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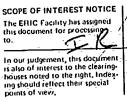ED 108 610   IR 002 122

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Three types of response boxes were tested. It was concluded that
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A study was conducted to measure the facility of kindergarten pupils in

taking an FYCSP Criterion Exercise on optically scannable sheets. Three

types of response boxes were tested. It was concluded that pupils are

able to handle a ten-item two-sided test with minimal practice and

directions.

PRELIMINARY TRYOUT OF OPTICALLY SCANNABLE FYCSP CRITERION EXERCISES

I. Introduction

Little attention has been paid to the ability of kindergarten children to use optically scannable response sheets in an instructional management setting. Pupils participating in the SWRL FYCSP presently use a one-sheet, four-page set of multiple choice items, selecting their answer by placing an "X" in the box under the appropriate answer. A machine readable Criterion Exercise is necessary to permit source data automation of an instructional management system.

Therefore, three response formats were designed for pre-IMS-installation tryout. The forms contained ten responses per side, three response choices per item, a picture for each numbered response, and a page number. Additional features included precoding of program name, unit number, and page number, as well as space for a binary pupil code. Thus, while the content is the same as the FYCSP Criterion Exercise, the three forms differ in appearance, the main difference being ten items per side versus five.

Two schools, a total of five kindergarten classes, in the Los Angeles City Schools, were selected for work in the tryout. While the purpose of the tryout was manifold, a basic intention was to determine if pupils below grade one can properly fill in a optically scannable Criterion Exercise form. Psychometric literature suggests that grade three is the minimal lowest grade level to introduce these

forms, but the IMS situation is sufficiently different that feasibility at the kindergarten level was felt to be an attainable objective.

II. Background and Related Literature

Gaffney and Maguire (1971) conclude that pupils in grades four and five can handle separate mark-sense response sheets when provided with specific directions and practice. Pupils above fifth grade were able to make valid responses regardless of type of instruction. Second and third grade pupils were unable to use separate answer sheets with success. All pupils involved, i.e., grades two through eight, were able to answer questions effectively when using a test booklet that was not machine scorable. Cashen and Ramseyer (1969) also tested pupil ability to use separate answer sheets in virtually the same manner as the above study. Results indicate that third grade pupils above average ability used the sheets effectively. McKee (1967), although presenting no empirical data, conclude that third grade pupils "seemed to" be able to use a separate answer sheet.

Culhane and Stodola (1967) administered opinion questions to pupils in grades one through eight and found that all were able to respond on mark-sense IBM cards, even though many of the marks were too light to be read by machine. The dependent variable in this study was the number of marks the machine could read in a designated field, while in the first two studies, correct responses on a parallel form test were the criterion. Hieronymous (1961), working with third graders, found no significant difference among three training methods. However, all pupils were able to use separate answer sheets effectively.

From these studies it was concluded that:

1. Separate answer sheets can be used on achievement tests with third grade pupils;

2. Training pupils on the use of separate sheets appears important, but no one method has been shown to be significantly more effective than others;

3. Mark-sense cards were used as early as first grade to gather data on an opinion questionnaire;

4. No work with kindergarten pupils on scannable answer sheets has been reported.

III. Statement of the Problem

It becomes obvious that the facility of kindergarten pupils in handling scannable response sheets is an empirical question. The problem to be resolved is presented in four parts:

1. Can kindergarten pupils respond to oral questions on a mark-sense Criterion Exercise?

2. How does form design affect pupil marking behavior?

3. What training materials and procedures elicit appropriate pupil response?

4. How effectively does the SWRL optical scanner read kindergarten pupil response sheets?

The problem of quality control on SWRL production of Criterion Exercises has been resolved by Gibbs and Hooper (TN 5-72-05). It was determined that Production Services could produce forms with print tolerances, paper stock specifications, and ink characteristics that would

meet requirements set forth by the Optical Scanning Corporation. What
remained to be answered was the question of grade level, forms design,
and training appropriate for development and use of machine readable
Criterion Exercises.

IV. Procedures

A. Materials

Criterion Exercises for FYCSP Unit 1 were generated. The tests
comprised one sheet, two sides, ten items per side, with a picture
as well as a number for each item to assist pupils in identifying
the proper response row. Three distractors per item were presented,
with a response box below each option. Pupils were instructed to
fill in the box under the correct response, making sure that the
mark was dark and shiny. (Regular FYCSP directions instruct
pupils to place an "X" in the appropriate box.) Three different
shapes of boxes were used: vertical, horizontal, and square. The
exercises were alike in all other aspects.

Characteristics of tryout materials and regular Criterion Exercises
are compared in Figure 1.

B. Population

Seventy-six pupils from five kindergarten classes in two schools
were involved. The age range was approximately four-and-one-half
years to six years. SWRL requested that all pupils involved be
using FYCSP. However, at least three classrooms were still

using the Instructional Concepts Program and had not begun the Communication Skills Program.

	FYCSP-regular	FYCSP-tryout (scannable)
#/sheets	1	1
size of sheet	11" x 17"	8½" x 11"
#/pages	4	2
#/items/page	5	10
paper stock	refined newsprint 40 pound book	60 pound offset white Mustang with Vellum finish
ink	black	black plus drop-out blue for marking boxes

Figure 1. Comparison of tryout materials with Criterion Exercises.

C. Data

Data comprised marks made by pupils on Criterion Exercise response sheets. Darkness of mark, direction of pencil stroke, multiple, missing, and crossed out responses, as well as stray marks were counted. Amount of test taking time and observations on teacher and pupil behavior were also recorded.

D. Analysis

Three types of analyses were conducted: 1) an examination of the manner in which response positions were marked. This included the pencil direction used to mark the response, the number of multiple marks, stray and missing marks, and changes in response choice; 2) an analysis of the Digitek DM 100 scanner's ability

to read the pupil marks entered in the response positions; and
3) notation of pupil and teacher behavior during test administra-
tion, plus SWRL observer reactions.

Tables 1-3 present an analysis of marks made on the Criterion
Exercises. The percentage figures for all measures other than
stray marks refer to item (Item N = 20 for all forms). Stray
marks are reported by average number per test sheet. For each
exercise sheet, there was approximately one stray mark, which
would be read by the scanner. Such marks must be erased by
clerical help before the exercises are read. The percentage of
total items that contained multiple marks ranged from 6.3 percent
for the square boxes to 3.1 percent for the vertical. Horizontal
marking boxes produced a total of 17 unmarked responses, or
3.4 percent of all items. The other two forms produced a much
lower percentage. The vertical box exercises showed a total of
16 response changes (indicated by crossing out the unwanted
response).

Table 4 presents a comparison of older (five years and above)
versus younger (below five years) pupils in the one class, using
the horizontal marking boxes. Younger pupils (under five years)
made more stray marks, multiple marks, mark changes, and left
more items unanswered.

Table 1. Analysis of pupil marks when vertical response boxes were used. Pupil N = 36.

DESCRIPTOR	N	%	$\bar{X}$ [a]
Stray Marks	76	-	1.06
Multiple Marks	22	3.1	-
No Mark	7	1.0	-
Mark Changed	16	2.2	

[a] Average per side

Table 2. Analysis of pupil marks when horizontal response boxes were used. Pupil N = 25.

DESCRIPTOR	N	%	$\bar{X}$ [a]
Stray Marks	61	-	1.02
Multiple Marks	24	4.8	-
No Mark	17	3.4	-
Mark Changed	3	0.6	-

Table 3. Analysis of pupil marks when square response boxes were used. Pupil N = 15.

DESCRIPTOR	N	%	$\bar{X}$ [a]
Stray Marks	5	-	.17
Multiple Marks	19	6.3	-
No Mark	2	.7	-
Mark Changed	1	.3	-

Table 4. Analysis of pupil marks when horizontal boxes were used (older versus younger pupils).

DESCRIPTOR	GROUP	N	%	$\bar{X}$ [a]
Stray Marks	Younger	43	-	1.95
	Older	18	-	0.64
	Total	61	-	1.02
Multiple Marks	Younger	19	8.6	-
	Older	5	1.7	-
	Total	24	4.8	-
No Mark	Younger	17	7.7	-
	Older	0	0.0	-
	Total	17	3.4	-
Mark Changed	Younger	3	1.3	-
	Older	0	0.0	-
	Total	3	0.6	-

An effort was made to determine how pupils filled in the response boxes. The teachers were instructed to tell their pupils to fill the boxes in completely, making sure that the marks were dark and shiny. They were not told the manner in which they were to make their mark. Table 5 shows the number of boxes filled in by marks judged to be vertical (V), horizontal (H), circular (C), or other (O). "Other" included combinations of the first three, basically. When presented with vertical boxes, pupils marked 93 percent of the response positions with vertical marks. Sixty-seven percent of the horizontal boxes were marked in a horizontal manner. When square boxes were used, 45 percent of the marks were vertical, three percent horizontal, and 39 percent termed "other."

Table 5. Pupil marking direction with three types of response boxes.

Shape of Response Box	Vertical				Horizontal				Square			
Marking Direction	V	H	C	O	V	H	C	O	V	H	C	O
Number	683	0	10	38	33	374	3	135	141	10	38	124
Percent	93	0	1	5	6	67	0	26	45	3	12	39

Response sheets possessing vertical boxes were read by the Digitek 100 DM scanner to determine: 1) whether pupils were able to mark in the appropriate positions, and 2) whether pupils were able to make marks dark enough to read by the machine. Nineteen errors were detected in reading 750 marks, an error rate of 2.5 percent. Fourteen of the errors were due to marks that were too light, leaving five, or 7/10 of one percent unexplained "misreadings" by the scanner. Since the horizontal and square response forms were not printed to tolerances required by the scanner, they were not considered in this part of the evaluation.

Observations recorded by SWRL observers are listed below.

. Pupils seemed happy to use pencils. For many of them it was the first time that they had used any writing instrument other than crayons in the classroom.

. By the third item the pupils started to mark the appropriate answer without specific instructions from the teacher. That is, once the appropriate cues were given they did not need to be told to fill in the box.

When the children were reminded after item three to make
their boxes dark and shiny many of them went back to items
one and two to make sure that the boxes they had filled in
were shiny. Repetition of instructions is helpful in
eliciting appropriate behaviors.

Some teachers felt that there are too many rows on the
test, but that with training the pupils could learn how
to take the Criterion Exercise. They agreed that a practice
exercise similar to the practice Criterion Exercise used
in FYCSP would be a great help in the test-taking process.

It was noticed that several of the pupils, especially the
younger ones, turned the page one-half turn so that they
could fill in the horizontal boxes by making vertical
marks. Also, several students curled their hands, so
that when they filled in the horizontal boxes they were
still making a vertical mark. More than one pupil was
noticed to outline the horizontal box before filling it in.

One teacher indicated that the marking quality of the pencils
was not consistent. A check showed that some pencils could
not make dark marks.

Testing time including directions and practice was approx-
imately 20 to 25 minutes.

VI. Conclusions

While the study was preliminary, several cautious conclusions can be drawn. The most important is the fact the Kindergarten pupils appear to be able to handle a ten item per page two-sided Criterion Exercise. Observation indicated that the m'''culty is that of identifying and maintaining the proper i... a which to make the response. With few exceptions, marks made by pupils were sufficiently dark and complete to be read by the optical scanner. The problem of light marks was traced in some cases to the quality of the lead in the primary pencils.

Multiple marks, i.e., two or more boxes per item filled in, cannot be interpreted for correct response by the machine, since all marks are read. While a human may be able to decide which response the pupil did intend as his correct answer and may be able to remove the inappropriate response by pre-processing, it is sometimes difficult or impossible to determine which response is intended. Assuming that the pupil intended to make only one choice, two possible reasons exist for multiple marks: 1) the pupil did not know how to cross out the incorrect response (It was noted in classroom observation that many pupils do not know how or were not able to mark a large X); or 2) the pupil did not know or remember that he had to cross out the incorrect response. Stray marks will always be a problem with scannable heets. The best resolution to this situation appears to be reminding the pupils not to make extraneous marks on the paper.

Missing responses may have two causes: 1) the pupil could not find the proper row on the page in which to fill in his answer; or the pupil did not know which answer to fill in after he had identified the row.

The direction in which pupils filled in the response boxes appears to be guided by the shape of the box. Over 90 percent of the marks in the vertical boxes were vertical and approximately two thirds of the horizontal boxes contained horizontal marks. It is interesting to note that 45 percent of the pupils filled in the square boxes with vertical marks, while only three percent of the pupils used a horizontal mark. It does appear, however, that pupils could be taught to use either horizontal marks or vertical marks that are dark and complete enough to be read by an optical scanner. Pupils used square boxes effectively, but the response area was so large that filling in the box became almost a coloring exercise. Smaller square boxes would seem more acceptable.

VII. Suggested Revisions

Th following suggestions should eliminate most of the problems encountered. 1) The initiation of a practice Criterion Exercise should familiarize pupils with the ten-item page and the necessity of filling in response positions completely with marks that are dark and shiny. 2) Teachers should check during the administration of the Criterion Exercises to make sure that pupils are on the right row and that marks are dark and complete. 3) To help correct the problem of

multiple marks teachers should demonstrate how to cross out a filled-in box and remind pupils once or twice during the administration of the Criterion Exercise to cross out any unwanted responses. A second possible alternative is that of issuing erasers to pupils. In one classroom observed, pupils used erasers with success. 4) Teachers should remind pupils not to make stray marks on the response sheets, and should check during the administering of the Criterion Exercise to make sure that pupils are marking response positions only.

VIII. Further Research

This study produced encouraging answers to the four questions addressed. However, the results must be termed preliminary. The following areas should be investigated in depth:

1. the effect of several forms design on pupil test taking behavior;

2. the development and refinement of training procedures that produce appropriate teacher and pupil response during assessment;

3. the cost for various types of Criterion Exercises, including the scannable booklet and test booklet/separate answer sheet format; and

4. the determination of grade levels at which various types of assessment devices may be introduced and used effectively.

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