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ABSTRACT

A study examined the efficacy of using various types of worksheets (representative of those typically used in instruction) that had been specifically designed to elicit differing achievement effects and to promote cognitive processing at the semantic level. Fifth grade students from five classrooms were divided into groups of high, middle, and low reading levels and were randomly assigned to one of three treatment groups, each based on worksheet type. The worksheet types were intended to reflect levels within various taxonomies of cognitive skills. Specifically, they were (1) those designed to elicit recall of factual information or details ("drill"): (2) those designed to promote application, analysis, synthesis, or evaluation of factual lesson material ("comprehension"): and (3) those requiring the student to locate and write main ideas appearing in the text ("structuring"). Following a week of instruction, the students were administered an achievement posttest. Results showed that high level readers in the drill and comprehension groups performed better on recall test items than did high level readers in the structuring group, high level readers in the drill group outperformed high level readers in the comprehension and structuring groups on comprehension items, and low level readers in the drill and comprehension groups performed better on recall items than did low level readers in the comprehension group. Overall, the findings for treatment were nonsignificant. (FL)

ACHIEVEMENT AS A FUNCTION OF WORKSHEET TYPE: APPLICATION OF A DEPTH OF PROCESSING MODEL OF MEMORY TO THE CLASSROOM

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Running Head: Classroom Application

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In recent years, a depth of processing model of memory has been proposed (Craik & Lockhart, 1972) and empiracally investigated (e.g., Hyde & Jenkins, 1973; Epstein, Johnson & Phillips, 1975). A basic assumption of the depth of processing model is that retention is a function of the degree or depth to which information is processed. It is further assumed that tasks requiring structural, phonemic, and semantic analysis result in deeper levels of processing, respectively. Hence, tasks which result in processing at the semantic level should also result in the greatest degree of retention.

A manner in which level of processing may be experimentally manipulated is via various question types. For example, a typical question designed to elicit processing at the structural level would be, "Is the word with which you are being presented written in capital letters?" A question designed to encourage processing at the phonemic level might ask, "Does the word rhyme with TRAIN?" Questions designed to promote processing at the semantic level necessitate knowledge of word meaning, e.g., "Is the word with which you are being presented the name of a type of animal?"

A large number of studies appear to support the depth or levels of processing model of memory (e.g., Hyde & Jenkins, 1969; Till & Jenkins, 1973; Walsh & Jenkins, 1973). Other studies have demonstrated the need to differentiate sublevels of processing within the semantic level of analysis (e.g., Craik & Tulving, 1975; Klein & Saltz, 1976; Schulman, 1974; Seamon & Murray, 1976).

Taxonomies of cognitive functions (e.g., Bloom et. al., 1956) suggest a hierarchical continuum of processes within the semantic level, ranging from the simple (viz., recognition of details) to the complex (viz., evaluation of information). Hence, tasks requiring application, analysis, synthesis, and/or evaluation of information would, presumably, result in greater retention of knowledge than tasks requiring recall or recognition of details. However, research regarding the hierarchical nature of various cognitive processes within the semantic domain has provided inconclusive results.

Although the depth of processing model has not been specifically examined for its relevance in the classroom, the model does have particular implications for classroom instruction. That is, classroom teachers provide various activities such as recitation, discussion, and seatwork to, presumably, encourage student processing of information at level which will facilitate knowledge acquisition and retention. Research findings reveal that seatwork is the category of classroom activity to which the greatest amount (an average of 50 percent) of pupil time is assigned (Good & Beckerman, 1978; McDonald, 1977). A particularly typical format for seatwork activities is the worksheet or ditto sheet (Redfield, 1979). There is, then, a need for educational research which centers on cognitive skill development in a typical seatwork format, e.g., the worksheet.

The purpose of this study was to examine the efficacy of using various types of worksheets specifically designed to elicit differing achievement effects. The worksheets were representative of those typically used in classroom instruction and were all designed to promote cognitive processing at the semantic level.

Methods

Students across five randomly selected fifth-grade classrooms were ranked on reading ability as measured by the reading subtest of the Comprehensive

Test of Basic Skills (CTBS). Subjects were then divided into equal thirds--high, middle, and low reading levels. Within each level, students were randomly assigned to one of three treatment groups.

The treatment was type of worksheet. Types of worksheets were designed to reflect levels within various taxonomies of cognitive skills. Types of worksheets were: (1) those designed to elicit recall or recognition of factual information or details, hereafter referred to as the "drill" treatment; (2) those designed to promote application, analysis, synthesis, or evaluation of factual lesson material, hereafter referred to as the "comprehension" treatment; and (3) those requiring the student to locate and write main ideas appearing in the text, hereafter referred to as the "structuring" treatment. The comprehension and structuring worksheets were designed to promote similar levels of cognitive processing. The cognitive processing required by the comprehension and structuring worksheets was hypothesized to be at a deeper level than that required by the drill worksheets.

Prior to the first day of the experiment, teachers of classes participating in the study were trained in experimental procedures by the experimenter. On each of three days during the week of the experiment, students were presented with an experimenter-prepared, teacher-read introduction to the day's lesson. Scripted lessons were used to facilitate equality of presentation across classrooms.

After presentation of the scripted introduction, students were asked to follow along in their textbook while the teacher read the designated textual material aloud. Teacher reading of the text was required to ensure that each student was exposed to the lesson material at least once despite a variation in student reading abilities.

Following teacher reading of each lesson, folders were distributed to the students. Treatment group assignment determined the type of worksheet contained

in each student's folder. Students were told they could refer to their textbooks to aid in worksheet completion.

To provide for consistency of teacher participation across classrooms, teachers were instructed to be available for assistance to individual pupils upon request, but were also instructed not to initiate any teacher-pupil interaction. Feedback to students consisted of returning their corrected worksheets on the school day following worksheet completion. All worksheets were experimenter corrected; incorrect answers were marked with a check (✓) to reflect the procedure normally used by the participating teachers. Students were directed to individually approach the teacher with any questions regarding their corrected worksheets. This instruction was used to avoid having different classrooms of children exposed to differing questions and possible ensuing discussions.

Time allowed for lesson presenatation and worksheet completion across all classrooms on each of the treatment days was 50 minutes. This amount of time proved sufficient for even the slowest workers to complete their worksheets. Those students who finished before 50 minutes had elapsed were instructed to silently read a library book or complete other unfinished class assignments.

Five controls, then, were implemented to allow for clear interpretation of the effects of the worksheets on achievement. These controls were provisions for: (1) consistency of lesson format via use of scripted lessons and teacher reading of the text, (2) consistency of teacher involvement by limiting teacher-initiated interaction with pupils during the time allotted for worksheet completion, (3) consistent time allotments for lesson completion across classrooms, (4) consistency of activities for students completing their worksheets before the end of the lesson period, and (5) consistency of feedback to students.

On the Monday directly following the week of the experiment, an experimenter-developed achievement test over the instructional material covered the previous week was administered. To investigate the issue of congruity between encoding

and retrieval processes (vide, Baddeley, 1978; Craik & Tulving, 1975; Morris, Bransford & Franks, 1977; Moscovitch & Craik, 1976), each student received four scores on the achievement posttest. These four scores were for the following categories, each containing ten items: (1) recall or recognition of nonincidental material (RN), (2) recall or recognition of incidental material (RI), (3) comprehension of nonincidental material (CN), and (4) comprehension of incidental material (CI). "Incidental," here, designated material covered by the textbook but not by the worksheets.

Results

The achievement test data obtained after three days of treatment were analyzed using a 3 (treatment group) x 3 (levels) x 4 (trials) analysis of variance for equal n's with repeated measures on the trials variable. Data were randomly deleted to obtain equal n's of ten per cell. Descriptive statistics for posttest achievement are presented in Table 1; a summary of the analysis of variance is presented in Table 2.

Significant main effects were found for reading levels ($F=21.08$; $df=2,81$; $p<.001$) and for trials ($F=80.98$; $df=3, 243$; $p<.001$). Tukey's HSD test (Kirk, 1968) was used to make pairwise post hoc comparisons of the significant findings.

Post hoc comparisons revealed that both high and middle level readers performed significantly better than low level readers across all trials and treatments ($p<.01$). The difference between high and middle level readers was significant for the CN trial only ($p<.05$). These results are depicted in Figure 1.

Post hoc comparisons also demonstrated that performance on the RN subscale was significantly higher than performance on the RI, CN, and CI subscales across all treatments and levels ($p<.01$). In addition, performance on the RI and CN subscales was significantly superior to performance on the CI subscale across all treatments and levels ($p<.01$). This consistent

finding with regard to scale performance, despite treatment or reading level (viz., RN > RI or CN > CI), is illustrated in Figures 2 and 3.

While the main effect for treatment was nonsignificant, additional examination of the raw data revealed some trends worthy of future study, particularly for high and low level readers. Differences among treatment groups for middle level readers appeared negligible.

High level readers in the drill and comprehension groups performed better on test items requiring recall or recognition than did high level readers in the structuring group. High level readers in the drill group outperformed high level readers in the comprehension and structuring groups on comprehension items.

Low level readers in the drill and structuring groups performed better on test items requiring recall or recognition than did low level readers in the comprehension group. On the comprehension items, treatment group differences among low level readers were relatively small. The mean scores for Recall/Recognition and Comprehension items by reading level and treatment group are presented in Table 3.

Discussion/Conclusions

Analysis of the data support four conclusions:

1. High and middle level readers outperformed low level readers on all subscale measures (RN, RI, CN, nad CI).
2. All groups of students, regardless of treatment or reading level, performed best on the RN subscale and least well on the CI subscale.
3. The finding for treatment was nonsignificant.
4. Examination of the raw data may suggest instructional considerations for high and low level readers.

The finding that high and middle level readers outperformed low level readers on all subscale measures was expected. It seemed reasonable to anticipate that better readers would outperform poorer readers on tasks requiring reading, e.g., completion of worksheets and test taking. Other researchers (e.g., McPeake, 1979; Meyer, 1977; Smiley et al., 1977) have obtained similar findings with regard to the relationship between ability and performance.

The finding that all groups of students, regardless of treatment or reading level, performed best on items requiring recall of information previously called for by the drill worksheets (i.e., the RN subscale) is not surprising from a theoretical standpoint. Of the items on the four subscales, items of the RN subscale were designed to tap the lowest taxonomical levels of cognitive processing. Therefore, worksheets designed to promote deeper sublevels of semantic processing (i.e., comprehension and structuring worksheets) should also have facilitated the recall of detailed information processed at lower levels (vide Meyer, 1977) by the structuring and comprehension treatment groups. However, item difficulty within achievement test subscales may have been a confounding factor. That is, regardless of treatment or reading level, the RN subscale may have contained the easiest test items.

The other significant finding for trials was that all students, regardless of treatment or reading level, performed significantly better on the RI and CN subscales than on the CI subscale. From a theoretical point of view, this finding was also to be expected. Items on the CI subscale called for comprehension of concepts not presented on even the comprehension worksheets. The only group that might have been expected to perform relatively well on the CI subscale was the structuring group. The structuring procedure may have, for some individuals, resulted in a higher sublevel of semantic processing than that called for by the comprehension worksheets. Again,

difficulty of test items may have been a confounding factor. The CN subscale may have contained the most difficult test items for all treatment groups within all reading levels.

Although scientific methodology does not allow for proving the null hypothesis, the nonsignificant finding for worksheet type does appear to support a depth of processing model of memory. All worksheets used in this study consisted of questions requiring semantic processing. Results, therefore, suggest tnat if students process information requiring semantic analysis of any kind, the nature of the task is irrelevant to ultimate achievement. In other words, type of worksheet does not seem to differentially affect student achievement providing the worksheet questions require processing within the semantic level. Thus, teachers may select the type of worksheet which best fits the instructional needs of given students without concern for differential achievement effects.

Examination of the raw data suggests that the instructional needs of students, particularly high and low level readers, may be influenced by reading ability. That is, for high level readers, drill-type tasks may be the most efficient for producing both recall/recognition and comprehension of textual material. Findings from classroom research studies (e.g., Fisher, et al., 1978; Rosenshine and Berliner, 1978) have demonstrated a positive correlation between time spent on-task and achievement. In this study, high level readers may have spent time on-task most efficiently while engaged in drill activities. This time on-task issue is further examined by Redfield and Roenker (1981).

While drill-type activities appear to result in the greatest recall/recognition of textual material for low level readers, none of the tasks

appear to particularly facilitate content comprehension. Smiley et al. (1977) contend that poor readers have difficulty with all types of activities requiring comprehension. Hence, if a student does not easily comprehend, tasks requiring comprehension or relatively high sublevels of processing (viz., comprehension worksheets) will not prove beneficial.

In summary, results of this study suggest that student achievement is not differentially affected by performing tasks designed to tap various sublevels of cognition if those tasks are designed to promote processing at the semantic level. Results additionally demonstrate a positive relationship between reading ability and achievement. Future research is required to examine the trends witnessed by the descriptive statistics for high and low level readers. Finally, if item difficulty on the achievement measure was not a confounding factor, then results indicate that student achievement, regardless of reading level or orienting task (i.e., type of worksheet), is greatest on RN measures and poorest on CN measures.

TABLE 1. Posttest achievement--means and standard deviations for RN, RI, CN, and CI subscales

	RN		RI		CN		CI	
roup x Level	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
: High	8.2	1.25	6.2	1.78	6.4	1.74	5.0	1.79
: Middle	7.0	1.10	6.5	.92	5.2	1.33	4.3	1.42
: Low	6.3	1.73	5.1	2.02	4.7	1.62	2.5	1.20
ension x High	8.6	1.50	6.8	1.33	6.1	.83	4.2	2.36
ension x Middle	7.5	1.57	6.1	1.22	5.5	1.43	3.6	1.96
ension x Low	5.4	1.74	4.0	1.34	4.7	1.10	2.7	1.95
ring x High	7.4	2.06	5.4	1.69	6.6	1.62	3.9	1.64
ring x Middle	7.7	1.90	5.5	1.86	5.8	1.33	3.8	1.17
ring x Low	5.1	1.58	5.2	1.99	4.8	1.72	2.8	1.08

TABLE 2. Posttest achievement--summary of analysis of variance

Source	df	MS	F	P
Between Groups				
Treatment	2	2.48	.51	n.s.
Levels	2	101.80	21.08	<.001
Treatment x Levels	4	2.32	.48	n.s.
Error	81	4.83		
Within Group				
Trials	3	173.29	80.98	<.001
Groups x Trials	6	1.53	.71	n.s.
Levels x Trials	6	2.54	1.19	n.s.
Groups x Levels	12	2.58	1.21	n.s.
Error	243	2.14		

TABLE 3. Posttest achievement -- mean scores for recall/recognition and comprehension items

Level by Group	Recall/Recognition	Comprehension
High by Drill	14.1	11.4
High by Comprehension	15.4	10.3
High by Structuring	12.8	10.5
Middle by Drill	13.5	9.5
Middle by Comprehension	12.6	9.1
Middle by Structuring	13.2	9.6
Low by Drill	11.4	7.2
Low by Comprehension	9.4	7.4
Low by Structuring	10.3	7.6

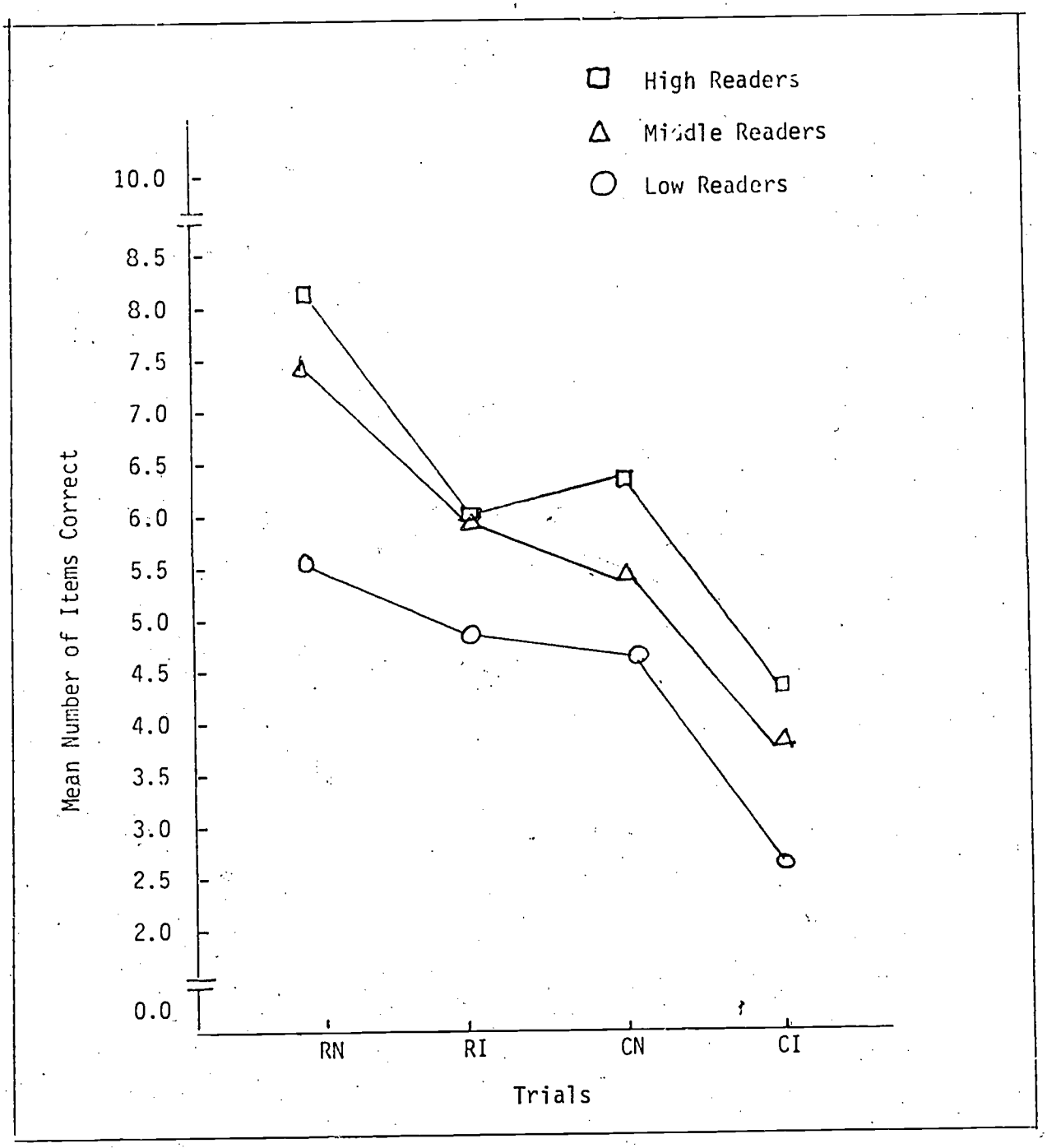

FIGURE 1. Posttest means for reading levels by trials

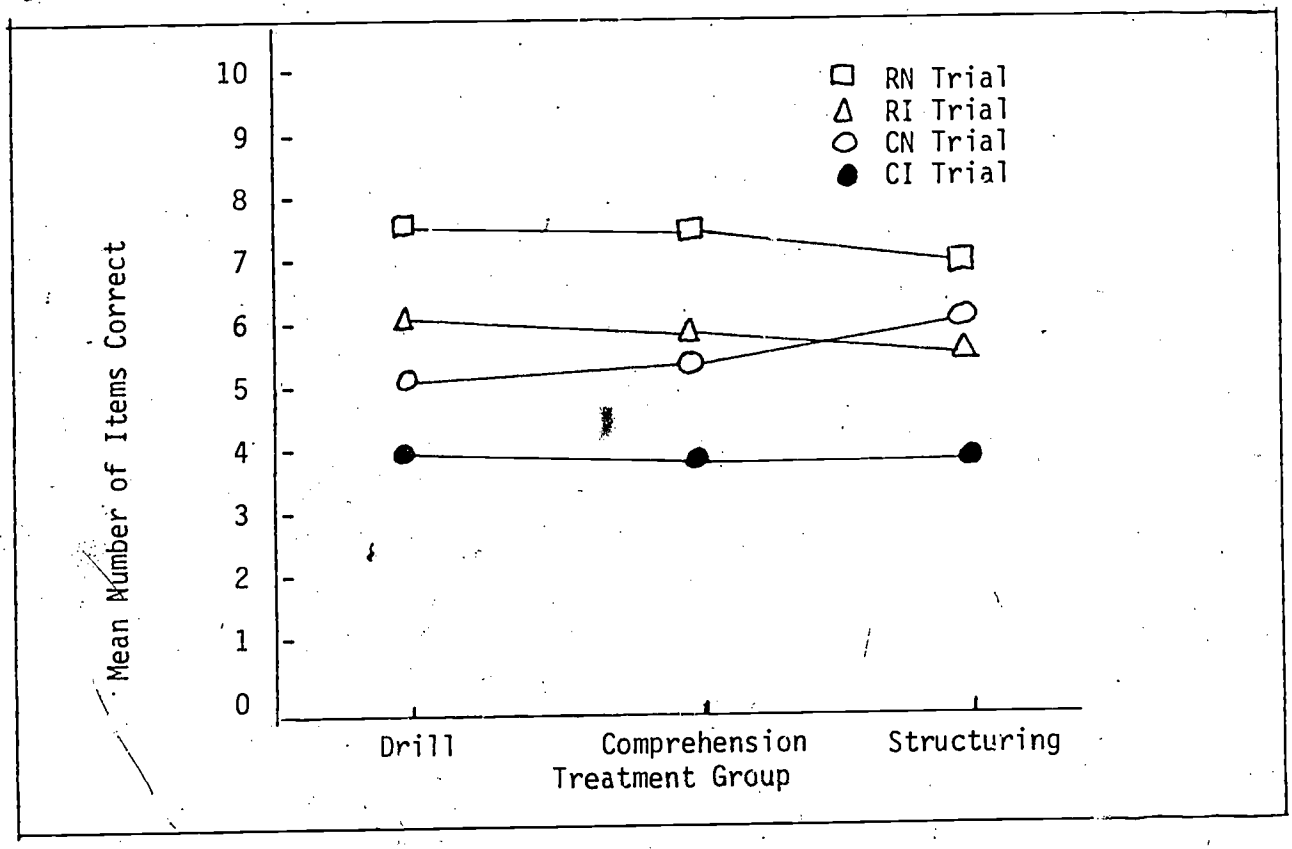

FIGURE 2. Posttest means for trial performances by treatment group

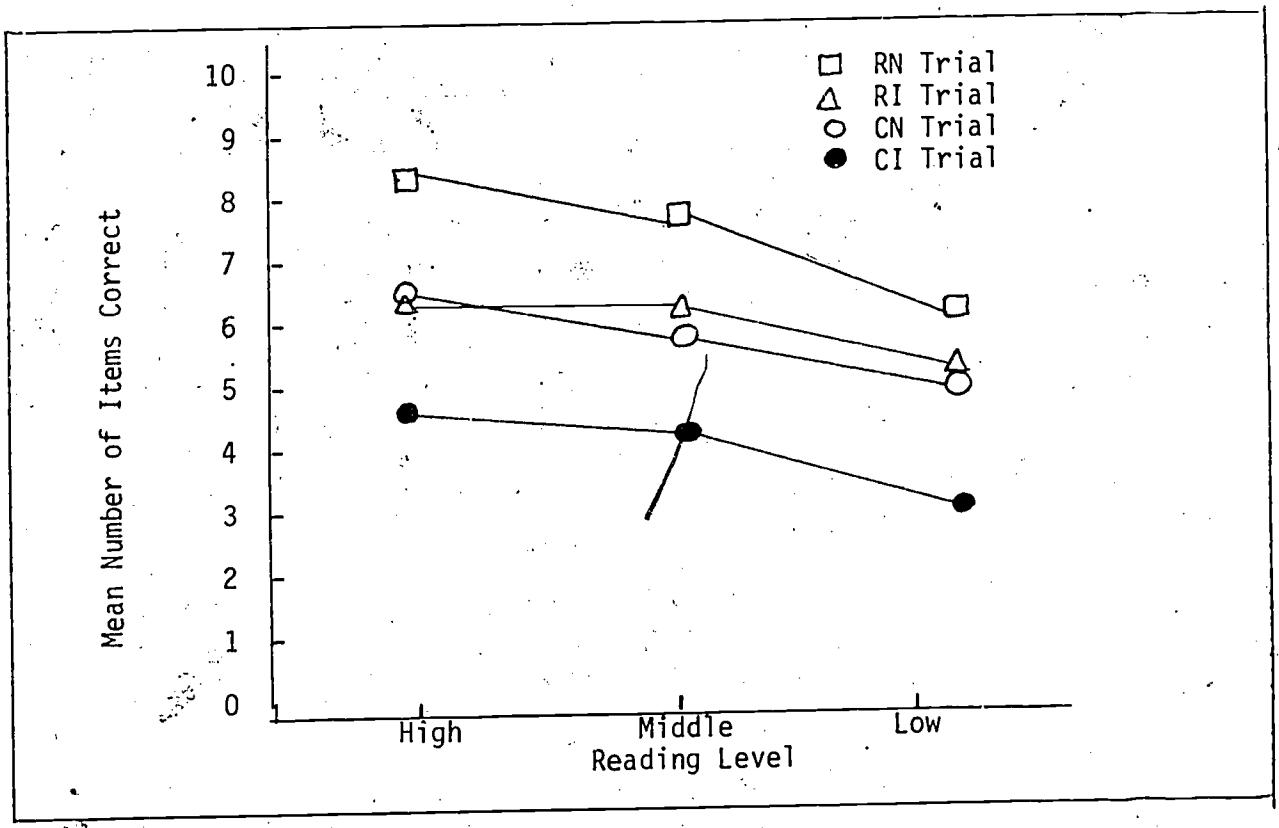

FIGURE 3. Posttest means for trial performances by reading level

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