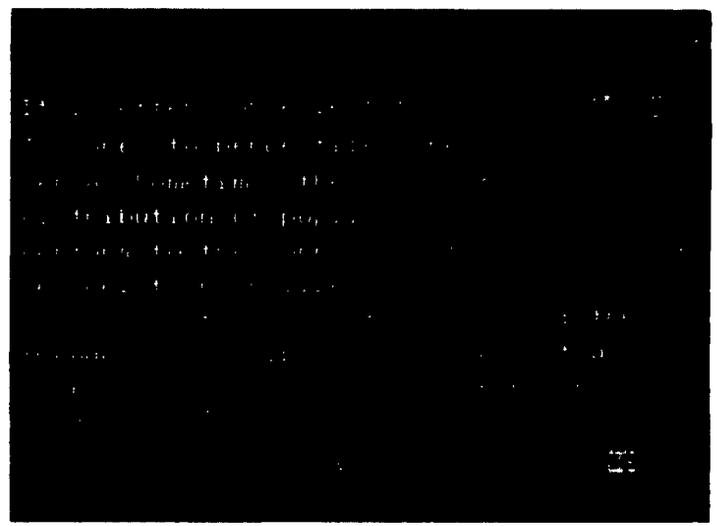
136-CRT



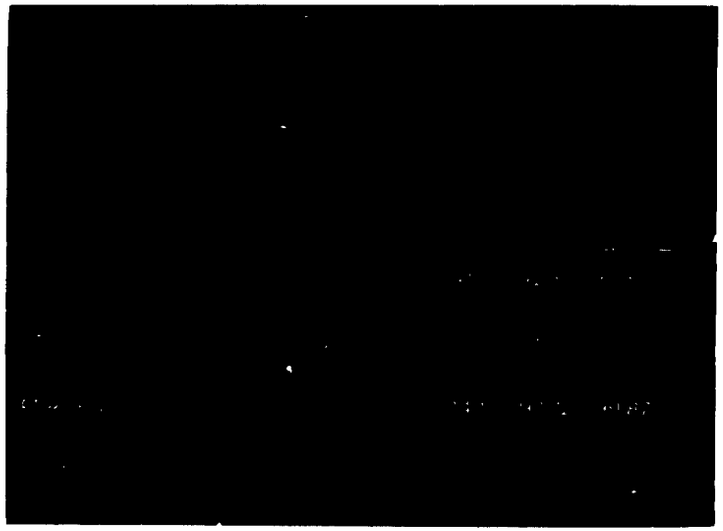
137-Comment

138-CRT refers the student to Plate 7.7 in the student handbook which accompanies the course. The Plate is included in this documentation inside the back cover. 140-CRT requires the student to use the Table to convert T-scores to percentile rank.

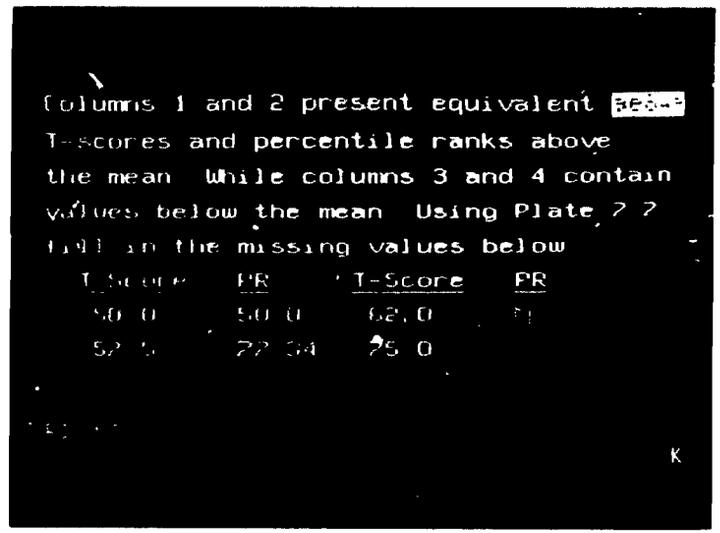
138-CRT



139-Image



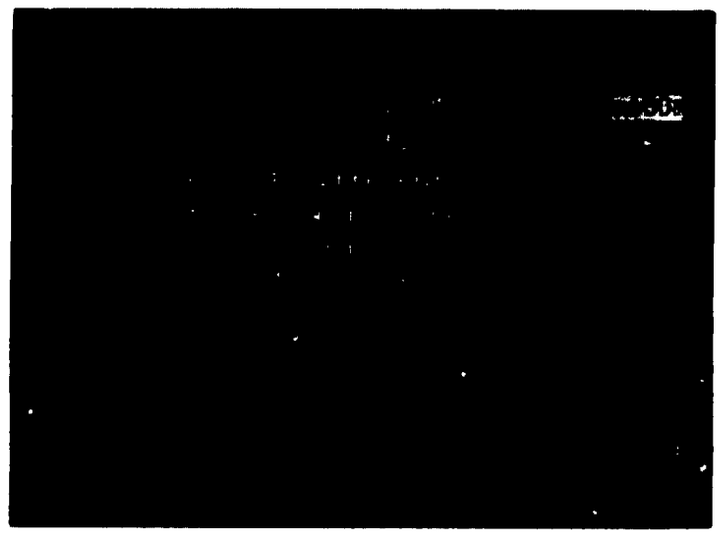
140-CRT



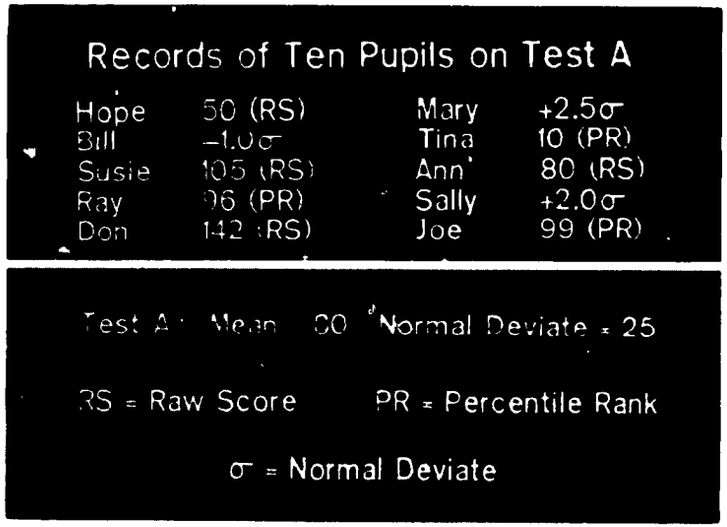
141-Comment

The following materials provide a culminating exercise which causes the student to apply his recently acquired skills in converting normal deviate scores, percentile ranks, and raw scores to a single standard score distribution in order to make appropriate comparisons of the ability measured by a given test for a group of ten children.

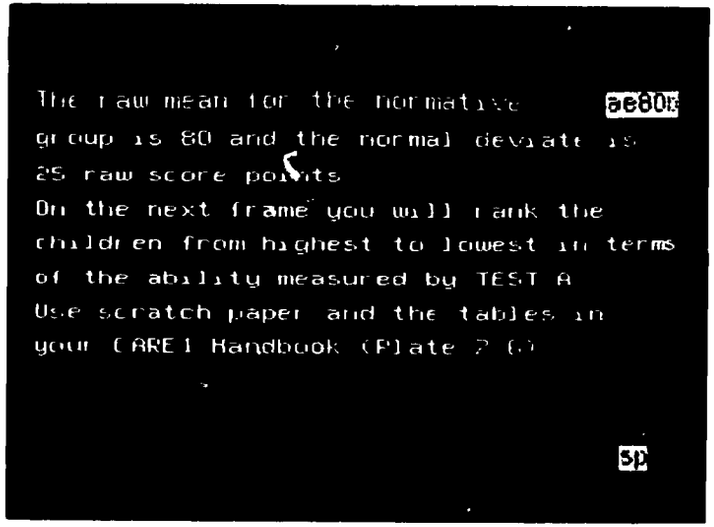
142-CRT



143-Image



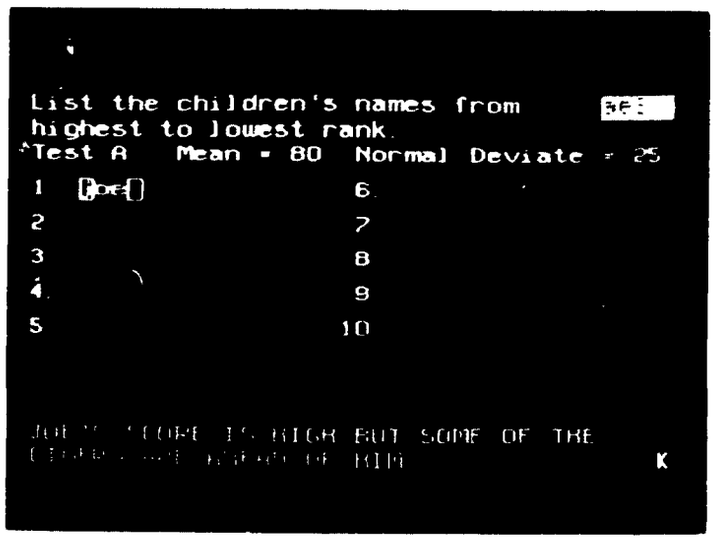
144-CRT



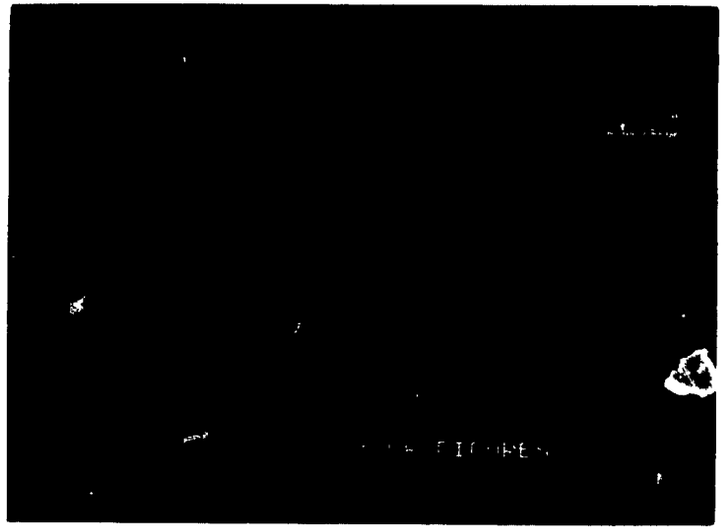
145-Comment

The student responded (146-CRT), received feedback, and is required to respond again. 146-CRT through 150-CRT show the student's attempts to solve the problems.

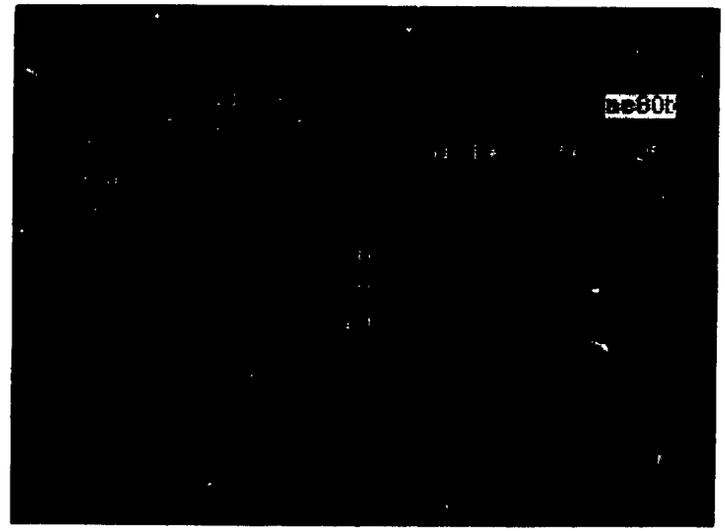
146-CRT



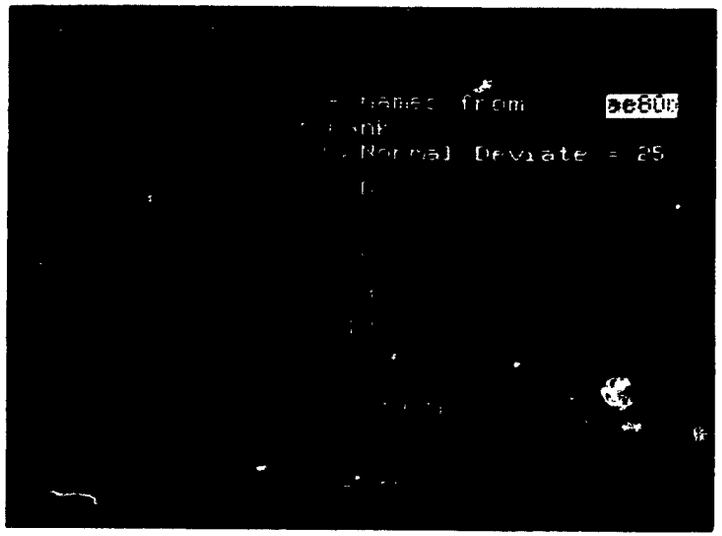
147-CRT



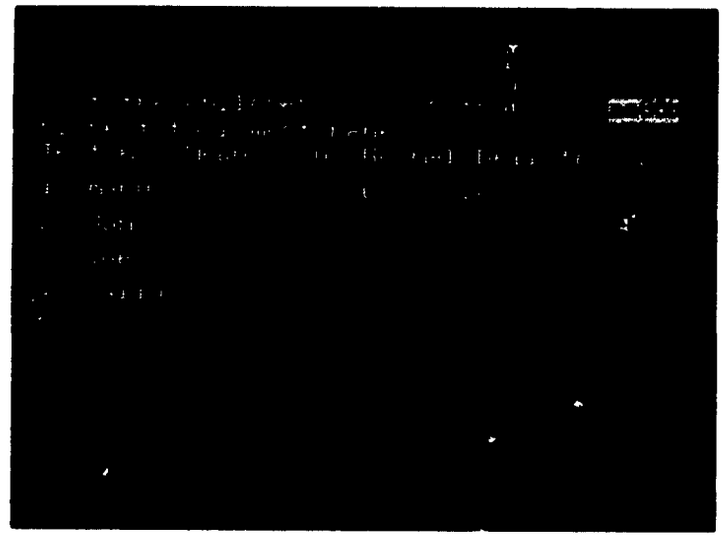
148-CRT



149-CRT



150-CRT



151-CRT

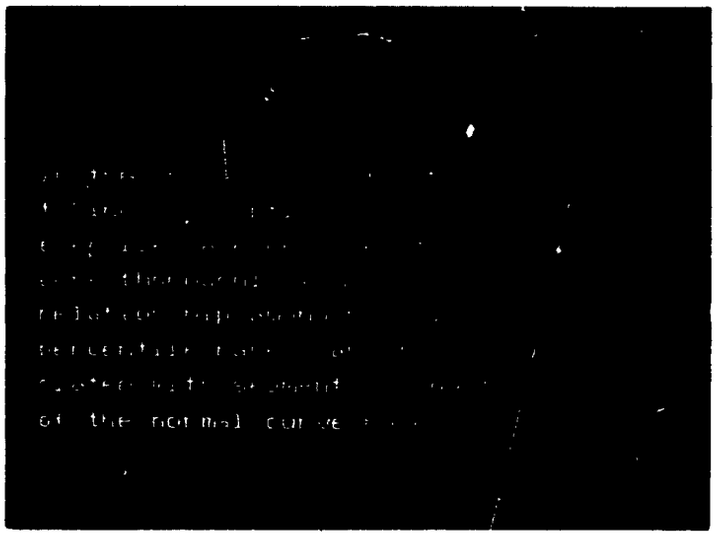


PLATE 7.6

Areas of Normal Curve

(1) Normal Deviate (σ)	(2) Area From Mean to σ	(3) Area In Larger Portion	(4) Area In Smaller Portion	(1) Normal Deviate (σ)	(2) Area From Mean to σ	(3) Area In Larger Portion	(4) Area In Smaller Portion
0.00	.0000	.5000	.5000	0.40	.1554	.1554	.3446
0.01	.0040	.5040	.4960	0.41	.1591	.6591	.3409
0.02	.0080	.5080	.4920	0.42	.1628	.6628	.3372
0.03	.0120	.5120	.4880	0.43	.1664	.6664	.3336
0.04	.0160	.5160	.4840	0.44	.1700	.6700	.3300
0.05	.0199	.5199	.4801	0.45	.1736	.6736	.3264
0.06	.0239	.5239	.4761	0.46	.1772	.6772	.3228
0.07	.0279	.5279	.4721	0.47	.1808	.6808	.3192
0.08	.0319	.5319	.4681	0.48	.1844	.6844	.3156
0.09	.0359	.5359	.4641	0.49	.1879	.6879	.3121
0.10	.0398	.5398	.4602	0.50	.1915	.6915	.3085
0.11	.0438	.5438	.4562	0.51	.1950	.6950	.3050
0.12	.0478	.5478	.4522	0.52	.1985	.6985	.3015
0.13	.0517	.5517	.4483	0.53	.2019	.7019	.2981
0.14	.0557	.5557	.4443	0.54	.2054	.7054	.2946
0.15	.0596	.5596	.4404	0.55	.2088	.7088	.2912
0.16	.0636	.5636	.4364	0.56	.2123	.7123	.2877
0.17	.0675	.5675	.4325	0.57	.2157	.7157	.2843
0.18	.0714	.5714	.4286	0.58	.2190	.7190	.2810
0.19	.0753	.5753	.4247	0.59	.2224	.7224	.2776
0.20	.0793	.5793	.4207	0.60	.2257	.7257	.2743
0.21	.0832	.5832	.4168	0.61	.2291	.7291	.2709
0.22	.0871	.5871	.4129	0.62	.2324	.7324	.2676
0.23	.0910	.5910	.4090	0.63	.2357	.7357	.2643
0.24	.0948	.5948	.4052	0.64	.2389	.7389	.2611
0.25	.0987	.5987	.4013	0.65	.2422	.7422	.2578
0.26	.1026	.6026	.3974	0.66	.2454	.7454	.2546
0.27	.1064	.6064	.3936	0.67	.2486	.7486	.2514
0.28	.1103	.6103	.3897	0.68	.2517	.7517	.2483
0.29	.1141	.6141	.3859	0.69	.2549	.7549	.2451
0.30	.1179	.6179	.3821	0.70	.2580	.7580	.2420
0.31	.1217	.6217	.3783	0.71	.2611	.7611	.2389
0.32	.1255	.6255	.3745	0.72	.2642	.7642	.2358
0.33	.1293	.6293	.3707	0.73	.2673	.7673	.2327
0.34	.1331	.6331	.3669	0.74	.2704	.7704	.2296
0.35	.1368	.6368	.3632	0.75	.2734	.7734	.2266
0.36	.1406	.6406	.3594	0.76	2764	7764	.2236
0.37	.1443	.6443	.3557	0.77	.2794	.7794	.2206
0.38	.1517	.6480	.3520	0.78	.2823	7823	.2177
0.39	.1517	.6517	.3483	0.79	.2852	7852	.2148

PLATE 7.6

Areas of Normal Curve

(1) Normal Deviate (σ)	(2) Area From Mean to σ	(3) Area In Larger Portion	(4) Area In Smaller Portion	(1) Normal Deviate (σ)	(2) Area From Mean to σ	(3) Area In Larger Portion	(4) Area In Smaller Portion
0.80	.2881	.7881	.2119	1.20	.3849	.8849	.1151
0.81	.2910	.7910	.2090	1.21	.3869	.8869	.1131
0.82	.2939	.7939	.2061	1.22	.3888	.8888	.1112
0.83	.2967	.7967	.2033	1.23	.3907	.8907	.1093
0.84	.2995	.7995	.2005	1.24	.3925	.8925	.1075
0.85	.3023	.8023	.1977	1.25	.3944	.8944	.1056
0.86	.3051	.8051	.1949	1.26	.3962	.8962	.1038
0.87	.3078	.8078	.1922	1.27	.3980	.8980	.1020
0.88	.3106	.8106	.1894	1.28	.3997	.8997	.1003
0.89	.3133	.8133	.1867	1.29	.4015	.9015	.0985
0.90	.3159	.8159	.1841	1.30	.4032	.9032	.0968
0.91	.3186	.8186	.1814	1.31	.4049	.9049	.0951
0.92	.3212	.8212	.1788	1.32	.4066	.9066	.0934
0.93	.3238	.8238	.1762	1.33	.4082	.9082	.0918
0.94	.3264	.8264	.1736	1.34	.4099	.9099	.0901
0.95	.3289	.8289	.1711	1.35	.4115	.9115	.0885
0.96	.3315	.8315	.1685	1.36	.4131	.9131	.0869
0.97	.3340	.8340	.1660	1.37	.4147	.9147	.0853
0.98	.3365	.8365	.1635	1.38	.4162	.9162	.0838
0.99	.3389	.8389	.1611	1.39	.4177	.9177	.0823
1.00	.3413	.8413	.1587	1.40	.4192	.9192	.0808
1.01	.3438	.8438	.1562	1.41	.4207	.9207	.0793
1.02	.3461	.8461	.1539	1.42	.4222	.9222	.0778
1.03	.3485	.8485	.1515	1.43	.4236	.9236	.0764
1.04	.3508	.8508	.1492	1.44	.4251	.9251	.0749
1.05	.3531	.8531	.1469	1.45	.4265	.9265	.0735
1.06	.3554	.8554	.1446	1.46	.4279	.9279	.0721
1.07	.3577	.8577	.1423	1.47	.4292	.9292	.0708
1.08	.3599	.8599	.1401	1.48	.4306	.9306	.0694
1.09	.3621	.8621	.1379	1.49	.4319	.9319	.0681
1.10	.3643	.8643	.1357	1.50	.4332	.9332	.0668
1.11	.3665	.8665	.1335	1.51	.4345	.9345	.0655
1.12	.3686	.8686	.1314	1.52	.4357	.9257	.0643
1.13	.3708	.8708	.1292	1.53	.4370	.9370	.0630
1.14	.3729	.8729	.1271	1.54	.4382	.9382	.0618
1.15	.3749	.8749	.1251	1.55	.4394	.9394	.0606
1.16	.3770	.8770	.1230	1.56	.4406	.9406	.0594
1.17	.3790	.8790	.1210	1.57	.4418	.9418	.0582
1.18	.3810	.8810	.1190	1.58	.4429	.9429	.0571
1.19	.3830	.8830	.1170	1.59	.4441	.9441	.0559

PLATE 7.6

Areas of Normal Curve

(1) Normal Deviate (σ)	(2) Area From Mean to σ	(3) Area In Larger Portion	(4) Area In Smaller Portion	(1) Normal Deviate (σ)	(2) Area From Mean to σ	(3) Area In Larger Portion	(4) Area In Smaller Portion
2.40	.4918	.9918	.0082	2 80	.4974	.9974	.0026
2.41	.4920	.9920	.0080	2.81	.4975	.9975	.0025
2.42	.4922	.9922	.0078	2.82	.4976	.9976	.0024
2.43	.4925	.9925	.0075	2.83	.4977	.9977	.0023
2.44	.4927	.9927	.0073	2 84	.4977	.9977	.0023
2.45	.4929	.9929	.0071	2.85	.4978	.9978	.0022
2.46	.4931	.9931	.0069	2.86	.4979	.9979	.0021
2.47	.4932	.9932	.0068	2.87	.4979	.9979	.0021
2.48	.4934	.9934	.0066	2.88	.4980	.9980	.0020
2.49	.4936	.9936	.0064	2.89	.4981	.9981	.0019
2.50	.4938	.9938	.0062	2.90	.4981	.9981	.0019
2.51	.4940	.9940	.0060	2.91	.4982	.9982	.0018
2.52	.4941	.9941	.0059	2.92	.4982	.9982	.0018
2.53	.4943	.9943	.0057	2.93	.4983	.9983	.0017
2.54	.4945	.9945	.0055	2.94	.4984	.9984	.0016
2.55	.4946	.9946	.0054	2.95	.4984	.9984	.0016
2.56	.4948	.9948	.0052	2.96	.4985	.9985	.0015
2.57	.4949	.9949	.0051	2.97	.4985	.9985	.0015
2.58	.4951	.9951	.0049	2.98	.4986	.9986	.0014
2.59	.4952	.9952	.0048	2.99	.4986	.9986	.0014
2.60	.4953	.9953	.0047	3.00	.4987	.9987	.0013
2.61	.4955	.9955	.0045				
2.62	.4956	.9956	.0044				
2.63	.4747	.9957	.0043				
2.64	.4959	.9959	.0041				
2.65	.4960	.9960	.0040				
2.66	.4961	.9961	.0039				
2.67	.4962	.9962	.0038				
2.68	.4963	.9963	.0037				
2.69	.4964	.9964	.0036				
2.70	.4965	.9965	.0035				
2.71	.4966	.9966	.0034				
2.72	.4967	.9967	.0033				
2.73	.4968	.9968	.0032				
2.74	.4969	.9969	.0031				
2.75	.4970	.9970	.0030				
2.76	.4971	.9971	.0029				
2.77	.4972	.9972	.0028				
2.78	.4973	.9973	.0027				
2.79	.4974	.9974	.0026				

PLATE 7.6

Areas of Normal Curve

(1) Normal Deviate (σ)	(2) Area From Mean to σ	(3) Area In Larger Portion	(4) Area In Smaller Portion	(1) Normal Deviate (σ)	(2) Area From Mean to σ	(3) Area In Larger Portion	(4) Area In Smaller Portion
1.60	.4452	.9452	.0548	2.00	.4772	.9772	.0228
1.61	.4463	.9463	.0537	2.01	.4778	.9778	.0222
1.62	.4474	.9474	.0526	2.02	.4783	.9783	.0217
1.63	.4484	.9484	.0516	2.03	.4788	.9788	.0212
1.64	.4495	.9495	.0505	2.04	.4793	.9793	.0207
1.65	.4505	.9505	.0495	2.05	.4798	.9798	.0202
1.66	.4515	.9515	.0485	2.06	.4803	.9803	.0197
1.67	.4525	.9525	.0475	2.07	.4808	.9808	.0192
1.68	.4535	.9535	.0465	2.08	.4812	.9812	.0188
1.69	.4545	.9545	.0455	2.09	4817	.9817	.0183
1.70	.4554	.9554	.0446	2.10	.4821	.9821	.0179
1.71	.4564	.9564	.0436	2.11	.4826	.9826	.0174
1.72	.4573	.9573	.0427	2.12	.4830	.9830	.0170
1.73	.4582	.9582	.0418	2.13	.4834	.9834	.0166
1.74	.4591	.9591	.0409	2.14	.4838	.9838	.0162
1.75	.4599	.9599	.0401	2.15	.4842	.9842	.0158
1.76	.4608	.9608	.0392	2.16	.4846	.9846	.1054
1.77	.4616	.9616	.0384	2.17	.4850	.9850	.0150
1.78	.4625	.9625	.0375	2.18	.4854	.9854	.0146
1.79	.4633	.9633	.0367	2.19	.4857	.9857	.0143
1.80	.4641	.9641	.0359	2.20	.4861	.9861	.0139
1.81	.4649	.9649	.0351	2.21	.4864	.9864	.0136
1.82	.4656	.9656	.0344	2.22	.4868	.9868	.0132
1.83	.4664	.9664	.0336	2.23	.4871	.9871	.0129
1.84	.4671	.9671	.0329	2.24	.4875	.9875	.0215
1.85	.4678	.9678	.0322	2.25	.4878	.9878	.0122
1.86	.4686	.9686	.0314	2.26	.4881	.9881	.0119
1.87	.4693	.9693	.0307	2.27	.4884	.9884	.0116
1.88	.4699	.9699	.0301	2.28	.4887	.9887	.0113
1.89	.4706	.9706	.0294	2.29	.4890	.9890	.0110
1.90	.4713	.9713	.0287	2.30	.4893	.9893	.0107
1.91	.4719	.9719	.0281	2.31	.4896	.9896	.0104
1.92	.4726	.9726	.0274	2.32	.4898	.9898	.0102
1.93	.4732	.9732	.0268	2.33	.4901	.9901	.0099
1.94	.4738	.9738	.0262	2.34	.4904	.9904	.0096
1.95	.4744	.9744	.0256	2.35	.4906	.9906	.0094
1.96	.4750	.9750	.0250	2.36	.4909	.9909	.0091
1.97	.4756	.9756	.0244	2.37	.4911	.9911	.0089
1.98	.4761	.9761	.0239	2.38	.4913	.9913	.0087
1.99	.4767	.9767	.0233	2.39	.4916	.9916	.0084

PLATE 7.7

Area T-Scores in Terms of Percentile Ranks

PERCENTILE RANK			
T-Score	Above Mean	Below Mean	T-Score
50.0	50.00	50.00	50.0
50.5	51.99	48.01	49.5
51.0	53.98	46.02	49.0
51.5	55.96	44.04	48.5
52.0	57.93	42.07	48.0
52.5	59.87	40.13	47.5
53.0	61.79	38.21	47.0
53.5	63.68	36.32	46.5
54.0	65.54	34.46	46.0
54.5	67.36	32.64	45.5
55.0	69.15	30.85	45.0
55.5	70.88	29.12	44.5
56.0	72.57	27.43	44.0
56.5	74.22	25.78	43.5
57.0	75.80	24.20	43.0
57.5	77.34	22.66	42.5
58.0	78.81	21.19	42.0
58.5	80.23	19.77	41.5
59.0	81.59	18.41	41.0
59.5	82.89	17.11	40.5
60.0	84.13	15.87	40.0
60.5	85.31	14.69	39.5
61.0	86.43	13.57	39.0
61.5	87.49	12.51	38.5
62.0	88.49	11.51	38.0
62.5	89.44	10.56	37.5
63.0	90.32	9.68	37.0
63.5	91.15	8.85	36.5
64.0	91.92	8.08	36.0
64.5	92.65	7.35	35.5
65.0	93.32	6.68	35.0
65.5	93.94	6.06	34.5
66.0	94.52	5.48	34.0
66.5	95.05	4.95	33.5
67.0	95.94	4.46	33.0

PERCENTILE RANK			
T-Score	Above Mean	Below Mean	T-Score
67.5	95.99	4.01	32.5
68.0	96.41	3.59	32.0
68.5	96.78	3.22	31.5
69.0	97.13	2.87	31.0
69.5	97.44	2 56	30.5
70.0	97.72	2.28	30 0
70.5	97.98	2.02	29.5
71.0	98.21	1.79	29.0
71.5	98.42	1.58	28.5
72.0	98.61	1.39	28.0
72.5	98.78	1.22	27.5
73.0	98.93	1.07	27.0
73.5	99.06	0.94	26.5
74.0	99.18	0.82	26.0
74.5	99.29	0.71	25.5
75.0	99.38	0.62	25.0
75.5	99.46	0.54	24.5
76.0	99.53	0.47	24 0
76.5	99 60	0.40	23.5
77.0	99.65	0.35	23.0
77.5	99.70	0.30	22 5
78.0	99 74	0.26	22.0
78.5	99.78	0.22	21.5
79.0	99.81	0.19	21.0
79.5	99.84	0.16	20.5
80.0	99.87	0.13	20.0