Title	Test-like events: An aid to learning
Author(s)	Fred L. Perry, Jr.
Source	*Singapore Journal of Education, 4*(2), 44-47
Published by	Institute of Education (Singapore)

Fred L. Perry, Jr.

Test-Like Events: An Aid to Learning

The chief use of testing in the classroom has been to measure the achievement of students in regards to a particular set of instructional objectives. Lesser emphasis on classroom testing has been to diagnose a student's weak points or those of the Instructional programme itself. Recently, however, there is evidence to suggest that the use of "test-like" events is a very effective technique to facilitate learning. Some teachers have understood this to mean that they should give frequent tests in order to aid learning. And yet, other teachers as well as students have complained that too much testing interferes with the learning of new materials. The chief purpose of this paper will be to propose a solution by discussing ways in which test-like events can be used to aid learning while, at the same time, not interfering with learning. First, a summary will be given of recent findings which highlight the learning effect produced by test-like events. The reader will find it necessary to understand an abbreviated presentation of a particular theory of cognitive processing and memory which the author hopes will not be hampered by its brevity. Finally, a discussion will be presented on practical ways these findings and theories can be applied to the classroom.

The term "test-like" events was coined by Rothkopf (1966) to refer to questions interspersed among instructional materials. However, before launching into the main body of this paper, a short note should be made regarding the use of orally presented questions as a teaching technique. As a general rule, courses on teacher methodology have promoted the idea that asking questions in the classroom aids learning (e.g. Cunningham, 1971; Hoover, 1976; Hunkins, 1972). A recent review by Winne (1979) suggests, however, that results from empirical research show conclusions still too premature for various reasons as noted by Andre (1979). First, agreement as to how to categorize various orally presented questions is lacking. Second, orally presented questions are typically responded to by one student at a time which reduces the chances that every student will process the information in preparation to give an answer: a necessary ingredient for question effectiveness, as will be argued later. Finally, evaluation of student achievement following orally presented questions has been too general to reveal the more specific learning effects of questions. Therefore, this paper will *not* address itself to the issue of orally presented questions as generally advocated in teaching methodology courses except in making final suggestions in the concluding remarks.

Several recent reviews of research (Anderson and Biddle, 1975; Andre, 1979; Rickards, 1979) have outlined the development of theory and related research regarding the effects of questions upon learning. This current interest was initiated by Rothkopf (1966) who proposed that "test-like events" (i.e. questions) facilitated the learning of textual materials. In the studies that followed, questions (adjunct questions) were either presented prior to (pre) or following (post) relevant parts of texts they were related to, typically just before or after a paragraph of texts. Adjunct questions and texts did not appear on the same page and subjects were advised not to proceed until they had finished each page nor to refer to any previous pages. Upon completion, they were given a comprehension test which included questions relating to information not previously tested by the interspersed questions as well as the questions previously encountered.

Results from these studies have been relatively consistent. Questions given prior to related paragraphs have aided retention of information directly related to the questions but failed to do so for unrelated material. Questions inserted after their respective paragraphs increased retention for both information directly related to the inserted questions and information not directly questioned.

Several cognitive strategies have been proposed to account for the above findings (Anderson and Biddle, 1975; Frase, 1970). The pre-question effect has been explained as the result of forward scanning behaviour. That is, once readers know the question prior to the test, they begin a search for the related information; unrelated information receives little attention and fails to be processed. On the other hand, the explanation has been given regarding the post-question effect that readers must attend to all the information in a paragraph until they encounter the questions after the text. In addition, to answer such questions the reader must rehearse the information mentally to find the answer to the question. As a result, retention

for both related and unrelated information is enhanced.

More recent findings, reviewed by Rickards (1979), have supported the notion that the effects of post-questions can differ depending on the nature of the question. Post-questions which ask for highly detailed information not only have a review effect upon previously given paragraphs but work in establishing a learning set toward the kind of information queried. To illustrate, if the interspersed questions are consistently asking for specific information such as names and dates, the reader begins to look for this type of information in succeeding paragraphs. Thus, the reader has developed a particular learning set (or pattern) toward remembering dates and names. On the other hand, when interspersed post-questions request information at a more generalized level of understanding, there is evidence to the effect that the reader approaches subsequent paragraphs with a higher state of awareness as well as the typical mental review effect.

Andre developed this theme further in his recent review of research (1979) which examined the differential effects of the level of questioning upon the retention of textual materials. The theme of this article centres on the merging of the 'depth-of processing' notion set forth by Craik and Lockhart (1972), the memory model proposed by Tulving (1972) and the questioning techniques developed by Bloom, Englehart, Furst, Hill and Krathwohl (1956) and Anderson (1972). Craik and Lockhart proposed that the "deeper" information is processed by the learner, the more enduring and accessible the information will be in memory. The determining factor in the level of processing is chiefly the degree to which the meaning has been processed. Consequently, information committed to rote memorization is stored at a higher and more superficial level than information which has been summarized or analyzed by the learner.

Tulving (1972) described a model for memory which consisted of the traditional components of *Sensory Registors, Working* and *Long-Term Memories.* The Sensory Registors comprise various parts of the human nervous system which initially record information, i.e. eyes, ears, nose and tactile mechanisms. Here information is "remembered" for very short periods measured in milliseconds. The Working Memory refers to all that people are totally conscious of at any given moment and is governed by a limited storage capacity. However, Tulving added a new dimension to Long-Term Memory when he divided it into *Episodic* and *Semantic* Memories. It is this distinction that has particular significance in education. Episodic Memory is a long-term memory bank characterized by the information being stored in association with a given episode or context. This information will only be recalled to Working Memory if the related context is given: usually a similar context that the student initially recorded the information in. This proposal provides an explanation for why students can recall information under one type of test conditions but not another.

Semantic Memory, according to Tulving (1972), contains more generalized knowledge. Information in this store has been liberated from only one contextual association so that it can be applied to new problems, therefore, making it more useful. For this reason, the obvious goal for an educator would be to find ways by which information can be transferred from Working Memory and/or Episodic Memory into Semantic Memory.

Andre argues along with others (Bloom, *et al.*, 1956; Anderson, 1972) that the type of question a reader encounters can play an important role in determining how the information is processed. Andre (1979) suggested that the deeper the level of Question – that is, the more cognitive involvement elicited by the question – the deeper the processing (in Craik and Lockharts' terms) and, therefore, the greater the opportunity for the information to be stored in Semantic Memory (*à la* Tulving). Andre then provides a useful description of the types of questions used in various research (p. 282). For example, factual questions simply require the reader to recall or recognize factual information previously encountered. However, paraphrased questions will require the reader to grasp the meaning of the passage before successfully completing it. Other types of questions such as application questions may require additional cognitive processes which according to Craik and Lockhart, produce a deeper level memory representation.

The related research reviewed by Andre (1979) supports the notion that various types of questions produce differential processing of information. One group of studies basically supported the conclusions made by Richards (1979); that is, that specific factual questions aid readers to focus on the related factual information while questions requiring more mental processing direct the readers to attend and remember more information.

The level of processing proposal was supported by a second body of research (Andre, 1979). Table I summarizes the principal findings. As indicated, all types of deeper level questions not only facilitated the memory for information but also caused information to be stored in a manner that could be used in other tasks.

Andre cites evidence from other research, however, which puts three constraints on the conclusions that can be made from such findings. First, the facilitation effect was limited to the

TABLE 1 EFFECTS OF DEEPER LEVEL ADJUNCT QUESTIONS UPON SUBSEQUENT LEARNING BEHAVIOUR

TYPE	RESULTS
Paraphrased	Comprehension increased, novel problem solving enhanced
Application	Enhanced making application in new situations and novel problem solving
Inferential	Aided in making new inferences

content area contained in the text. In other words, one could make application to novel situations which related to the information studied but not unrelated novel situations. Second, the effects summarized in Table 1 were less obvious for subjects who were considered highly academically capable. Andre attributed this latter finding to the fact that good students have developed their own learning strategies to the point that they do not require such instructional aids. In essence, they automatically employ strategies which process information at deeper levels. Finally, the reader must be able to derive the answer from the text to answer the adjunct question in a correct way. Questions that are too difficult will result either in no information or incorrect information being stored in memory. This, of course, would defeat the purpose of using adjunct questions.

In summary, the above discussion has provided evidence to suggest that questions, or test-like events, can be used for reasons other than evaluating students' academic achievements. Adjunct questions have been shown to have two functions in aiding people in learning strategies: to orient people toward specific learning strategies and to regulate the cognitive level at which a person processes information. The first function can either work for or against the learner, however. Orienting students toward the use of specific strategies is fine as long as this is one of the instructional objectives. However, it is misleading to students to use one type of test continually requiring certain cognitive strategies and then, without notice, to test them requiring other strategies. For example, if students are continually tested on their memory of factual information in classroom situations, many students will focus on factual information during their studies. When they later encounter exams which present questions asking them to apply concepts to new problems or draw inferences, etc., they will find themselves at a great disadvantage.

The second function of adjunct questions is to determine at what level information gets processed. Again, if students are mainly asked to reflect back to the teacher in a verbatim fashion the information they were to learn, information seldom reaches levels of meaningful learning. This type of testing leads to students using mnemonic devices such as rhyming, rote rehearsal, or building elaborate pictoral scenes which work to hold large quantities of detailed information in memory. Such strategies are useful for remembering things as names, dates, terms, etc., but provide no guarantee that meaning, relationships, practical use, etc. are being processed. However, the use of deeper level questions in the classroom will aid the student to process information at more meaningful levels.

Before applying the above discussion, there are two constraints put forth by Anderson and Faust (1973). First, everyone must respond to each question in order to promote the desired mental processing. Second, students must not be able to see or hear the questions until after they have been exposed to the instructional material. If exposure is premature, then a scanning behaviour will follow resulting in little information being processed other than what is directly related to the question.

One particular way adjunct questions have been applied to education has been the use of adjunct questions in textbooks. Although such a procedure looks at first to be implementing adjunct questions, serious doubts exist regarding their effectiveness based on the two constraints mentioned above. First, many students, pressed for time, simply bypass the questions and get on with the reading. Others, having no restraints to keep them from using such questions before reading the test, *scan* for relevant information and ignore the rest.

However, all hope is not lost. These constraints can be maintained for textual materials in areas such as Computerized Instruction where

students cannot see the question after the text until they have pushed the RETURN key. If programmed correctly, the text will then be erased from the screen followed by the appearance of the question(s). In addition, the following text will not appear until the student has responded correctly. Consequently, there is more insurance that the student will use the appropriate cognitive strategies without taking any short cuts.

Using adjunct questions in the classroom, on the other hand, has its main drawback in that if orally presented, only one student typically responds. The hope that the other students are making internal responses is partly justifiable but most likely, this is not the case. However, to increase the probability that every student will respond, the instructor may pose a deep level question to students following the presentation of a section of instructional materials which everyone must respond to by paper and pencil. Thus, everyone is able to respond and students can have an opportunity to bring together or apply in a novel situation the material they were most recently exposed to. In addition, the teacher will avoid producing the negative results of interference produced when students prepare for a test outside the classroom.

The above recommendation will not replace the test constructed to measure achievement but will facilitate learning. Since it is the goal of every teacher to help students learn the instructional materials, using subject questions may prove to be very beneficial. However, research regarding the use of adjunct aids in the classroom is still lacking and, therefore, teachers should experiment for themselves as to how adjunct questions might help in their specific learning situation.

References

Anderson, R. C. How to construct achievement tests to assess comprehension. *Review of Education Research,* 1972, *42,* 145–170

Anderson, R. C. and Faust, G. *Educational psychology.* New York: Dodd Mead, 1973.

Anderson, R. C. and Biddle, W. B. On asking people questions about what they are reading. In G. Bower, (Ed.), *Psychology of learning and motivation, 9,* New York: Academic Press, 1975.

Andre, T. Does answering higher level questions while reading facilitate productive learning? *Review of Educational Research,* 1979, *49,* 280–318.

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H. & Krathwohl, D. R. (Eds.) *Taxonomy of educational objectives: Cognitive Domain,* New York: David McKay, 1956.

Craik, F.I.M. and Lockhart, R. S. Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behaviour.* 1972, *11,* 671–684.

Cunningham, R. T. Developing question-asking skills. In J. E. Weigand (Ed.), *Developing teacher competencies.* Englewood Cliffs, N. J.: Prentice-Hall, 1971.

Frase, L. T. Boundary conditions for mathemagenic behaviors. *Review of Educational Research,* 1970, *40,* 337–347.

Hoover, K. H. *The Professional Teacher's Handbook.* Boston: Allyn and Bacon, 1972.

Hunkins, F. P. *Questioning strategies and techniques.* Boston: Allyn and Bacon, 1972.

Rickards, J. P. Adjunct postquestions in text: A critical review of methods and processes. *Review of Educational Research,* 1979, *49,* 181–196.

Rothkopf, E. Z. Learning from written materials, An exploration of the control of inspection behavior by test-like events. *American Educational Research Journal,* 1966, *3,* 241–249.

Tulving, E. Episodic and semantic memory. In Tulving, E. and Donaldson, W. (Eds), *Organization of memory.* New York: Academic Press, 1972.

Winne, P. H. Experiments relating teachers' use of higher cognitive questions to student achievement. *Review of Educational Research,* 1979, *49,* 13–50.