DOCUMENT RESUME

ED 373 741 IR 016 751

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TITLE Promoting Generative Learning with Elaboration Training in Computer-Based Instruction.

PUB DATE 94

NOTE 12p.; In: Proceedings of Selected Research and Development Presentations at the 1994 National Convention of the Association for Educational Communications and Technology Sponsored by the Research and Theory Division (16th, Nashville, TN, February 16-20, 1994); see IR 016 784.

PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.

DESCRIPTORS *Achievement; *Adult Students; *Computer Assisted Instruction; Control Groups; Experimental Groups; Intermode Differences; *Learning Strategies; Pretests Posttests; Professional Development; Recall (Psychology); Recognition (Psychology); *Training Methods

IDENTIFIERS *Elaboration; Embedded Training; *Generative Processes

ABSTRACT

Relative effects on adult learners who received experimenter-provided elaborations or who generated personal elaborations, using strategies taught by means of detached versus embedded training, were examined in 80 employees in a professional-development course at a large corporation. Subjects were assigned to a control group, a group receiving experimenter-provided elaborations, and groups receiving training to produce learner-generated detached or embedded elaborations. Recall, recognition, and application of the lesson content (professional-development topics) were measured in a posttest. Subjects generating elaborations surpassed control-group subjects on three or four comparisons. However, there were no significant advantages for either learner-generated-elaborations group versus the experimenter-generated-elaborations group. It may be that the level of generative processing achieved in the experimenter-generated category was sufficient to produce elaborations that function similarly to learner-generated elaborations. Contrary to the hypothesis, the embedded-training group did not demonstrate higher achievement than did the detached-training group. One table summarizes means and standard deviations. (Contains 29 references.) (SLD)

Title:

Promoting Generative Learning with Elaboration Training in Computer-Based Instruction

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Despite the emphasis on cognitive learning principles in contemporary instructional theories, strategies that initiate only a superficial level of processing continue to dominate computer-based instruction (CBI) (Hooper & Hannafin, 1991; Winn, 1988). A direct response to this problem is to make greater use of generative strategies in CBI designs (Jonassen, 1988). Generative learning is intended to promote interpretation and comprehension by requiring learners to relate new information to their existing knowledge (Jonassen, 1988). Consequently, the level of processing is deepened through the activation of existing knowledge schemata (Craik & Lockhart, 1972; Wittrock, 1978, 1989).

A common means of engendering generative processes is through elaboration strategies (Jonassen, 1988; Mayer, 1980; Wittrock, 1989). Researchers and practitioners have described elaboration strategies in several ways, including cognitive skills that add meaning to new information (Rohwer, 1970), encoding strategies that link new information with existing knowledge (Brezin, 1980), comprehension/retention strategies that increase the memorability of material (Dansereau et al.,1979), and information-processing strategies through which learners make the material more meaningful by "adding to" or "expanding on" the presented information (Jonassen, 1988).

Uses of elaboration strategies have generally shown positive effects on learning, provided the elaborations are meaningful to learners and directly relevant to instructional objectives (see Mayer, 1980). Previous studies have shown positive effects on achievement using a variety of verbal and/or imaginal elaboration strategies with diverse learner groups, including elementary school students (Barker, 1987), secondary students (Weinstein, 1978b) undergraduates (Dansereau et al., 1979), and military recruits (McCombs & Dobrovonlny, 1982). In cases where elaboration has not proven effective, the major problems inferred have been subjects' inexperience with the particular elaboration strategies used or lack of congruence between the elaboration activities and the learning outcomes assessed (e.g., Agesilas, 1987; Weinstein, Rood, Roper, Underwood, & Wicker, 1980).

Concerns about student abilities to generate appropriate elaborations have prompted efforts to examine the effects of subject-generated as opposed to experimenter-generated elaborations. Although results from verbal learning studies have generally favored subject-generated elaborations on memory tasks (e.g., Bobrow & Bower, 1969; Slamecka & Graf, 1987), concerns have been expressed regarding how effectively students can generate elaborations on their own in more complex learning situations. This consideration raises the question of whether elaboration skills training could be used to help learners improve the quality of their elaborations (Jonassen, 1988.) The most common form of elaboration skills training is "detached programs" (Rigney, 1978) which operate independently of the instructional presentation. Dansereau et al. (1979), used this orientation by giving undergraduates two hours of weekly training in comprehension/retention techniques over a 12-week period. Results from that study as well as several others (e.g., McCombs & Dobrovonlny, 1982; Pflaum, Benton, Glover, & Ronning, 1980; Weinstein, 1978a) supported the training condition over a control (no-training) condition.

An alternative elaboration training method is the embedded approach (Rigney, 1978). Jones (1983) describes an application in the Chicago Mastery Learning Reading Program with Learning Strategies (CMLR/LS). The program incorporated information processing instructions directly into reading materials used by teachers and students. Step-by-step prompts, multistep directions on how to think, adjunct study questions, and study prompts are examples of the types of embedded training aids used. Unfortunately, no formal evaluation of the CMLR/LS program was conducted; nor have embedded strategies received much attention in the literature. Relative to detached strategies, the embedded approach has the advantage of making the training contiguous and directly integrated with the instructional task (Linder & Rickards, 1985; O'Dell, 1990). The embedded approach also seems highly compatible with CBI due to the ease of making appropriate training frames and/or elaboration prompting standard or adaptive features of the instructional program. As the learner acquires increased experience in making elaborations independently, such support can be gradually faded and eventually eliminated.

The purpose of the present study was to extend previous research by examining the relative effects for adult learners of receiving experimenter-provided elaborations or generating personal elaborations, using strategies taught via detached versus embedded training. Where previous studies have concentrated primarily on the effects of elaboration on rote learning, the present focus included higher-order learning as well (e.g., application of new information). It was hypothesized that higher achievement would be associated with uses of: (a) learner-generated and experimenter-provided elaboration strategies relative to a control (no-elaboration) condition, (b) learner-generated relative to the experimenter-provided elaborations, and (c) embedded- relative to detached-elaboration training. Additional research interests were the types of elaborations generated and the relationships between types of subject elaborations and learning outcomes.

Method

Subjects and Design

Subjects were 80 employees enrolled in a professional development course at a large corporation in a midwestern city. The course content dealt with diverse topics such as improving communications with managers and co-workers, understanding one's own job, interacting with others to improve performance, and similar topics related to interpersonal communications. The subjects were all administrative assistants with extensive typing and computer experience, but no prior experience with the particular course. The experimental treatments were integrated with the regular course instruction so as to serve as the actual lesson material. Subjects were recruited by sending a letter to 350 corporate employees asking for volunteers for a training study. Employees called and signed-up for a convenient time to participate.

The first 80 subjects who volunteered were randomly assigned to one of four groups (n=20 in each): (a) a control group that received no elaborations or elaborations training, (b) a group that received experimenter-provided elaborations during the lesson, (c) a group that received detached elaborations training and generated elaborations during the lesson, and (d) a group that received embedded elaborations training and generated elaborations during the lesson. Major dependent variables were recall, recognition, and application of the lesson content as measured by a posttest. In addition, content analyses were made of the elaborations produced in the two learner-generated elaboration treatments. An alpha level of .05 was used in judging significance in all statistical tests.

Training Program and Materials

Elaboration strategies training program. A one-hour training unit on elaboration strategies was designed based on effective programs described in the literature (Dansereau et al., 1979; Weinstein, 1978b; Weinstein et al., 1980). The unit was presented to the entire group in one session by the first author. The introductory section emphasized the need for instructional training that stimulates thinking and engages participants in the learning process. Several techniques, such as mnemonic devices and analogies, were then introduced using specific examples from the corporation's existing training courses. Part 2 described elaboration in terms of its value, features, specific techniques (mnemonics, paraphrasing, etc.), and effective procedures. Part 3 discussed and illustrated uses of elaboration in other training and work situations.

Instructional unit. The instructional unit, adapted from "Communicating for Productivity" (D'Aprix, 1982), focused on a model of supervisory communication. The unit contained three sections: introduction to the lesson, new instruction, and summary of main points. The new instruction section covered six supervisory tasks and specific communication practices for each task. Using HyperCard™, four variations of the instructional section were designed for use on a Macintosh™ computer.

One course variation, designed for the control group, presented primary displays (major content) but no secondary displays (elaborations). The first computer frame presented a description of the supervisory principle while the second frame presented the specific communication activities for the principle.

A second variation designed for the experimenter-generated elaborations group, presented primary displays (major content) as well as secondary displays (elaborations). Experimenter-provided verbal elaborations included descriptive information that related the content to current job experiences and/or stated implications for use of the supervisory model. To design the elaborations as precisely as possible, a company subject matter expert assisted in the development of the elaborations.

A third variation, designed for the learner-generated elaborations detached training group, presented primary displays but no secondary displays. Instead, orienting tasks instructing the subject to generate elaborations after each primary display were incorporated. The learner was specifically told to type descriptive information relating the content to current job experiences and, where relevant, stating implications of the concepts described to the job environment.

A fourth version, designed for the learner-generated elaborations, embedded training group, contained primary displays followed by an elaboration strategies instructional unit. The unit was patterned on the detached-training program described in the preceding section, with appropriate modifications required for computer presentation and immediate on-line applications of the strategies. The instruction provided an overview of elaboration strategies, descriptive information regarding their value and features, and an overview of specific elaboration techniques. As for the detached-training treatment, subsequent lesson frames included orienting directions instructing the subject to generate elaborations relating the content of each primary display to current job experiences. An on-line help system for the using elaboration strategies was incorporated. The help system was an electronic version of the "effective elaborating procedures" section (Part 2) of the detached training unit. The learner-generated elaborations were stored on disk for latter analysis.

The four lesson formats were evaluated by one corporate and two academic instructional designers, and were field tested with 10 administrative assistants from the same population as participants in the study. Revisions of the lesson formats were made based on the review and developmental testing.

Achievement test. A paper-and-pencil achievement test, consisting of 8 recall, 10 recognition, and 8 applications items was designed. Recall questions required subjects to name the supervisory principles and specific communication activities. For example, one item was "Name the principle that provides the employee with the answer to the question 'How am I doing?'" Recognition questions listed communication activities contained in the lesson, and asked subjects to associate each with one of the six principles listed. To measure ability to apply the content, a case study describing a work situation was presented. Multiple-choice questions required subjects to resolve different case-related problem situations based on what they had learned from the lesson.

The achievement test was evaluated for face validity by three instructional designers and was pilot tested with 10 administrative assistants who had reviewed the lesson material and 20 who had not reviewed it. The instrument was revised as suggested by the panel review and by the item analysis (e.g., individual items that were correctly answered by 75% or more of the pilot test sample were replaced or increased in difficulty). Internalconsistency reliability coefficients for the final test, computed via Cronbach's Alpha formula, ranged from a low value of .82 for the recognition section to a high of .92 for the recall section.

Procedure.

One week prior to the initiation of the instructional phase, subjects in the detached-training group attended the elaboration strategies training session in the corporation's training facility. The instructional phase was implemented during a normal work week as done for most training courses at the corporate headquarters. Subjects reported to the assigned training room in groups of five, one per computer. Before beginning the lesson, the proctor read instructions stating that (a) participants should try to do their best in learning the new information; (b) there would be a test on the material; and (c) there would be no time limits. Subjects in the two elaboration conditions were also told that spelling, punctuation, capitalization, and typing mechanics could be disregarded; and there was no need to spend time on formatting text. The proctor remained in the room to provide assistance when needed. After each subject completed the assigned treatment, he/she took a 10-minute break and then returned for administration of the posttest.

Results

Achievement

Posttest scores were analyzed via a one-way multivariate analysis of variance in which the dependent variables were recall, recognition, and application. Treatment means and standard deviations on these variables, along with total score (maximum points=26), are shown in Table 1. As shown in the table, the direction of the means on all subtests and on the total score favor the two learner-generated elaborations groups (detached and embedded) over the control group and the experimenter-provided elaborations group. Statistical results showed the overall multivariate treatment effect to be significant. Univariate analysis of variance indicated significant treatment effects on recall scores, F (3, 76) = 7.90, MS_W = 2.12; and application scores, F (3, 76) = 5 41, MS_W = 1.47; but not on recognition scores.

Insert Table 1 about here

Tukey pairwise comparisons of the recall means indicated that the performance of both the detached-training group (M = 6.80) and the embedded-training group (M = 7.35) surpassed the performance of the control group (M = 5.20). The experimenter-provided elaborations group (M = 6.30) did not differ significantly from any of the groups.

Results of Tukey followups on the application means indicated that the embedded-training group (M = 5.50) surpassed the control group (M = 4.00). The experimenter-provided elaborations group (M = 4.65) and the detached-training group (M = 5.00) did not significantly differ from any of the groups.

Analysis of Elaborations

The elaborations generated by subjects in the embedded- and detached-training groups (total n per individual = 6) were analyzed initially via a total word count to determine verbalization length. Although the embedded-training group gave slightly longer elaborations (M = 477.45 words) than did the detached-training group (M = 446.45 words), a t-test comparison of these means was not significant. Both group means, however, were significantly lower than the word count of 659 for the experimenter-provided elaborations. Word counts were not significantly correlated with recall, recognition, application, or total scores in any elaboration treatment or for all elaboration subjects combined.

Each elaboration was further analyzed and categorized in two ways. One dimension was "personal" vs "impersonal." Elaborations that contained personal nouns, specific names of people and departments, or examples of private or personal situations were classified as "personal." The following elaboration given by one subject exemplifies this category:

> In my group, I have yet to hear what our goals and mission are. I have not had a review with my supervisor or manager and have asked for one. I feel like I'm doing a good job, but no one has confirmed this. I have to prompt my supervisor for feedback and receive very little guidance. I feel out of place in our department because I am not sure what all the services are that we offer. I have been there for 9 months and ieel an overview of the department would have been helpful. Luckily, I am the type of person that finds out for myself. I feel our department needs a lot of help.

On the other hand, elaborations that contained second-person language (you, your), generic names of people and departments (employees, managers, etc.), and company-wide policies or procedures for examples were classified as "impersonal." The following elaboration represents this classification:

> By clarifying work unit goals and objective, the employees are better informed of the mission, goals, and objectives of the department. Without the knowledge, the employees would be going off in different directions. Having a manager keep you current on the department's goals and objectives helps you do a better job and be more productive. Also by keeping your employees informed, they feel more like part of the team and their contributions are valued.

Second, each elaboration was classified in relation to the lesson content as "irrelevant," "paraphrased," or "new idea." If the elaboration was obviously not related or incidental to the content, it was categorized as "irrelevant." If it was a restatement of the principles and activities presented in the lesson, it was categorized as "paraphrased." When the elaboration expanded on the information presented so that new concepts, principles, and/or activities emerged, it was categorized as "new idea." Classifications were made independently by two raters. Where disagreements oc[illegible]ed, the classifications were discussed and revised to achieve consensus.

Inspection of the descriptive data indicated a tendency for subjects to generate personal elaborations more often than impersonal elaborations (71 percent and 29 percent respectively), C^2 (1)= 40.83; and to paraphrase content (60 percent) more often than they generated new ideas (33 percent) or gave irrelevant elaborations (7 percent) C^2 (2)=104.25.

A 2(embedded vs. detached-training group) x 2(type of elaboration) chi-square analysis of the frequencies of personal and impersonal elaborations was conducted to determine the relationship between elaboration training and type of elaboration generated. Overall, subjects in the embedded-training group generated a significantly greater number of personal elaborations (83 percent) than did those in the detached-training group (58 percent), C^2 (1) = 56.68. A 2(group) x 3(type of elaboration), chi-square was then conducted on the number of irrelevant, paraphrased, and new idea elaborations made by subjects in the two elaboration groups. It yielded a significant value of C^2 (2) = 109.02. The embedded training group paraphrased the content more frequently (67%) and gave new ideas less frequently (28%) than did the detached training group (54% and 38%, respectively). In a final series of analyses, the frequency counts for the different elaboration categories were each correlated with recall, recognition, application, and total posttest scores. None of the relationships was significant.

Discussion

It was hypothesized that subjects either generating elaborations or receiving experimenter-generated elaborations would learn more effectively than would a control group that received no elaborations or instructions to elaborate. The results supported this hypothesis for subject-generated but not for experimenter-generated elaborations.

Consistent with the findings of Mayer (1980), Barker (1987), and Speaker (1987), subjects generating elaborations surpassed control group subjects, on three out of four posttest comparisons. The generally rich and detailed elaborations (averaging close to 100 words each) of the two learner-generated groups are evidence of subjects attempting to form relations between the content and their own experiences. While the majority of elaborations (60%) were paraphrases of the content, two-thirds were new ideas generated from the content. Further, almost three-fourths were examples from subjects' experiences, thus including personalization as a dimension to increase the memorability of information (Kulhavy, in press) and its relatability to existing schemata (Anand & Ross, 1987; Davis-Dorsey, Ross, & Morrison, 1991). Only on the recognition measure, which was least cognitively demanding of the three subtests, did an advantage for learner-generated elaborations fail to occur.

However, in contrast to other studies (Bobrow and Bower, 1969; Slamecka and Graf, 1978), there were no significant advantages for either learner-generated elaborations group relative to the experimenter-generated elaborations group. However, results on the all posttests directionally favored the learner-generated elaborations groups, and, as just described, the latter groups significantly surpassed the control group on two out of three subtests where the experimenter-generated condition failed to do so on any.

In contrast to the verbal learning tasks employed in previous studies on experimenter-provided vs. subject-generated elaborations (e.g., Bobrow & Bower, 1969), the experimenter-provided communication principles and activities used here directly related to subjects' jobs and common events that most individuals should have found easy to relate to everyday work experiences. Several open-ended attitude responses suggested covert attempts to generate relations between the experimenter elaborations and individual experiences[1]. For example, one subject wrote:

> Some managers, like my own, really don't have the qualifications to be a manager. She doesn't give you any feedback, unless you've really done something terrible, and she doesn't know the organization of the company. We need an effective training program for all managers. This course made me think about how to better communicate with my manager, and what steps I can take as an individual to get the results I think are due me as an employee.

It is thus possible that the level of generative processing achieved in the experimenter-provided group was sufficient for those elaborations to serve similar functions as the learner-generated ones. However, higher-order learning, such as application and synthesis of information, is difficult to measure, particularly using instruction of short duration and objective-type test items. Limitations of the present instruments for assessing such outcomes might have masked stronger treatment differences reflecting deeper processing by the learner-generated group.

It was also hypothesized that the embedded training group would demonstrate higher achievement than would the detached training approach. This hypothesis was not supported by posttest comparisons. However, from an efficiency standpoint, the embedded strategy had the advantage of integrating the delivery of the elaboration training and the lesson in the same presentation. Accordingly, subjects could proceed through the training at their own pace and, in future lessons, bypass the training if it were no longer needed. The savings from eliminating the detached session would far exceed over time the development costs of the elaboration unit (which, with minor modifications, could be easily used on other CBI units as well). The detached training also seemed more successful in engendering attempts to relate the material to personal experiences.

From an instructional design standpoint, the results overall are supportive of incorporating elaboration strategies, where reasonable and feasible, in CBI lessons. In particular, two major advantages are indicated for the embedded strategies approach. First, the time required to develop the embedded training and orienting tasks for the learner-generated elaborations was considerably less than the time required to develop the experimenter-provided elaborations. Second, with instructional time at a premium in both school and corporate training environments, the elimination of the pretraining session by the embedded approach can substantially increase its efficiency relative to the detached training strategies.

Another consideration for designers is learners' ability to generate verbal elaborations from the content presented. In fact, all subjects attempted to construct some type of elaboration at each prompt to do so. Of the 240 (40 subjects x 6) elaborations generated, only 16 (6.7%) were classified as "irrelevant." In the present study, subjects generally found it easy to relate the material, which dealt with a work-related theme, to their everyday experiences. This personalization and higher level of learning is in agreement with the outcomes predicted by constructivists when using a generative learning approach (Biggs, 1987; Duffy & Jonassen, 1991). By comparison, Mayer (1980) presented material on computer programming that was less familiar to subjects, and therefore needed to be accompanied by special prompting and illustrations to guide subjects' production of elaborations. Effective design of elaboration strategies therefore requires careful front-end analyses of the instructional content in relation to learner backgrounds.

Further research that emphasizes qualitative analyses of elaborations is needed to obtain additional insight into how types of elaborations influence different levels of learning. The present results were inconclusive in this regard, perhaps as a result of insensitivity of the dependent measures. If such effects are known, researchers could explore uses of embedded strategies training to guide learners on-line in generating the specific types of elaboration most suited to particular learning objectives.

The full version of the paper was published in 1992, *Contemporary Educational Psychology, 17*, 125-135.

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Table 1

Means and Standard Deviations for Achievement Subtests

Group	Recall		Recognition		Application		Total	
	M	SD	M	SD	M	SD	M	SD
Control	5.20	2.29	6.45	1.76	4.00	0.97	15.65	3.54
Experimenter-provided	6.30	1.17	6.25	1.83	4.65	1.42	17.20	3.07
Learner-gen., detached	6.80	1.15	6.80	1.15	5.00	1.56	18.60	2.56
Learner-gen., embedded	7.35	0.75	6.55	1.61	5.50	0.69	19.40	2.19

Note: n = 20 in each group. Scores could range from 0 to 8 for recall, 0 to 10 for recognition, 0 to 8 for application, and 0 to 26 for total score.

Footnotes

[1]Attitude data comparing treatment groups' reactions to the lesson and to the elaboration strateg where used, were also collected but are not reported in this article.