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ABSTRACT

When the context of instructional discourse maximizes the likelihood of interaction with preexisting knowledge structures, productive learning outcomes may be increased. In the present study, 44 undergraduate students who read a hierarchically structured text were asked to recall its contents immediately and again six weeks later. The generation of topically related knowledge prior to text processing, coupled with the availability of text topics and hierarchical structure at retrieval, produced the highest level of overall recall after a six-week interval had elapsed. The availability of text topics and hierarchical structure also enhanced the generation of productive ideas when recall was tested after six weeks. These findings suggest that students should be discouraged from processing instructional discourse along solely reproductive lines. If new information is compartmentalized and differentiated from preexisting knowledge, then learning outcomes will be limited. Students who process instructional material productively can generate legitimate new products by combining newly acquired information with preexisting referential knowledge. (Author/RD)

Effects of Assimilatory and Retrieval Contexts on the Reproductive and Productive Recall of Text

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Abstract

When the context of instructional discourse maximizes the likelihood of interaction with preexisting knowledge structures, productive learning outcomes may be increased. In the present study, 44 college students who read a hierarchically structured text were asked to recall its contents immediately and six weeks later. The generation of topically related knowledge prior to text processing, coupled with the availability of text topics and hierarchical structure at retrieval, produced the highest level of overall recall after a six-week interval had elapsed. The availability of text topics and hierarchical structure also enhanced the generation of productive ideas when recall was tested after six weeks.

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The comprehension and retention of instructional discourse is heavily dependent upon the context in which information input occurs. If the context of discourse minimizes the likelihood of interaction with preexisting knowledge structures, then learners will accurately reproduce the transmitted information (e.g., Howe, 1970; Zangwill, 1972). However, if contextual arrangements stimulate interaction between discourse information and existing stores of referential knowledge, then extratextual extensions of meaning may be included in recall (Kintsch, 1976; Spiro, 1977).

In the present study, an assumption was made that similar processes are responsible for reproductive and productive learning outcomes (see Cofer, Chmielewski, & Brockway, 1976). Accordingly, a prediction was made that total recall, that is, reproductive and productive ideas combined, would be maximized when both the assimilatory context (prior to text study) and the retrieval context (subsequent to text study) facilitated interaction with learners' preexisting knowledge stores. In addition, an assumption was made that the generation of productive ideas following text study is influenced by the demand characteristics of the learning situation (Orne, 1962; Spiro, 1977). In actual school settings, learners are often encouraged to strive for accuracy when they study textual materials. Similarly, in this study learners were instructed to be accurate in their recall. In response to these instructions, learners may tend to

censor their productive ideas. The censorship of productive ideas was expected to be less pronounced on a delayed test of recall than on an immediate test because the distinction between reproductive and productive ideas would become less clear with the passage of time.

Method

Subjects and Design

Participants were 44 undergraduate students enrolled in introductory educational psychology courses. Two factors were orthogonally combined to form four experimental groups: assimilatory context (related information generation vs. unrelated information generation) and retrieval context (structural outline present vs. structural outline absent).

Textual Material

The text was generated from 15 hierarchically structured topics employed in Bower, Clark, Lesgold, and Winzenz's (1969) mineral conceptual hierarchy. These 15 topic names were paired with three attribute categories in a matrix of mineral information (see Glynn & Di Vesta, 1977). The three attributes of the matrix were the characteristic physical properties, modes of processing, and past and present uses of the minerals. The matrix was used to generate three statements about each of the 15 mineral topics. In its final form, the text consisted of 15 three-sentence paragraphs, each devoted to one of the topics. For example, the following paragraph selected from the text is about diamonds:

> Diamonds are used in many types of rock drills. As is the case with natural diamonds, the formation of synthetic diamonds requires extremely high pressure. Diamonds are composed entirely of crystalline carbon.

Structural Outlines

The Minerals Structural Outline depicted the 15 passage topics and their inherent hierarchical relations (i.e., superordinate topics subsumed subordinate topics and categorically related topics were in close spatial proximity). The content of this outline was as follows:

MINERALS

I. Metals
   A. Rare Metals
      --Silver
      --Gold
   B. Alloys
      --Steel
      --Brass

II. Stones
   A. Gem stones
      --Diamond
      --Ruby
   B. Masonry stones
      --Granite
      --Marble

The Animals Structural Outline, on the other hand, provided subjects with a comparable prereading activity which engaged assimilatory structures unrelated to passage content. This outline assumed the following form:

ANIMALS

I. Mammals
   A. Land Mammals
      --Fox
      --Bear
   B. Water Mammals
      --Dolphin
      --Whale

II. Reptiles
   A. Snakes
      --Cobra
      --Rattlesnake
   B. Lizards
      --Gila Monster
      --Iguana

Procedure

Assimilatory context. Subjects were tested in groups of four; one person in each group was randomly assigned to one of the four experimental conditions. Prior to reading the minerals passage, one-half of the subjects were presented the Minerals Structural Outline; the other one-half received the Animals Structural Outline. All subjects were instructed to generate (in writing) two accurate items of information about each of the 15 topics which comprised their outlines. All subjects then read the minerals passage; subjects were informed that testing would follow their reading.

Retrieval context. Recall was assessed immediately and again six-weeks later. At both recall periods, one-half of the subjects received a Minerals Structural Outline with instructions to refer to it during recall; the other one-half of the subjects received no retrieval aid. All subjects received the following general instructions:

> Write down in any order you wish all of the sentences you can recall from the passage you read. Report your information in the form of sentences and not as isolated words. Try to be as exact as you can in your recall. If you are uncertain that you read a particular fact, report it anyway in sentence form and in your own words.

Recall Measure

In general, acceptable propositions (idea units) were recalled statements which associated one of the 15 mineral topics with an item of information subsumed under one of the three attribute categories. An acceptable proposition was classified as either replicated, transposed, or elaborated.

Replicated propositions. As its name suggests, a replicated proposition is a reproductive learning outcome. This kind of proposition linked a mineral topic name with its associated attribute item (value) as given in the text. For example, "Diamonds are used in many types of rock drills."

Transposed propositions. A transposed proposition is a productive learning outcome; it paired a mineral topic name with an attribute value that was originally associated (in the text) with another topic name. For example, "Diamonds are used to make lasers." The attribute value "lasers" was originally paired with the topic "rubies." Transposed propositions were reasonable if not always technically accurate.

Elaborated propositions. Another type of productive learning outcome is the elaborated proposition. For example, "Steel is used for lightning rods." Here, "lightning rods" is an attribute value which is logically subsumed under the category of use; however, this value was not among those discussed in the text. Hence, it is an importation based on the interaction of the text and the learner's referential knowledge.

Results

A 2 x 2 x 2 x 3 mixed analysis of variance was performed in which assimilatory context and retrieval context were between-subjects factors and retention interval and type of proposition recalled were within-subjects factors. The data of five subjects who were unable to return for a second session six weeks later were excluded from this analysis.

Overall recall was higher when related statements were generated prior to reading (M = 26.52) than when unrelated statements were generated

(M = 17.92), $F(1, 35) = 326.23$, $p < .001$, $MS_e = 10.22$. In addition, overall recall was higher when retrieval outlines were present (M = 27.11) than when they were absent (M = 18.33), $F(1, 35) = 9.12$, $p < .01$, $MS_e = 10.22$.

Immediate overall recall (M = 13.68) was higher than recall after six weeks (M = 9.04), $F(1, 35) = 25.01$, $p < .001$, $MS_e = 5.57$. This main effect was qualified by a significant interaction between retention interval and retrieval context, $F(1, 35) = 13.58$, $p < .001$, $MS_e = 5.57$, which indicated that the retrieval outlines were most useful when recall was assessed six weeks after text reading. Thus, overall immediate recall with an outline (M = 14.16) was no better than overall immediate recall without an outline (M = 13.20); however, six weeks later, overall recall with an outline (M = 12.96) was superior to overall recall with no outline (M = 5.13).

The significant three-way interaction (see Table 1) of assimilatory context, retrieval context, and retention interval, $F(1, 35) = 6.11$, $p < .01$, $MS_e = 5.57$, indicated that the generation of related statements prior to text reading, in combination with the availability of a Minerals Structural Outline at retrieval, produced the greatest amount of overall recall after six weeks.

A significant main effect for type of proposition recalled, $F(2, 70) = 26.59$, $p < .001$, $MS_e = 8.23$, revealed that replicated propositions (M = 11.46) were recalled better than transposed (M = 5.44) and elaborated (M = 5.83) propositions, which were recalled equally well. This effect must be interpreted in light of the significant interaction between type of proposition recalled and retention interval, $F(2, 70) = 71.12$, $p < .001$, $MS_e = 4.45$, which showed that the immediate recall of replicated propositions (M = 8.82)

was superior to that of transposed ($\underline{M}$ = 2.07) and elaborated ($\underline{M}$ = 2.80) propositions; six weeks later, however, the recall of replicated propositions ($\underline{M}$ = 2.64) approximated that of transposed ($\underline{M}$ = 3.38) and elaborated ($\underline{M}$ = 3.03) propositions.

The interaction of retrieval context, type of proposition recalled, and retention interval was also found to be significant, $\underline{F}(2, 70) = 5.69$, $\underline{p} < .01$, $MS_e = 4.45$. As can be seen in Table 2, the provision of a retrieval structural outline six weeks after text reading effected greater recall of transposed and elaborated propositions.

Discussion

The present findings indicate that total text learning (i.e., reproductive and productive) can be enhanced by two factors: (a) the generation of topically related knowledge prior to text processing and (b) the availability of text topics and hierarchical structure (via the structural outline) at retrieval. Furthermore, these factors in combination can ensure that learning outcomes are stable and relatively long lasting (i.e., at least six weeks).

When learning is assessed immediately after text study, reproductive ideas outnumber productive (i.e., transposed and elaborated) ideas. Learners who perceive accuracy to be a demand characteristic of the task at hand presumably fail to report the productive ideas which they have generated. Indeed the demand for accuracy appears to override the knowledge "prompts" provided by the retrieval structural outline. Six weeks later, however, the presence of the structural outline during recall can reverse these outcomes. Perhaps, when text information is related to a preexisting knowledge store, the former is assimilated into the latter. Over the course

of time, text information loses its unique identity and the boundaries separating preexisting information, text information, and newly constructed information may become less distinct.

In general, the present findings suggest that students should be discouraged from processing instructional discourse along solely reproductive lines (in the fashion of subjects in typical memory experiments). If new information is compartmentalized and differentiated from preexisting knowledge, then learning products will be limited. Instead, students should be encouraged to process instructional material "productively." Students who combine newly acquired information with preexisting, referential knowledge can generate legitimate new products.

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Table 1

Mean (Overall) Recall of Propositions

Assimilatory and Retrieval Contexts	Immediate Recall	Recall After Six Weeks
Related Statement Generation		
Retrieval Outline Present	15.33	17.36
Retrieval Outline Absent	14.90	5.45
Unrelated Statement Generation		
Retrieval Outline Present	12.98	8.55
Retrieval Outline Absent	11.50	4.80

Table 2

Mean (Categorized) Recall of Propositions

	Immediate Recall			Recall After Six Weeks		
Retrieval Context	Repli-cated	Trans-posed	Elab-orated	Repli-cated	Trans-posed	Elab-orated
Retrieval Outline Present	9.25	1.96	2.95	2.90	5.16	4.90
Retrieval Outline Absent	8.38	2.17	2.65	2.38	1.59	1.16

Note. Maximum score per cell for replicated propositions equals 45.