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PROMOTING FUNCTIONAL LITERACY THROUGH COOPERATIVE LEARNING

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ABSTRACT

The effects of cooperative learning strategy manipulations on the enactment and recall of a medical procedure were explored. One hundred and twenty-three college students completed the experiment. During training, participants were randomly assigned to a dyad in one of four conditions: (a) no-strategy, (b) baseline strategy, (c) prompting strategy, and (d) planning strategy. During testing, participants both performed and produced written recalls of the procedure instructions. Test order was counterbalanced within dyad. Training and test performances were videotaped. The planning group produced the best recalls and recalled more conditions of the procedure. The prompting group performed best. Recall of the procedure in all groups was enhanced by prior performance. However, performance was enhanced by prior recall in only two groups. The groups differed also in the nature of the transition from training to testing. Theoretical and applied implications of these findings are discussed.

The present experiment explored the efficacy of a variety of cooperative strategies in promoting functional literacy. Functional literacy, as used here, may be defined as the kind of literacy which is demonstrated when a person reads a set of

instructions and successfully performs the series of actions described (e.g., getting money from an automatic teller, playing videogames, using automated information services, assembling toys, etc.). These kinds of tasks have been studied under a variety of rubrics, including that of functional literacy (Fisher, 1981), "reading to do" (Sticht, 1985), "job literacy" (Mikulecky, 1982), and procedure or skill acquisition (Anderson, 1982, 1983). These kinds of tasks (tasks requiring functional literacy) are important because of their prevalence, especially in the workplace, and also because of the consequences of functional literacy training. There is evidence that training in "job specific" literacy readily transfers to general literacy (Sticht, 1985).

Functional literacy differs from general literacy in the nature of the activities and texts which are likely to promote its development. General literacy is developed primarily through the use of narrative or expository text from which declarative knowledge is acquired. Furthermore, the activities likely to promote general literacy have been studied extensively. Activities such as oral summarization (Ross & DiVesta, 1976; Spurlin, Dansereau, Larson, & Brooks, 1984; Yager, Johnson, & Johnson, 1985), elaboration (Reder, 1980), metacognition (Pressley, Levin, & Ghatala, 1984), and cooperative learning (Dansereau, 1985), have been shown to facilitate the acquisition of declarative knowledge and promote the development of general literacy. General literacy is typically assessed through the use of intraverbal measures (e.g., recall, cloze procedure, and multiple choice).

In contrast to general literacy, functional literacy is most closely associated with the processing of technical text, and much of the knowledge acquired is procedural. Technical text usually consists of detailed descriptions of equipment and its functions, and how the equipment is to be used in carrying out assembly, maintenance, and trouble-shooting tasks. Extraverbal tasks (e.g., appropriate performance of a task) provide the best indicators of functional literacy. Few studies have been conducted using technical text and those which have (e.g., Mayer, 1980; O'Donnell, Dansereau, Rocklin, Hythecker, Lambiotte, Larson, & Young, 1985) typically have not included the actual enactment of target tasks as an outcome measure. As a consequence, little is known about which activities promote functional literacy.

Much of the research which has been done has been concerned with delineating the differences between general and functional literacy (Mikulecky, 1981, 1982), documenting the kinds of reading which occur in different occupational settings (Guthrie, Seifert, & Kirsch, 1986; Kirsch & Guthrie, 1984; Mikulecky & Winchester, 1983), and developing tests of functional literacy (Fisher, 1981; Kirsch & Guthrie, 1977). The present experiment is a first step toward identifying the kinds of activities which promote functional literacy.

Although functional literacy is commonly associated with "reading to do," procedures in many technical settings must often be retained over time. As a consequence, the present experiment is focused on both the initial enactment and

the retention of a concrete procedure. The target procedure was the administration of an intravenous infusion (IV). This task was chosen because the steps involved are visible to an outside observer, it is analogous to many procedures taught in technical training settings, and some approximation of skilled performance can be achieved within a relatively short time period.

The present experiment was designed to identify activities which facilitate the transition from instructional text to procedural enactment as well as those that impact on the retention of the procedure. The approach taken to the development of strategies for the promotion of this type of functional literacy involved the incorporation of the theoretical perspectives on skill acquisition developed by J. R. Anderson (1982, 1983) into a previously explored framework of text processing strategies (Dansereau, 1985).

Three stages of skill acquisition have been proposed (Anderson, 1982, 1983); (a) the declarative stage, in which the learner acquires an initial characterization of the skill; (b) the knowledge compilation stage, in which the learner eliminates errors from the procedure; and (c) the proceduralization stage, which is characterized by the appropriate application of the procedure in an automated manner. Two subphases of the declarative stage of procedure acquisition can be identified: (a) the translation of text into a declarative representation, and (b) the translation of a declarative representation into a first procedural enactment. The current experiment focused on the first stage of skill acquisition, the declarative stage. This particular stage was selected for exploration because it has an important impact on later stages of learning. It also intersects with other approaches to literacy.

The baseline strategy employed in the present study emerges from a text processing strategy which has been extensively explored and has consistently resulted in positive outcomes (Dansereau, 1985) on intraverbal measures (e.g., free recall). The strategy involves cooperation between pairs of students (dyads). Cooperation among students has been shown to facilitate general academic achievement (Slavin, 1983), text processing (Dansereau, 1985), and certain aspects of writing (O'Donnell, Dansereau, Rocklin, Lambiotte, Hythecker, Larson, & Young, 1985). In addition, the cooperative scenario makes certain cognitive processes explicit which might otherwise be unavailable for observation.

In the baseline strategy group, both members of a dyad read a section of the text describing the target procedure, after which one partner performed the procedure described. The other partner provided feedback on any errors or omissions in the performance.

Two manipulations of the baseline strategy were developed and utilized in other treatment groups in the present experiment. The first manipulation (planning group) involved the inclusion of a planning activity prior to performance. Dyads in the planning group were directed to plan the procedure aloud prior to performance. Dyads in this group were expected to emphasize the text processing component of the transition from instructional text to actual enactment because they were required

to rely on memory as a result of being required to both plan and perform from memory. Verbalization in the form of oral summaries has been shown to facilitate text processing (Spurlin et al., 1984; Yager et al., 1985), and Anderson (1983) has alluded to the potential of verbal mediation to keep declarative knowledge of a procedure in working memory.

The second manipulation of the baseline strategy (prompting group), incorporated the approach to procedural learning espoused by Anderson (1983) and Gagne (1985) by allowing the cooperating dyad to benefit from the availability of prompts while learning to perform the procedure, that is, they could refer to their instructions or confer with their partners at any point in the training period. Because of the availability of prompts, the dyads in this group were expected to emphasize performance.

A fourth group of participants were included who were not provided with structured activities. This group was included in order to provide information about how pairs of participants spontaneously acquire procedural knowledge.

In summary, the present experiment explores the efficacy of various strategies in facilitating the learning of a concrete procedure. The knowledge state of the learner after a first procedural enactment was assessed by the inclusion of both declarative (written recall) and procedural (performance) outcome measures. These measures were designed to assess outcomes from the text processing and performance phases of the target task. Both initial performance of the procedure and retention of the procedure were assessed.

METHOD

Participants

One hundred and twenty-three undergraduates (mean age was 20 years) at Texas Christian University completed all phases of the experiment and received credit in their respective courses in return for their participation.

Materials

The target procedure for the experiment was the administration of intravenous therapy. The procedure was presented to the students in a text passage, consisting of four sections (approximately 300 words per section). A group of experienced nurses ($n=6$) rated the description of the procedure and its mode of presentation as being very similar ($M=8.1$ and 8.0 respectively, on a 10-point scale) to that found in nursing textbooks.

The equipment necessary to perform the administration of the intravenous infusion was provided to the pairs of participants (including a rubber arm).

Procedure

Each participant took part in two experimental sessions. Each session lasted approximately 90 minutes.

First session. The participants were randomly assigned to same-sex dyads in 1 of 4 experimental conditions: (a) baseline strategy group ($n = 29$), (b) planning strategy group ($n = 31$), (c) prompting strategy group ($n = 33$), and (d) a no-strategy group ($n = 30$). The n reported here is the number of individuals for whom complete test data were available.

The same baseline strategy (with appropriate modifications) was used by all the strategy groups. Both partners in a dyad read a section of the instructions. They then put the material away. One partner performed that part of the procedure described in the section and his or her partner provided feedback on any errors made. Upon completion of the first section, the partners then read the second section and alternated roles. The partners proceeded in this manner until the entire procedure was completed.

In the planning group, the performer described aloud how he or she planned to perform the procedure delineated in the first section of the text prior to performing the procedure. In the prompting group, the performers were allowed to refer to their instructions or confer with their partners. The observers were directed not to provide information for their partners unless requested to do so by the performers. The dyads in the no-strategy group were not given any specific instructions about how to interact or how to proceed with the task of learning and performing the procedure.

Each dyad first watched a videotape demonstrating the use of the strategy appropriate to their experimental condition. Each dyad was then videotaped as they used the assigned strategy to learn and perform the IV administration. Fifty minutes were allocated for the completion of the task.

Second session. During the second session, which occurred after an interval of 5 days, each participant took a free-recall test over the text material studied at the previous session and performed the task of setting up and administering an IV. The test order for the two tasks was counterbalanced within dyad, with one member of the dyad performing the procedure first and then recalling, while his or her partner did the reverse. All participants then completed the post-experimental questionnaire and were dismissed.

RESULTS

Data for the training session was available for 67 dyads. The data for two other dyads was lost due to mechanical failure. Complete test data were available for 123 of the 138 individuals who completed the first session. The reduced number of

individuals for whom test data were available was due to the failure of some of the participants to show up for the second session ($n = 11$), failure to follow the free-recall instructions ($n = 2$), and equipment problems during the videotaping of the performance ($n = 2$).

Scoring procedures. Each of the free-recall essays was scored by trained raters according to predetermined keys and without knowledge of group affiliation. The procedure for scoring the free-recall procedures was based on the procedures developed by Meyer (1975) and by Holley, Dansereau, McDonald, Garland, and Collins (1979). The scoring key for the intravenous infusion passage listed all the propositions (idea units) from the passage. Each proposition present in a participant's free-recall test was scored on a scale from "present but inaccurate" (1) to "present and completely accurate" (4). A total score for each participant was derived from the scoring of the free-recall tests. Interrater reliabilities were assessed by having a colleague rescore a randomly selected subset (16%) of the free-recall tests. A correlation of .91 was achieved between the two sets of scores.

The training and test performance videotapes were scored using similar procedures to those already described. The scoring key consisted of a list of all the actions to be completed while performing an administration of intravenous therapy and was identical to that used for rating the training performance. The videotapes were scored by a trained rater, without knowledge of group affiliation. Each action completed by the participant on the videotape was scored on a scale from "present but inaccurate" (1) to "present and completely accurate" (3). A more limited scale was used for rating the actions performed than was used for rating the free recall of propositions, as the range of accuracy exhibited in performance was judged to be more restricted. Again, a total score on performance for each dyad during training, and each participant during testing was derived from the ratings of the videotapes. Interrater reliability was established by having a colleague rescore a randomly selected subset of the videotapes (16%). Reliability coefficients of .91 and .93 were achieved for total performance scores for training and test performances, respectively.

Reliability coefficients were also computed, using the same procedure as described above, for the following measures: total time on the procedure, total time spent in preparation for performance, total performance time, total time spent verbalizing during performance, and ratings of how well each dyad was using the experimenter-provided strategies during each section of the procedure. The ratings were made using an 8-point scale from "not used at all" (1) to "used very well" (8). The median correlation achieved for these measures was .94. The measures were subsequently used to check that the strategy manipulations were successful.

A checklist of the components of the experimenter-provided strategies (e.g., alternate roles) which were used spontaneously by the no-strategy dyads was completed for each section of the passage.

No-Strategy Dyads

A proportion of the total number of sections in which a strategy component from the experimenter-provided strategies was actually used by a dyad in the no-strategy group was tabulated. The no-strategy group emphasized "referring to the text" (.96), "reading" (.90), "referring to the partner" (.87), and, to a lesser extent, "explaining the procedure" (.32). They rarely "rehearsed the procedure verbally" (.23) and almost never "alternated roles" (.07) or "put the material away" (.00). Thus, the methods used by the no-strategy dyads were judged to be most similar to the prompting strategy.

Strategy Manipulation Check

Three aspects of the deployment of the experimenter-provided strategies were examined. First, the emphases placed on the different activities as a result of strategy manipulations were examined. Second, in order to verify that differences between groups could not simply be attributed to differences in learning time, the actual time on task was examined. Third, the implementation difficulty of the strategies was examined in order to ensure that differences between groups could not be attributed to the fact that one strategy was more difficult to implement than another strategy. When post hoc procedures were required, Tukey's HSD (Kirk, 1982) was employed.

Effectiveness of strategy manipulations. This set of analyses was directed at establishing that the strategy manipulations were effective. The groups differed on the amount of time spent in preparing to perform, $F(2, 48) = 53.57$, $p < .001$, $MSe = 18.71$, with both the planning group and the baseline strategy group spending significantly more time in preparation than the prompting group ($ps < .05$). In addition, the planning group spent more time preparing for performance than did the baseline strategy group ($p < .05$). The preparation time included time spent on all activities engaged in prior to performance.

Significant differences were also found between the groups on actual performance time $F(2, 48) = 19.89$, $p < .001$, $MSe = 45.58$. The prompting group spent significantly more time on performance than the baseline strategy group and the planning group ($ps < .05$). The baseline strategy group, in turn, spent more time on performance than the planning group ($p < .05$). Groups also differed on the amount of time spent verbalizing during performance $F(2, 48) = 4.0$, $p < .05$, $MSe = .02$, with the prompting group engaging in significantly more verbalizations than the baseline group. Time on verbalization, as used here, is the proportion of time verbalizing while performing. The group means and standard deviations for time spent on preparation, performance, and verbalization are presented in Tables 1 and 2.

Table 1

Means and Standard Deviations of Times (Seconds) Spent on Preparation and Performance during Training

Group	*n**		Preparation	Performance
Baseline Strategy	17	*M*	1,080.2	1,065.2
		SD	(233.3)	(138.7)
Prompting Strategy	17	*M*	582.8	1,573.0
		SD	(193.7)	(368.7)
Planning Strategy	17	*M*	1,503.3	700.6
		SD	(332.0)	(171.2)

*The *n* reported here is the number of dyads in strategy groups with data available from the training session.

Table 2

Proportion of Training Performance Time Spent on Verbalizations as a Function of Experimental Group

Group	*n**	*X*	*SD*
Baseline Strategy	17	0.21	0.13
Prompting Strategy	17	0.32	0.09
Planning Strategy	17	0.31	0.16

*The *n* reported here is the number of dyads for whom training data was available.

Time on task. There were no significant differences between groups on the total time spent on the activities related to learning and performing the task. Consequently, between-group differences on subsequent performance cannot be attributed to simple differences in learning time.

Implementation difficulty. The ratings of how well the dyad used the strategy across sections were combined to form a total "strategy use" score. A one-way analysis of variance (ANOVA) was conducted with "strategy use" as the dependent measure and experimental group as the single factor. The differences between the groups on the strategy use score were not significant, indicating that the strategies were not differentially difficult to implement.

In summary, the strategy manipulations were effective in that the different strategy groups used the time available in different ways. The planning strategy called primarily for an emphasis on preparation and, in fact, the group using this

strategy did emphasize this activity. The prompting strategy successfully promoted an emphasis on performance. No significant differences between groups were found for the total time spent in learning the procedure and on task related behavior upon completion. In addition, the groups did not differ on how well they used the strategies (i.e., no single strategy was more difficult to implement than the others).

Test Data

The scores for the participants were standardized within-task (free recall and performance), as the possible scores available for the two tasks were not the same. The standardization of the scores allowed for direct comparisons of effectiveness across tasks.

A three-way repeated measures ANOVA was conducted. Because the order in which recall and performance were tested was counterbalanced, the two between-subjects factors included were test order and experimental group. The within-subjects factor was task—free recall or performance of the IV procedure. The results of the ANOVA indicated that there were no main effects for experimental group or for test order. A significant two-way interaction (Task × Test order) was found $F(1, 115) = 16.61$, $p < .01$, $MSe = 5.27$. In addition, the interaction of group and task was significant $F(3, 115) = 2.79$, $p < .05$, $MSe = .88$. Finally, the Test order × Task × Group interaction was also significant $F(3, 115) = 3.10$, $p < .05$, $MSe = .98$. The interaction of group and test order was not significant. In order to facilitate the interpretability of the results, only the three-way interaction is reported here.

Test order × task × group. The three-way interaction of test order, task, and group is reported here in terms of how test order and group interacted for each task separately.

Written recall. Performing first and then recalling during the test phase of the experiment resulted in better written recall performance than the reverse test order (see Figure 1). This was true for all of the experimental groups. This is scarcely surprising as performing first with the equipment provided cues for subsequent recall. In the perform/recall test order condition, members of the planning strategy group who performed first and then recalled, significantly outperformed members of the baseline strategy group ($p < .01$) and the prompting strategy group on written recall ($p < .05$). When in the reverse test-order condition (recall/perform), the planning strategy group exhibited the worst performance of all the groups on written recall. The recall scores of the members of the planning group who performed first were significantly better than the recall scores of members of the same group who had the reverse test order ($p < .01$). No significant differences between groups on written recall in the recall/perform condition were found.

Performance scores. Recalling first did not enhance performance in all of the groups. The performance of the no-strategy and the prompting strategy group was

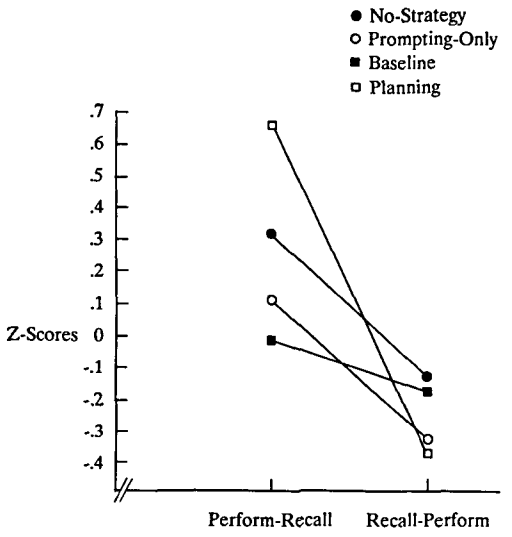

Figure 1. Standardized mean recall scores as a function of test order.

enhanced by an initial free recall. The planning and the baseline strategy groups, however, exhibited the reverse pattern of performance (see Figure 2).

In the perform/recall condition, the planning group significantly outperformed the no-strategy group ($p<.05$). In the recall/perform condition, both the prompting strategy group and the no-strategy group significantly outperformed the baseline strategy group ($ps<.05$). The order of test performance was of particular importance for the no-strategy group as those members of this group who recalled first and then performed significantly outperformed those who performed first and then recalled ($p<.05$).

Type of Information Recalled

Overall, there was no difference between groups in the amount of information recalled on the free-recall task. To explore the possibility that different kinds of information were recalled as a result of the strategy manipulations, the propositions from the IV passage were classified as belonging to one of two categories of information: condition or action. Simon's (1980) definition of procedures as condition/action sequences was used to classify the propositions. According to Simon, appropriate action is linked to the recognition of necessary conditions. Both kinds of information were scored in the free-recall tests whereas only "action" information was scored for the performance measure.

Two new scores were computed. The first score was a composite of all the "action" propositions in the passage. The second score was a composite of all the

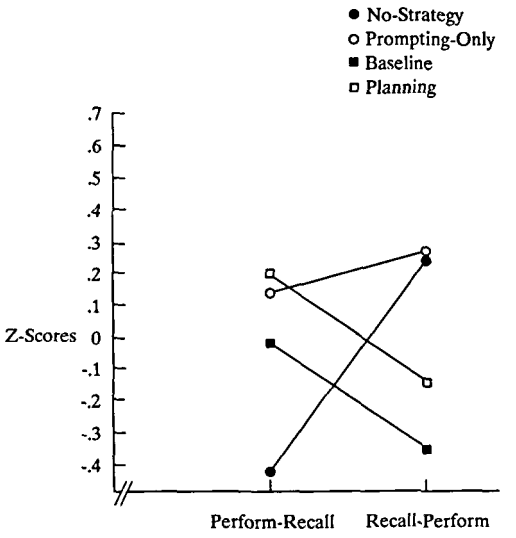

Figure 2. Standardized mean performance scores as a function of test order.

"condition" propositions. Two-way ANOVAs, with experimental group and test order as the between-subjects factors, were conducted for the "actions" and "conditions" scores. The analysis of the "actions" score yielded a significant main effect for test order, $F(1, 115) = 10.18$, $p < .01$, $MSe = 475.15$. Recall of "actions" was better ($M = 70.3$) when written recall was preceded by performance than when performance was preceded by written recall ($M = 57.7$). No other effects were significant.

The analysis of "conditions" also yielded a significant main effect for test order, $F(1, 115) = 4.69$, $p < .05$, $MSe = 164.96$. Recall of "conditions" was also enhanced by a prior performance ($M = 22.9$ and 17.88 for the two test order conditions, respectively). Groups differed significantly on the recall of "conditions," $F(3, 115) = 3.96$, $p < .05$. Post hoc analyses indicated that the planning group recalled significantly more "conditions" than the baseline strategy group and the prompting only group. The means and standard deviations are presented in Table 3.

Training to Testing Transition

The relationship of performance during training and testing was examined. A two-way repeated-measures ANOVA was conducted with experimental group as the between-groups factor and task (training/testing) as the within-subjects factor. The results of the analysis revealed a significant group effect, $F(3, 50) = 8.20$, $p < .05$), $MSe = 390.57$, with the no-strategy group outperforming the baseline strategy and planning groups ($ps < .01$). The prompting group, in turn, outperformed the

Table 3

Means and Standard Deviations for "Action" and "Condition" Scores as a Function of Test Order and Experimental Group

Group	n*		Perform/Recall Actions	Perform/Recall Conditions	Recall/Perform Actions	Recall/Perform Conditions
No-Strategy	29	*M*	71.00	24.14	58.07	22.00
		SD	(21.39)	(13.42)	(20.43)	(13.50)
Baseline Strategy	31	*M*	67.24	15.94	60.86	16.93
		SD	(24.11)	(11.48)	(22.77)	(11.03)
Prompting Strategy	33	*M*	69.24	18.41	58.50	14.69
		SD	(18.21)	(11.47)	(20.29)	(6.01)
Planning Strategy	30	*M*	74.20	32.13	53.67	18.07
		SD	(29.77)	(14.14)	(14.52)	(9.70)

*The *n* reported here is the number of individuals for whom complete test data were available.

baseline and planning groups ($ps<.01$). The means and standard deviations are presented in Table 4. The main effect for task was also significant, $F(1, 50)=18.98$, $p<.01$, $MSe=130.34$. The performance on practice was better than performance on testing. The interaction of the task and treatment group was also significant. $F(3, 50)=20.07$, $p<.01$). The interaction is due to the significant between-group differences on the first task (training) and the lack of between-group differences during testing. During training, the no-strategy group outperformed all other groups ($ps<.01$) and the prompting group outperformed the baseline strategy group and the planning group ($ps<.01$). There were no significant differences between groups during testing although the no-strategy group performed significantly worse on testing than they had on training ($p<.01$). The prompting group also performed significantly better during training than during testing ($p<.05$).

In summary, those groups who were allowed access to their instructions during training performed significantly better than those groups who did not have access to instructions. To provide a more direct comparison between those focusing on "reading to do" (instructions available) and those focusing on "reading to learn" (instructions unavailable), a supplementary analysis of the training to testing transition was conducted.

A two-way repeated measures ANOVA was conducted with task (practice or test) as the within-subjects factor and group (instruction availability) as the between-subjects factor (this involved collapsing the no-strategy and prompting only groups and the baseline and planning strategy groups). The main effect for group was significant, $F(1, 52) = 21.95$, $p<.01$, $MSe = 394.03$, with those groups who

Table 4

Means and Standard Deviations of Performance Scores during Training and Testing as a Function of Experimental Group

Group	*n**		Training	Testing
No-Strategy	12	*M*	102.83	66.96
		SD	(16.13)	(7.66)
Baseline Strategy	14	*M*	58.07	63.54
		SD	(17.24)	(11.78)
Prompting Strategy	14	*M*	85.36	70.36
		SD	(19.62)	(11.85)
Planning Strategy	14	*M*	62.07	69.11
		SD	(20.59)	(18.66)

*The *n* reported here is the number of dyads with complete data from both the training and test sessions.

had access to their instructions while training significantly outperforming those who did not (standardized means = 0.31 and −0.31, respectively). The Group × Task interaction was also significant, $F(1, 52) = 42.14$, $p < .01$, $MSe = 152.56$. Post hoc analyses indicated that those who accessed their instructions during training significantly outperformed those who did not on training performance ($p < .01$) but not on testing. The significant group effect is largely due to differences in performance during training.

DISCUSSION

Due to the exploratory nature of this experiment, a large number of analyses were conducted and the results are therefore interpreted cautiously. The results of this experiment indicated that the activities of a learner in the declarative stage of procedure/skill acquisition can be manipulated and that the structure of the learner's knowledge emerging from this phase of acquisition can also be manipulated.

In the current study, the various experimental groups spend approximately the same amount of time on task. The strategy manipulations were shown to be effective. The planning and prompting groups were expected to emphasize text processing and performance respectively and in fact, did emphasize these activities. The planning group emphasized text processing by focusing on preparation while the prompting group spent more time on performance. Furthermore, the strategies were not differentially difficult to implement. Thus, differences between groups during

testing could not simply be explained by the various groups having differing amounts of time to learn the procedure, or some strategies being more difficult to implement than others.

Test Performance

Differential effects on written recall and procedural enactment were found as a result of the strategy manipulations. When performance preceded recall, the planning group outperformed all other groups on both recall and performance measures. In addition, the planning group recalled significantly more of the conditions of the procedure than the other groups. When recall preceded performance, however, the no-strategy group produced the best recall and had almost identical performance scores to those of the prompting group.

The differences between groups, however, were not particularly strong. One factor which may have contributed to the lack of very strong effects may be that all of the groups in this experiment involved cooperative dyads. Dyadic cooperation among peers has consistently been shown to facilitate academic performance, particularly when compared to individual efforts (e.g., McDonald, Larson, Dansereau, & Spurlin, 1985; Hall, Rocklin, Dansereau, Skaggs, O'Donnell, Lambiotte, & Young, 1988). Each of the groups were provided with an effective learning system (cooperation with a partner), irrespective of the additional strategy manipulations. Strategy manipulations in this context may result in subtle but important differences in knowledge structure and organization, rather than in sheer amount of information acquired.

There was some evidence to suggest that the strategy groups did differ in the structure of the information acquired. In all of the groups, performing first during the test session facilitated subsequent recall of the material. However, recalling first only facilitated performance in the no-strategy and the prompting groups. It is possible that knowledge of performance and verbal information are strongly connected in these two groups, and that engaging in one kind of activity (recall or performance) serves to cue the other.

Transition from Training to Testing

Differences in the connections between the two kinds of knowledge in the prompting and no-strategy groups and those in the planning and baseline strategy groups, may be developed as a result of how the transition from text to a procedural enactment occurs. Certain features of the implementation of the strategies during training and an examination of the relative training and testing performances point toward some of the processes which possibly operate to produce differences in knowledge structure.

The translation of declarative knowledge to procedural enactment in the no-strategy and prompting groups is accompanied by a verbal overlay. The verbal

overlay accompanying performance was simply the ongoing commentary provided by either of the partners as the procedure was actually performed such that talking about an action and then performing it occurred very close together in time. The members of these groups were allowed access to their instructions and could confer with their partners during the course of the training session. The prompting group, in particular, spent more time on performance and a greater proportion of that time verbalizing, than did the members of the other strategy groups.

The planning and baseline strategy groups, on the other hand, were not characterized by a verbal overlay during performance. In fact, the baseline strategy served to minimize verbalization during training whereas the planning strategy sharply separated verbalization from actual performance. This separation of verbalization from performance in the planning group and the absence of verbalization in the baseline strategy group may promote compartmentalization of knowledge for the members of these groups.

The strategy employed by the baseline strategy group did not strongly emphasize either the text processing or performance components of the target task, and did not provide the opportunity for linking verbal and performance knowledge by verbalization during performance, as the actual strategy utilized in this group minimized opportunities to do so. For members of this strategy group, the verbal knowledge and performance knowledge may have been completely compartmentalized.

Although the presence or absence of verbalization during the training performance may have served as an explicit determinant of the outcomes from training, the change in performance from training to testing points toward some less explicit processes likely to be involved in determining the resulting knowledge structures. The performances of the no-strategy and the prompting strategy groups during training were significantly better than their performance during subsequent testing. The members of both of these groups emphasized the performance component of the task. They had access to the instructional materials while performing the task during training and in fact, seemed to rely on the instructions fairly heavily. A parallel may be drawn between the view of note-taking as an external storage device (Carter & Van Matre, 1975) and the possible effects of reliance on the instructional materials. The availability of prompts may have, in essence, provided the participants with an external storage device. It is not surprising that without the instructions available during testing, the participants in the prompting and no-strategy groups did not perform as well as they had during training.

In contrast to the training/testing performance of the no-strategy and the prompting strategy groups, the test performance of the planning strategy and the baseline strategy groups was better than their respective training performances. This improvement was possibly due to the effort involved in the initial training. During training, the members of both groups had to rely on their memories of the material in order to perform the task. The cognitive effort involved may have facilitated

subsequent test performance. Although the differences between the groups on actual testing performance were negligible, the nature of the transition from training to testing is important in that it reflects differences in how the information is acquired and in the structure of that information.

The most obvious disparity is the difference in performance between those groups focusing on "reading to do" (instructions available during training) and those "reading to learn" (instructions unavailable). Although the "reading to do" groups exhibited similar patterns of achievement in training and testing, the no-strategy group significantly outperformed the prompting-only group during training whereas the prompting-only group performed better than the no-strategy group during testing. The results for these groups indicate that the imposition of a strategy in the prompting only group resulted in different processing of the information than that which occurred in the no-strategy group, although both groups could be considered as "reading to do" groups.

Implications

The structure of the learner's knowledge emerging from the declarative stage of skill acquisition of a task requiring functional literacy, has important implications for later stages of skill acquisition. The relative importance of emphasis on either the text processing or performance components of a task will depend, in part, on the nature of the target procedure and the desired outcomes.

Two of the groups (no-strategy and prompting-only dyads) emphasized performance during training. In Sticht's terms (1977, June; 1985), these groups emphasized "reading to do." In contrast, the planning group and the baseline group emphasized "reading to learn." These two sets of groups differed significantly from one another during training, with the "reading to do" groups performing best. However, within each of these two general categories of activities ("reading to do" and "reading to learn"), there were differences between groups, indicating that the effectiveness of "reading to do" or "learn" can be manipulated.

Most tasks in the workplace have multiple goals, including adequate performance (both immediate and delayed), communication to others about the task, and remembering the procedure if the task is infrequently performed. "Reading to do" approaches to procedure learning are most effective for immediate performance while either "reading to do" or "reading to learn" approaches appear to work for retention of the procedure. Certain kinds of "reading to learn" strategies (i.e., planning) appear to be most promising if the goal is to communicate about the procedure. It is likely that the acquisition of different procedures will necessitate different emphases during the initial stages of acquisition. Appropriate tailoring of training will necessitate a clear specification of the nature of the target procedure and the desired outcomes.

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