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Assessing Understanding in School-aged Children

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Abstract

Previous studies have shown that adult subjects can recognize and, under certain conditions, recall material they have learned, but not understood (Wilson & Probst, 1990). Under conditions where the material must be understood to be applied, however, comprehenders and non-comprehenders are not equally successful (Wilson, 1991). Since children's cognitive processes differ from adults', this experiment attempted to replicate Wilson and Probst using 63 fifth-grade students to see if previous findings applied to children.

How many of you are familiar with the expression, "A watched pot never boils?" If you were in my classroom and I used that expression, you would probably understand that I mean "When you're waiting for something, it seems to take a long time." My use of the idiom would solidify the point in your mind. If, however, I were to say "He's like a bottle in the smoke," you might not understand the analogy. So, no matter how appropriate the expression may be, it would not help you learn what I'm teaching.

Suppose now that it's Friday, and I give you a test on those two expressions. Will you remember what the pot doesn't do? Where the bottle is? If I phrase the questions in that way, you probably will be able to answer them. If, on the other hand, I ask you "What happens when you're waiting for something" or "How vital do I consider this person," will you know the answers? Most likely, you will be able to answer the first question, but not the second. More importantly, you will not be able to use the information inherent in the second analogy for anything but carefully worded tests.

This is, in fact, what happens in many of our schools on a daily basis. Our students do not know which area of their background knowledge to activate to understand the new information we give them. In the above example, one would have to know "a bottle in the smoke" is a Biblical idiom. Then one would need to remember that in ancient Middle Eastern culture, unlike our culture, bottles were made of animal skins. A bottle that was left to hang near the fire, or in the smoke, would dry out and become unfit for service. So "a bottle in the smoke" was a colloquialism for something that had become useless. If you were unable to understand this expression, you were momentarily in the same position as a student who doesn't understand the expression A = L x W. Both expressions can be memorized, but they are of no value for future understanding. Children may be able to repeat the formula applied to a given concept, but they do not know how to actually solve problems. Simply learning the vocabulary and mnemonics isn't sufficient. Since the concept hasn't been learned, the students cannot recognize how to apply it or what constitutes errors (Wilson, 1987). This doesn't only happen to children. College students may have the same experience when studying statistics, physics, or neuropsychology.

Numerous experiments have demonstrated the relationship between comprehension of context and memory. (Bransford & Johnson, 1972, 1973; Fisher & Craik, 1977; Morris, Bransford & Franks, 1977; Tulving & Thomson, 1973; Wittrock, 1991). Wilson and Probst (1990) presented subjects with a series of sentences that were difficult to understand without knowing the context. For example, the sentences "The pin was important because the teeth broke" and "We went into the cornfield because the student forgot his glasses" are confusing if one does not know the context of the sentences. The "comprehenders" in the study heard a context cue before each sentence, such as "Blue jeans: The pin was important because the teeth broke." or "Driver's ed: We went into the cornfield because the student forgot his glasses." The noncomprehender group heard the sentences without any context cues. Later, the subjects were tested for recall using a cue physically related to the original sentence (a surface structure cue) or to the meaning of the sentence (a deep structure cue).

Examples of recall cues:

The pin was important because the teeth broke.
ss: teeth broke ds: fastener substitute

We went into the cornfield because the student forgot his glasses. ss: cornfield ds: auto accident

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Following the recall test, subjects were given a recognition test for the original sentences. Recognition was very good for both those who received the cue at the time of encoding (comprehenders M = .95) and those who did not (non-comprehenders M =.97). Hence, recognition was not affected by comprehension. Similarly, recall using surface structure retrieval cues was not affected by comprehension. A physical part of the sentence (a surface structure recall cue) worked equally well in retrieving the structural encoding of the original sentence for both groups (M = .40 and .44). However, when deep structure cues related to the meaning were presented, the performance of comprehenders improved to 64 percent recall, while that of the non-comprehenders dropped to 10 percent. When dealing with the meaning of the sentence, non-comprehenders were left to their own devices.

Why should students be able to remember things if they haven't really learned them? The above findings agree with studies of transfer appropriate processing (Fisher & Craik, 1977; Morris, Bransford, & Franks, 1977), and encoding specificity (Tulving & Thomson, 1973). Theoretically, if learning were tested in a way that matched a person's original processing, the material would be well recalled. If the material was learned in terms of its surface structure, rather than its meaning, we would expect cues related to its surface structure to be good retrieval cues. For example, if academic tests resemble the original material closely enough, the student can rely on the physical similarities between the original material and the test items to fill in the blank or choose the right multiple-choice answer. Yet, a discussion of the concepts involved may reveal that the student cannot understand the meaning of the concepts.

Since children's cognitive abilities may differ from adults' (Piaget & Inhelder, 1973), it is important to know how these findings apply to them. If, as hypothesized, children show the same ability as adults to recognize and recite material they do not understand, we as educators must be careful in our assessment of learning.

Method

Materials

A series of sentences, which were difficult to understand without knowing the context, was pretested on a pilot group of fifth-grade children. The children first heard the sentences without the context and asked if they could understand the sentences. Then each sentence was given preceded by the context as a comprehension cue. The children were asked if they understood the sentences this time. If so, they were asked individually to tell what they thought the sentences meant. Sentences that could be correctly understood with the comprehension cue, but not without it, were used for the acquisition list for the study.

Setting and participants

Sixty-three fifth-grade children participated in the study. Thirty-two children (17 boys and 15 girls) were in the experimental group. The other thirty-one children (17 boys and 14 girls) were assigned to the control group.

The entire "regular education" fifth grade class for the school visited during the study was housed in a double classroom, a holdover from the open classroom practice of previous years. Although the students were officially divided into two classes on the rolls, the group functioned as one class. Two teachers team-taught all the students, dividing teaching responsibilities between themselves. Many daily learning activities were conducted in small groups in various corners of the classroom. This study was conducted in the students' regular classroom with students in the two conditions gathered in different parts of the room as they would be for regular daily instruction.

This particular class was exceptionally large, so there were two full-time instructional aides assigned to the classroom. The classroom aides presented the study as though it were part of an ongoing series of exercises on listening and following directions. All the instructions for the study were given on audiotape or by the aides.

Procedure

The children were separated into groups for the study and asked to meet in different sections of the room. Both conditions were run simultaneously, in order to prevent the children from talking about the experiment with children in the other condition, and to complete the study as efficiently as possible so as to be least disruptive to the regular classroom schedule. At the beginning of the study, one of the aides read aloud the instructions to the entire group of children. This included an explanation that all the sentences would be presented on tape and the students had to listen carefully, because nothing could be repeated. In addition, the children were to rate each sentence for comprehensibility on a numbered sheet that had been provided for them. The aide went over the five-point rating scale and had the children mark which numbers meant "easy to understand" and which numbers meant "hard to understand". The purpose for rating the sentences was to keep the children on task as they listened to the materials.

The acquisition sentences for each condition were prerecorded and presented on audiotape at ten second intervals. The control group heard the acquisition sentences without the context comprehension cues ("non-comprehenders"). The experimental group heard the sentences preceded by the comprehension cues ("comprehenders"). The children were asked to rate the sentences for comprehensibility as they heard each sentence. After all the sentences had been presented, the two groups were subdivided for counterbalancing of the test materials. Those with odd-numbered test packets went to one side of the room with one of the instructional aides, those with even-numbered packets went to the other side of the room.

Both the cued recall and recognition tests were given on audiotape, to eliminate confounding due to discrepancies in reading ability. The cued recall test (given first) comprised seven deep structure cues and seven surface structure cues, intermingled in a predetermined random order. Deep structure and surface structures cues for each sentence were counterbalanced across subjects. The students had 40 seconds to write the sentence that corresponded to the cue. (The time allotment had been predetermined by observing the pilot group). The recognition test consisted of seven target sentences from the original list randomly mixed with fourteen foils. Students were given a page numbered from one to fourteen with the words Yes and No written after each number. They were asked to circle Yes if they remembered hearing the sentence in the first part of the exercise and No if they did not remember it.

Examples of (acquisition context cues), sentences, and surface and deep structure recall cues:

(Watching television) The picture was poor because the wind blew. ss: wind blew ds: TV antenna

(Snowman) The man grew smaller when the sun came out. ss: grew smaller ds: melting figure

(Grandfather clock) The hand stopped because the chain broke. ss: chain broke ds: telling time

Results

The pattern of results for the research with children was the same as those found for adult subjects. Recognition performance did not separate comprehenders from non-comprehenders, t (61) = .28, ns. Comprehenders (M = .86, sd = .10) and non-comprehenders (M = .87, sd = .11) did equally well on the recognition test. All tests in this study were conducted with an alpha level of .05.

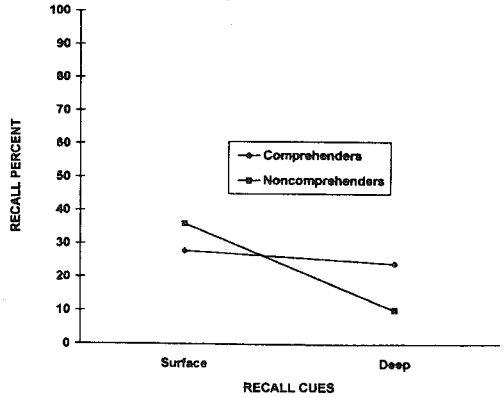

Figure 1. Comprehenders' and noncomprehenders' recall as a function of type of cue

A mixed design analysis of variance using comprehenders vs. noncomprehenders as a between subjects variable and deep or surface structure recall cues as a within subjects variable indicated there was a significant main effect for type of recall cue F (1, 61) = 22.22, MSe = .68, and a significant interaction between cue and experimental group, F (1,61) = 12.73, MSe = .39, but there was no effect for group, F (1, 61) = .44, MSe = .03. Planned comparisons found no difference between the two groups with respect to recall using surface structure cues, F (1, 61) = 2.01, MSe = .05. Deep structure cues, however, did separate comprehenders' recall from noncomprehenders', F (1,61) = 8.46, MSe = .04. The recall means for comprehenders and noncomprehenders shown in Figure 1 were M = .28 and M = .36 for the surface structure cues and M = .24 and M = .10 for the deep structure cues.

Discussion

When the to-be-learned material was re-presented at the time of test, either as an item to be recognized or as a surface structure cue, there were no test differences between the comprehenders and the noncomprehenders. When the children were given deep structure cues related to the meaning of the sentence, only the comprehenders were able to answer the questions correctly. The noncomprehenders did not understand the sentences and were not able to use the information in the sentences intelligently. This research demonstrates that recall using surface structure cues is not adequate for assessing understanding.

We asked the pilot group what they had learned from the sample sentences. It was clear that their understanding did not always match the original intent of the message. The sample sentences were from a list which was comprehensible to adults who heard the context (Wilson & Probst, 1990). Adults who are presenting new material to children must keep in mind that children have a different set of experiences from which to draw when interpreting new information. Background knowledge that is deficient must be filled in before attempting to build new structures on it.

One finding in the current study that differed from the data pattern obtained with adult participants was that the children in the comprehender group did not show better deep structure cued recall than surface structure cued recall. This may be attributable to the fact that inferential thinking is still a relatively new skill in fifth grade. Many students demonstrate a vulnerability to the way worksheets and tests are worded. When children are in the process of developing a cognitive skill, they may sometimes fall back on previously used strategies or vacillate between two or more strategies (Flavell, 1979, p. 221; Siegler, 1987, 1988).

Frequently we use tests which require no more than recognition or recall of learned material. The results of this study suggest that noncomprehenders as well as comprehenders could often fill in the blanks, select the right multiple-choice answer, or answer true/false questions. Furthermore, in situations where educators teach to the test, the assessment is tantamount to a simple recognition test. Results for our recognition test were very high. Recognition and surface-structure-cued recall may not measure understanding and consequently would not assess the ability of the learner to use the material in appropriate contexts. The

continued on page 45

Mentor Roles

continued from page 20

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Assessing Understanding

continued from page 14

ability to make inferences, understand consequent events, recognize novel instances, and detect gross errors are necessary for transfer of learning, critical thinking and problem solving by adults (Wilson, 1987). More research is needed to see if children comprehenders have similar abilities.

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