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ABSTRACT

The purpose of this study was to determine if verbalizing while attempting to seek the solution to a typical reading comprehension question would enhance pupil performance on a standardized measure of reading comprehension. Sixty-one seventh graders from an urban public school were selected as subjects; fifty-one were randomly assigned to eight treatment groups and ten were assigned to a control group. All subjects were administered Form 1M, Level E of the Gates-MacGinitie Reading Test as a pretest measure. The treatment conditions were: (1) like materials with reinforcing comments and daily practice for five consecutive days, (2) like materials with reinforcing comments and only one practice, (3) like materials with non-reinforcement and daily practice, (4) like materials with non-reinforcement and one practice, (5) unlike materials with reinforcing comments and daily practice, (6) unlike materials with reinforcing comments and only one practice, (7) unlike materials with non-reinforcement and daily practice, and (8) unlike materials with non-reinforcement and only one practice. The results substantiated the use of verbalizing or thinking aloud techniques as an instructional procedure in the classroom, and practice efforts should be reinforced by comments from the teacher. (WR)

Verbal Coding as an Instructional Strategy in Improving Pupil Performance on Standardized Measures of Reading Comprehension

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Verbal Coding as an Instructional Strategy in Improving Pupil Performance on Standardized Measures of Reading Comprehension*

Recent writers in education (Finder, 1969; Simons, 1971) have mentioned the importance of distinguishing between the product and process involved in reading comprehension. The psychological processes used in reading comprehension are covert mental acts and hence not amenable to direct observation. On the other hand, product operations are observations made about a subject's behavior once the process has occurred. Thus, research efforts regarding the processes of reading comprehension have been of a post hoc nature. That is, subjects are directed to read passages and then answer various questions about them. From the responses received the investigator then makes inferences with respect to the psychological processes the subjects might have used.

Simons cites and evaluates seven methodolical approaches that have been used by researchers to shed light on both the products and processes of reading comprehension. These include: listing of skills, measurement of pupil performance on standardized tests, factor analysis techniques, correlational studies, readability research, study of readers' introspective reports, construction of psychological models, and psycholinguistic research. With the exception of psycholinguistic research efforts which look at surface and deep structure in passages, Simons contends that very little knowledge is

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available to explain the psychological processes utilized in reading comprehension. This "sad state of the art" is particularly perplexing to classroom teachers, especially those teaching beyond the primary grades. Reading instruction beyond word recognition stages, has typically stressed the importance of acquiring reading comprehension skills. Practice material in workbooks and basal readers are used by teachers and pupils that present reading comprehension skills in a sequential and ordered format. Pupils practice with these materials in order to learn the skills of reading comprehension. Teachers frequently complain that the materials designed to accommodate growth in comprehension skills are ineffective, i.e., pupils seem unable to transfer the learning that presumably occurred from the practice exercises to other content or skill areas. This difficulty is further complicated by the myriad of standardized tests that are available to delineate pupil strengths and weaknesses in reading comprehensions.

Of the previous research methods mentioned, the introspective or thinking aloud technique, on the surface, appears to be amenable to direct classroom practice to provide pupils with an instructional strategy for improving reading comprehension. In introspective studies, subjects are asked to verbalize about how they answered particular comprehension questions. For example, Smith (1967) used an introspective technique with eighth grade subjects to obtain data on the success of subjects ability to answer comprehension questions. She also attempted to gather data to describe the processes used by the subjects in reading for specific purposes. She found that good readers differed significantly from poor readers in their ability to read for details and general impressions, make adjustments to specific purposes for reading, and hold in mind longer their purposes for reading.

Introspective or verbalizing techniques employed in reading comprehension research are highly similar to verbal coding research efforts in defining human problem solving. One could also make the case that the inferred psychological processes involved in reading comprehension, as defined thus far by investigators, seem highly similar to the processes defined as taking place during problem solving activities. Writers in cognitive psychology have devoted considerable time and energy in defining and describing the hypothetical processes involved in human problem solving. The research literature is replete with models that describe human thinking and strategies or rules governing problem solving activities. (de Groot, 1961), (Gagne', 1964), (Johnson, 1964), (Newell, Shaw, and Simon, 1958), and (Simon and Newell, 1970).

Most researchers have described problem solving processes as proceeding through various distinct but overlapping stages. For example, an individual 1) initially perceives a statement of a problem; i.e., a situation is recognized as having "problem-like" properties, 2) defines a problem by distinguishing unique or essential features, 3) searches for, either systematically or randomly, and formulates hypotheses for the solution to the problem, and 4) attempts to verify the solution to the problem. In addition to the above stages, D'Zurilla and Goldfried (1968), insist that a predisposition or an orientation must exist as a set or attitude, within an individual to facilitate problem solving activities. Such a predisposition may be an internal or mediational tendency on the part of an individual to be aware of problem situations. In addition, individuals will need a set of cognitive operations or strategies for solving problems. Consequently, the individual is able to recognize and accept problematic conditions when they occur and react either impulsively

or passively in the face of the problem situations.

Typically, the delineation of stages or strategies for problem solving have been the product of research efforts where subjects have been observed solving algebra word problems, playing chess or differentiating among geometric patterns. The experimental situations were designed to determine the subjects reactions to unique or novel situations.

Two differing methodological techniques have been experimentally utilized by writers to gain insight into how subjects arrive at solutions to problems. Paige and Simon (1966), after analyzing human behavior data, refined a computer program as a research tool to simulate human information processing strategies. The computer program, STUDENT, was capable of solving algebra word problems and, as such, attempted to simulate processes that subjects conceivably used with the same algebra word problems. de Groot (1965) used introspective experimentation, namely verbalizing, to describe cognitive strategies subjects used in various problem solving settings. Subjects were directed to think aloud in 1) traditional problem solving situations, 2) by reproducing chess positions, and 3) by providing definitions of known concepts. Johnson (1964) utilized the thinking-aloud procedure in analyzing protocols from subjects who were asked to hypothesize concerning properties which differentiated one set of patterns from another. The analysis of the verbal transcripts yielded an information-processing model judged to be successful in the simulation of problem solving behavior of subjects on a variety of problems.

Writers have rigorously defended the use of the verbal coding technique as a viable experimental technique for collecting problem solving data. Its primary purpose is to provide the researcher with information about the cognitive processes the subject uses while solving a problem. de Groot (1965,

p. 21) contends that such experimental procedures yield data that conceivably are a linear sequence of operations that are actively carried out by the subject according to a system of linkings governed by laws. The analysis of such data then, should yield a classification of human mental operations to cover every method, trick (sic), heuristic that may be conceived of as problem solving.

The purpose of the present study was to determine if verbalizing, while attempting to seek the solution to a typical reading comprehension question, would enhance pupil performance on a later standardized measure of reading comprehension. The pupils were provided with an audio-taped message that demonstrated how to solve a particular problem. The examiner on the taped message read the stimulus passage and then proceeded to read the comprehension questions. Each of the foils was read and the examiner, referring to the previously read passage, would state reasons as to why each foil could be correct or incorrect. The subjects were told to model the taped message. Each set of comprehension questions was preceeded with taped instructions. The subjects were also provided an opportunity to practice modeling the examiner prior to attempting the items in the experiment. All subjects in the study practiced verbalizing and audio taped protocols were secured from each subject. Subjects were randomly assigned to practice groups to determine the effects of varying the amount of practice time, use of differing stimulus materials, and reinforcing comments on the part of the examiner,

METHOD

SUBJECTS

61 seventh grade pupils from an urban public school were selected for

the study. In order to minimize reading problems it was decided to include only pupils with average scores on a standardized measure of reading comprehension in the study. Therefore, pupils with grade equivalent scores of 7.0 or greater on the sub tests of vocabulary and reading comprehension on the Form 1M, Level D Gates-MacGinitie Reading Test, administered in the fall 1971, were included. 51 pupils were randomly assigned to eight treatment groups and 10 pupils were assigned to a control group.

PROCEDURES

All subjects were administered Form 1M, Level E of the Gates-MacGinitie Reading Test as a pre test measure. This measure was later used as a covariate in the analysis of the data to determine mean performance differences. The treatment subjects were then randomly assigned to eight practice groups, where the three treatments, previously described, were presented in differing orders.

Each treatment subject then met individually with the examiner and practiced with audio-taped instructions describing the experiment. The instructions were utilized to demonstrate how to verbalize and the subjects were asked to "think out loud" when answering the comprehension questions. Subjects were directed to model the examiner. After reviewing the directions, the subjects were allowed to practice reading a sample item before proceeding with the treatment. If errors occurred the examiner corrected the subject before proceeding. Each item, printed with primary type on a separate page, was presented individually in a loose leaf binder. Subjects were directed to read the stimulus passage and then answer the questions presented on the lower portion of the page.

The 10 Ss of the control group completed the pre and post test sessions with the treatment group Ss. They received no instruction in verbalizing.

FIGURE 1

Treatment Procedures Utilized in Verbal Coding Study

Group	N	Pre test	Treatment Order			Post test
1	5	Gates-MacGinitie Reading Test, Form 1M, Level E	L[a]	R[b]	D[c]	Gates-MacGinitie Reading Test, Form 2M, Level E
2	7		L	R	O[d]	
3	6		L	NR[e]	D	
4	6		L	NR	O	
5	8		UL[f]	R	D	
6	6		UL	R	O	
7	7		UL	NR	D	
8	6		UL	NR	O	
Total	51	All groups				All groups

[a] Like materials
[b] Reinforcing comments
[c] Daily practice (five consecutive days)
[d] One practice (in five day experimental period)
[e] Non reinforcement (no comment from examiner)
[f] Unlike materials

The treatments shown in Figure 1 were as follows:

1) Stimulus materials used in the study.

Subjects in groups 1 through 4 were instructed to verbalize using like stimulus materials (L). These consisted of representative items chosen from the Gates-MacGinitie Reading Test, Form 2M, Level E. The test yields four separate scores, Speed, Accuracy (both scores from the same sub test), Vocabulary, and Comprehension. Subjects in groups 5 through 8 verbalized with materials that differed in both content

and format from the Gates-MacGinitie items. These items were constructed and used in a previous study (Schreiner, 1968) and were defined: 1) verbal reasoning, 2) cause and effect, 3) locating the main idea of a paragraph, and 4) speed of noting details. The unlike items are labelled UL in Figure 1. Each subject practiced verbalizing with one sample item of each type before the responses were tape recorded. Three items of each type were presented in each practice session.

2) Reinforcing comments from the examiner:

Subjects in groups 1, 2, 5 and 6 were told by the examiner after verbalizing each item that the answer chosen was correct and the procedure used was satisfactory. If the subject chose an incorrect response, the examiner directed the subject, in a reassuring manner, to the correct answer. The groups receiving reinforcing comments are labelled R in Figure 1.

Subjects in groups 3, 4, 7 and 8 received no reinforcement or feedback from the examiner. Subjects received instruction on the verbalizing technique and the examiner, except for directing the subject to the next item, remained mute. The non-reinforcing treatment is labelled NR in Figure 1.

3) Amount of practice time provided for verbal coding:

Subjects in groups 1, 3, 5 and 7 practiced verbalizing with the stimulus materials for thirty minutes a day for five consecutive days. Subjects in all groups met individually with the examiner; protocols were obtained for all subjects

on audio-tape. The subjects who practiced daily are labelled D in Figure 1.

Subjects in groups 2, 4, 6, and 8 practiced verbalizing with the stimulus materials once during the experimental period. Practices in these groups were staggered throughout the experimental period so that an equal number of subjects practiced on day one through day five. The groups receiving one practice verbalizing are labelled O in Figure 1.

ANALYSIS OF THE DATA

A one-way analysis of covariance to determine the extent of treatment effects, was performed on each of the adjusted mean scores for the four separate sub tests of Form 3M, Level E of the Gates-MacGinitie Reading Test. The adjusted mean scores of eight treatment groups and the control group were included in these analyses. Dunnett's t statistic (Winer, 1962, p. 89) was used to compare each treatment with the control condition to determine significant mean differences. Finally, a three-way analysis of covariance was performed on each of the adjusted mean scores for the four separate sub tests achieved by the eight treatment groups. The experimental variables of interest in this study were: 1) like materials vs. unlike materials, 2) five daily practices vs. one practice session, and 3) reinforcement vs. non-reinforcement. The covariate in each analysis was the mean score of each of the four sub tests of Form 1M, Level E of the Gates-MacGinitie Reading Test which served as a pre test measure.

RESULTS

F-ratios generated by the one-way analysis of covariance failed to reveal significant treatment effects favoring the verbalizing groups over

the control group on the sub tests of speed, accuracy, and vocabulary. However, a treatment effect difference ($F = 1.94$, df; 8/61, $p < .07$) was observed on the separate sub test of reading comprehension.

(Insert Table 1 here)

Relevant pre test, unadjusted post test, and adjusted post test means are presented in Table 1. The post test data were used in determining significant differences between treatment and control conditions. 32 separate calculations were made using Dunnett's t statistics, as a posteriori test. None of the differences observed approached statistical significance. ($p. < .05$) It should be noted, however, that the use of Dunnett's t statistic imposes a penalty when obtaining the approximate error term in the denominator of the equation for calculating significant mean differences. Hence, while none of the differences was statistically different, an examination of Table 1 reveals that 24 of 32 unadjusted post test scores obtained by the treatment groups were equal to or greater than similar scores achieved by those members of the control group. In addition, among those Ss that verbalized, 23 or 28 unadjusted post test mean scores were greater than the mean pre test measures on the same sub tests. These results would appear to lend support to the notion that verbalizing appears to be an appropriate instructional technique for producing higher scores on a standardized measure of reading comprehension.

TABLE 1

Pre test*, Unadjusted Post test, and Adjusted Post test Means for Eight Treatment Groups and the Control Group on Sub tests: Speed, Accuracy, Vocabulary, and Comprehension

Group		Speed			Accuracy			Vocabulary			Comprehension		
	N	Pre	Post^{u}	Post^{a}	Pre	Post^{u}	Post^{a}	Pre	Post^{u}	Post^{a}	Pre	Post^{u}	Post^{a}
1	5	15.60	16.20	13.81	14.80	15.80	13.35	30.20	29.00	25.24	43.60	41.40	36.79
2	7	11.43	12.14	13.87	11.00	12.14	13.70	23.14	24.57	26.24	35.14	32.57	36.29
3	6	11.50	12.50	14.16	11.17	12.17	13.55	24.00	25.83	26.84	37.00	37.83	39.72
4	6	11.50	15.17	14.85	13.00	14.50	13.95	25.67	29.50	29.23	43.33	37.67	33.32
5	8	14.50	17.38	16.07	13.25	15.75	14.93	26.50	27.62	26.71	39.88	37.50	36.59
6	6	15.00	15.00	13.20	14.17	14.83	13.05	26.83	26.17	25.00	39.17	39.00	38.76
7	7	12.71	14.57	15.03	11.71	13.14	13.94	23.43	24.71	26.16	36.71	35.71	37.88
8	6	12.17	15.00	15.99	11.50	14.33	15.36	24.67	26.50	27.00	40.17	31.50	30.28
Control	10	12.80	14.10	14.48	12.30	13.40	13.59	24.80	25.70	26.09	37.60	35.00	36.30
Total	61												

* covariates

^{u} unadjusted Post test $\bar{X}$) Criterion measures

^{a} adjusted Post test $\bar{X}$)

TABLE 2

Three-Way Analysis of Covariance Using Adjusted Mean Scores Between Eight Treatment Groups on Comprehension Sub Test

Source	df	SS	MS	F	p-value
Practice	1	118.88	118.88	3.95	.05
Reinforcement	1	40.49	40.49	1.34	.25
Practice x Reinforcement	1	173.57	173.57	5.76	.02
Materials	1	5.41	5.41	.18	.67
Practice x Materials	1	1.65	1.65	.06	.82
Reinforcement x Materials	1	39.24	39.24	1.30	.26
Reinforcement x Practice x Materials	1	11.12	11.12	.37	.55
Adjusted Error	42	1264.54	30.11		

F-ratios generated by the three-way analysis of covariance between treatment groups failed to reveal significant main effect or interaction effect differences on the adjusted mean scores on the sub tests of speed, accuracy, and vocabulary. However, significant main effect differences ($p < .05$) were found when comparing mean post test differences in favor of those groups that received daily practice. A significant practice x reinforcement interaction effect ($p < .02$) were also observed. The results of the three-way analysis of covariance between the adjusted means for the eight treatment groups are shown in Table 2.

FIGURE 2

Practice x Reinforcement Interaction Effects

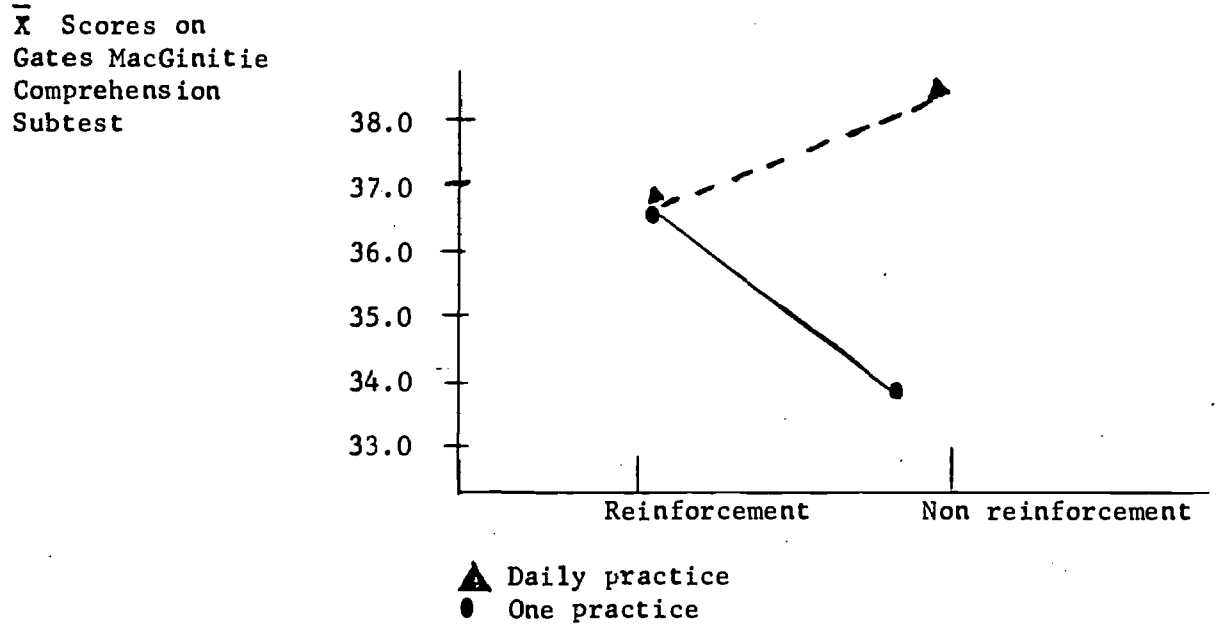

Figure 2 graphically represents the practice x reinforcement interaction effect observed from the three-way analysis of covariance performed on adjusted mean scores on the comprehension sub test. It was concluded that reinforcing comments from the examiner to the Ss appeared to facilate approximately equal scores despite the amount of practice times involved. ($\bar{X}$ = 36.8, daily practice vs. 36.7, one practice) However, non-reinforcement on the part of the examiner appeared to have a deleterious effect on the scores of those Ss who received but one practice session. On the other hand, daily practice, despite reinforcing or non-reinforcing comments resulted in significantly higher mean post test scores on the reading comprehension sub-test.

A further examination of Table 1 revealed that 7 of the 8 treatment groups had lower mean post test scores than pre-test scores on the sub-test

of comprehension. One possible explanation of this result may be related to the format of the comprehension sub test. Comprehension was measured on this sub-test, using a modified cloze procedure. Subjects were required to read sentences in paragraphs with selected words deleted. From five alternative words presented below the text, the subjects were to choose the appropriate response. The subjects completed the remainder of the passage in this manner. Since time limits were a factor on the test, Ss who took time to verbalize may have been undully penalized for their intervening efforts.

DISCUSSION

The results of this study would appear to substantiate the use of verbalizing or thinking aloud techniques as an instructional procedure in the classroom. Additionally, the results indicate that several practice sessions in verbalizing would be necessary to enhance growth in comprehension performance. Finally, the practice efforts should be accompanied by reinforcing or reassuring comments on the part of the teacher.

It should be noted that the increased scores on the measures of speed, accuracy, and vocabulary by members of the treatment groups could be related to experimental conditions. Perhaps the pupils had a clearly understood purpose or set for reading the stimulus materials. Consequently, the pupils would more readily analyze the content of the written passages. For example, subjects tended to substitute synonyms found in the question portion of the test for words they recalled from the passages. Thus, they appeared to look for similar words before deciding that a response was correct. It would appear that verbalizing may cause readers to be analytic

in identifying syntactic relationships among words and phrases in printed passages. This condition would tend to explain the lower post test scores for the treatment subjects on the sub test of comprehension when Ss read connected discourse from which words were deleted.

It is shown in Table 2 that no significant main effect or interaction effect differences were found between treatment groups practicing with differing materials. One group practiced with an equivalent form of the pre and post test measure while the other group used materials that differed completely in format and content. This apparent lack of transfer of learning from the treatment condition would have some instructional implications for the improvement of reading comprehension skills. Logically one would expect greater mean achievement from the group that practiced with the equivalent form of the pre and post test measure. The results would seem to indicate that the methods rather than the specific materials used were responsible for improved post test scores. This result would indicate that caution should be exercised when using materials or standardized reading tests that purport to teach or test specific reading comprehension skills.

Additional study needs to be made regarding the lasting effects of instruction in verbalizing as an asset in improving comprehension. If such a technique proves to be useful for the improvement of reading comprehension, a follow-up study after a lapse of time would be appropriate. It should also be noted that this study would be classified as product research by Simons criteria. Presently, a transformational-generative analysis of the taped protocols is being conducted to determine if meaning can be attached to pupils performance during the study. Hopefully, such an analysis will shed some light on the psycho -linguistic processes used during reading comprehension activities.

Finally, it should be noted that the results of this study appear to be applicable to those pupils whose reading comprehension scores were greater than grade seven. The results would not appear appropriate for pupils who demonstrate decoding difficulties.

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