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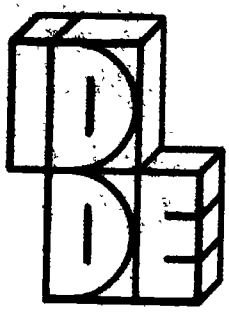
ABSTRACT

Self-instructional booklets simulating computer-assisted instruction (CAI) were used to teach four basic concepts in science to first graders in three treatment groups which received different types of feedback--hints, correct answers, and right or wrong. A control group received neither instruction nor feedback. A multiple-choice test was administered to the 47 students in the 4 groups following completion of the instruction. It was found that the group provided with hints had the highest mean; the group provided with the correct answer had the second highest mean; the group provided with right/wrong feedback had the second lowest mean; and the control group had the lowest mean. The results were inconclusive with respect to the hypotheses as there were no significant differences among the group means. Possible causes are suggested in the discussion that concludes the report. A table summarizing the means and standard deviations, a flowchart showing the hypothesized model of relationships between different forms of feedback, and samples of generalities, practice items, and test items are provided. Lists of 12 references and 10 prior IDD&E working papers are also included. (Author/RP)



INSTRUCTIONAL DESIGN, DEVELOPMENT, AND EVALUATION

WORKING PAPERS

THE EFFECT OF THREE DIFFERENT KINDS OF FEEDBACK: HINT, CORRECT ANSWER, AND RIGHT/WRONG

by

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ABSTRACT

Self instructional booklets were used to teach four basic concepts in Science to 47 first graders. Different kinds of feedback were applied to different treatment groups. A multiple-choice test was administered to students following their completion of the instruction. The group provided with hints had the highest mean. The group provided with the correct answer had the second highest mean. The group provided with right/wrong feedback had the second lowest mean. And the control group had the lowest mean. The results were inconclusive with respect to the hypotheses. There was no significant difference among the group means. Possible causes are suggested in the discussion section.

INTRODUCTION

When students are made aware of the correctness or incorrectness of their response, they remember more on a later test (Anderson, Kulhavy & Andre, 1971; Gilman, 1969; Meyer, 1960). Kulhavy (1977) identified four concerns related to feedback. They are feedback-as-reinforcement, availability of feedback, feedback and learning, feedback and learner expectations.

First, when feedback is used as a reinforcer to shape a student's behavior, there is little evidence to support the behaviorists' assumption that desired events will occur. Feedback does not have its greatest effect on correct responses (Anderson et al; 1971). There is no good reason to believe that the way a reinforcer is used to shape behavior in a laboratory will occur in learning. In a laboratory, pigeons look for food because of hunger. In a classroom situation, it isn't necessarily true that students hunger for knowledge. There is evidence from previous research that feedback does not act as a functional reinforcer. In fact, the Delay-Retention Effect (DRE) strongly opposes the reinforcement interpretation of feedback: learners who receive immediate knowledge of the correct responses, or feedback, retain less than learners for whom feedback is presented after a period of delay(Kulhavy & Anderson, 1971).

Secondly, studies show that students learn little if they can copy answers from cues available instead of reading text (Anderson, 1970; Kulhavy & Yekovich, 1976). The term 'presearch availability' refers to situations when students can locate the correct answer very easily without first searching through the text. When presearch availability is high, students simply copy the right answer. When presearch availability is low, students have to study hard to produce a correct answer, and students learn more through the laborious search (Anderson, Kulhavy & Andre, 1971, 1972).

Thirdly, feedback has two effects on each response that a student makes. One is merely to let him know when he is wrong. The second is to correct him or let him correct himself when he is wrong. The theoretical perspective for this aspect of feedback is information processing theory. This theory assumes that students possess at least some prior knowledge which can be related to the material being studied. Feedback to a correct response confirms the action and informs the student of his overall comprehension. Feedback on incorrect answers acts as a correcting agent to correct wrong responses.

The DRE study (Kulhavy & Anderson, 1971) further supports this notion. It found that if delay occurs between the error and the feedback, incorrect responses tend to be

forgotten, and there is a greater likelihood that the correct answer will be learned from the feedback. The DRE research clearly shows that feedback not only works to identify errors, but also helps the students to correct them. Again, such conclusion is based on the assumption that the students comprehend the instruction in the first place. Feedback has little effect if the students are unable to comprehend the instruction or to fit it into their existing information framework (Kulhavy & Parson, 1972).

Fourthly, Kulhavy speaks of the concern of relating feedback effects to student perceptions. The interaction between student expectation and feedback has a powerful effect on what the student remembers from the instruction (Kulhavy, Yekovich, & Dyer, 1976). If a student has high confidence but the response chosen is a wrong one, the student will spend a substantial amount of time figuring out where the problem is. Consequently, the student is more likely to replace the error with the correct answer on a later test (Kulhavy, Yekovich, & Dyer, 1976). It was found that high-confidence correct responses yield the shortest feedback study times, high-confidence errors yield the longest time, and low confidence answers fall somewhere in between.

There are studies showing that feedback does not facilitate learning (McDonald & Allen, 1962; Sullivan, Baker & Schutz, 1967; Sullivan Schutz & Baker, 1971). Most of the research showing no feedback effect are usually so heavily cued that students need not study the content of the instruction at all. Basically, these studies have a different kind of definition of feedback from the kind that we have discussed. In general, there is little doubt that feedback is one of the most powerful tools in instruction.

We postulate that the most powerful aspect of feedback lies in its corrective function. It is surprising that little work has been done to determine what kind of feedback results in the best learning. We are interested in examining what specific kind of feedback message is most effective for the correction of errors. We postulate that providing hints rather than merely the correct response after an error should improve learning because it requires learners to exert more effort to search for the correct answer. Thus, it generates greater depth of information processing. The purpose of this study is to test this proposition.

Definitions

The word 'feedback' is used in this study to represent any kind of message that (1) is related to a response and

(2) is provided to students after the response. It can be presented in the form of a hint, the correct answer, or right/wrong knowledge of results. A hint is defined as information providing clues for the discovery of the error when an incorrect response is made and identified. A correct answer is the response that should have been given in place of an incorrect answer. It does not include information about the correct process to use. Right/wrong knowledge of results is telling students if their responses are right or wrong, and nothing more.

The hypothesized model in Figure 1 illustrates different stages of how different forms of feedback function during the learning process. The rightmost branch indicates a process when no correct answer is provided. In this case, the learner has no other choice but to go on to the next practice item. In other words, as information processing theory puts it, no action of encoding or decoding is happening. It is predicted that the amount of learning, in this case, is minimal. The next branch to the left indicates what happens when a learner is provided with the correct answer. Some kind of process is taking place in the learner's brain, for he has to replace the error with the correct answer. The second next branch to the left indicates what happens when a learner is provided with a hint. Given a hint to work as a corrective agent which provides clues leading to discovery, the student is likely to spend more time on the problem. At the same time, he has to go through more complicated information processing. First, he has to locate the source of the mistake. Then, he has to find out the correct answer. This involves several runs through of encoding and decoding which should automatically increase the level of comprehension.

Insert Figure 1 about here

There is evidence that the presence of feedback in any form can facilitate learning (Anderson, Kulhavy & Andre 1971; Gilman, 1969; Meyer, 1960). We hypothesize the same thing : that feedback in any form will result in better learning than no feedback. We also hypothesize that supplying a 'hint' after an error is more effective than providing other forms of feedback. This hypothesis is made based on the fact that whenever learners are made aware of their wrong performance, they must not only eliminate the wrong response, but must also look for the correct response to replace it. A hint, in this case, works as the corrective agent. It functions in two ways. First, it helps the students to identify the inaccuracy of the instructional response. Second, it acts as a corrective agent leading the students to the discovery of, and deep encoding of, the correct answer, not just a superficial, rote processing of the

correct answer. Hence, hints require a great deal of active information processing throughout the corrective process.

METHODS

Students

The students were three classes of first graders in a private elementary school. In this private school, academic achievement, discipline and conservative biblical belief are equally emphasized on a daily basis. The academic standing of the first graders in this school is higher than that of the first graders in public schools at Syracuse. Nevertheless, they are just normal kids from the general population. A total of 47 first graders took part in this experiment. Students in classes I and II were assigned randomly to three different treatment groups. Students in class III were all assigned to the control group.[1]

Design

The experimental design was a posttest-only control group design (Campbell & Stanley, 1962). A one-way analysis of variance was chosen as the statistical procedure. Also, results were covaried with Stanford Standardized Letter and Sound Test scores.[2]

Task and Materials

For this study, a self instructional booklet was used to teach four basic concepts in Science : solid matter, liquid matter, gas, and energy. In this self-study instruction, the definition of each concept was presented and followed by examples. Then, practice followed. Since this study investigated the effectiveness of feedback of different forms, rather lean instruction was used. Only one example was provided for each of the four concepts. The emphasis was on the last phase of the instruction - 'practice'. It was during practice that different kinds of feedback were planned for different treatment groups. Samples of the definition and examples are provided in Figure 2. Samples of practice for each treatment group are provided in Figure 3.

Insert Figures 2 & 3 about here

Only one practice item appeared per page. The question and the multiple choices were printed on the left half of each page. Feedback was printed on the right half of the page opposite each of the multiple choices (see Figure 3). All the feedbacks on the right side were covered up with colored strips of paper that were taped on both ends. Students were instructed to peel only the strip corresponding to the choice they made during practice. An inspection of the booklets after the study was run revealed that the students did in fact follow this procedure correctly.

Treatments

There were three treatment groups and one control group. The CA group was provided with the correct answer when an error was identified during practice. The Hint group was provided with hints when an error was identified during practice. The R/W group was provided with information as to whether their responses were right or wrong during practice. When students in the Hint and CA groups did give the correct answer, they were given the feedback 'excellent'. The control group was given no instruction nor feedback of any kind. See Figure 3 for an example of each kind of feedback.

Delivery

The instruction was intended for Computer Assisted Instruction (CAI). Since micro-computers were not available at the school, a close simulation of the materials in the form of booklets was used.

Tests and Measures

A test of 20 multiple-choice questions was administered to all students immediately following the treatment. The test was at the application level, which required the students to apply what they had learned to new instances. None of the examples nor the practice items from the self-study instruction appeared in the test, but all items (E, P, and T) were drawn from the same pool. The test was reviewed by one of the teachers beforehand, and was revised according to

the teacher's recommendation. A sample of the test items is provided in Figure 4.

Insert Figure 4 about here

Prior to the data collection, three conferences were scheduled with one of the teachers to verify the content of the materials and the level of the instruction. Materials were reviewed by the teacher. Some minor details were revised following the teacher's recommendations. One first grader from a public school pilot-tested the materials and failed to complete the task. Therefore we decided to change our strategy by sacrificing one student from the sample population for an additional pilot test. This student promised to keep this a secret between us. He told me that he did not talk about any of this to any of his classmates. He went through the self-study instruction and the test in less than half an hour. Some minor revisions were made accordingly.

Procedures

The study was carried out class by class. Upon entering the classroom, the students were told that this was a new project they were going to be working on. Directions were given orally. And they were told to work at their own pace. Following the directions, a list of new words was written on the blackboard and was taught by the teacher to the whole class very discretely. 'Discretely' means that the teacher made an effort to separate the meaning of the word from the concepts taught by the study. For example, when teaching the word 'helium', it was presented as something put inside the baloon which would make the ballon go up. Actually, most of the new words were recognized immediately after they were pronounced. Then, the self-study instruction booklets were handed out randomly. The students worked on their own booklets individually, and raised their hands when they were done with them. Students then returned the instruction booklets to the teacher and received the test. Those who finished early were directed to an open area at the back of the classroom to work on previously assigned homework.

Class II went through the same procedures immediately after Class I had finished their experiment. The control group (Class III) was given the test only after Class II had finished their experiment.

RESULTS

The analysis of covariance was not performed because the covariate was not significantly correlated with the dependent variable. An analysis of variance for the overall posttest yielded an F-ratio significant at the 0.007 level of probability. A summary of means and standard deviations is shown in Table 1.

Insert Table 1 about here

Hypothesis 1 stated that feedback in any form will be better than no feedback. A post hoc pairwise comparison (Duncan) was performed to test this hypothesis (see Table 1). It revealed that the Hint group and the CA group performed better than the Control group, but the differences among the Hint group, the CA group, and the B/W group were not significant. The difference between the B/W group and the Control group was not significant. Hypothesis 2 stated that supplying a 'hint' after an error is more effective than providing other forms of feedback. According to the results of the post hoc pairwise comparison, there really isn't any significant difference among the Hint group, the CA group, and the B/W group. The means were all in the hypothesized order, but none of these differences were significant.

DISCUSSION

Hypothesis 1, that feedback in any form will do better than no feedback, is partially supported. Results from this study show that there are significant differences between the Hint group and the Control group, and between the CA group and the Control group. But the power is not great enough to detect significance for the difference between B/W feedback and the Control. Anderson et al (1971) concluded from their study that telling students whether or not their answer is correct increases the amount of material remembered on a later test. The lack of significance between the B/W feedback and the control could possibly be due to the fact that different task levels are involved in the different studies. Anderson et al (1971) studied the remember level, while we investigated the application level. A more likely explanation, given the strong empirical support for this hypothesis (Anderson, Kulhavy, & Andre, 1971; Gilman, 1969; Meyer, 1960), is that our power was not sufficient to detect a real difference.

Hypothesis 2, that providing a 'hint' after an error is more effective than providing other forms of feedback, is only partially supported. There was no significance among any of the feedback groups. However, the means were in the hypothesized direction, and again the power was low in this study.

The lack of significance could also be the result of insufficient practice items. Insufficient practice in a study investigating the effects of feedback might be detrimental, because the effects of feedback will be larger when practice and feedback carry the major burden of the instruction. When the generality and examples are rich and plentiful, feedback will probably make such less of a difference. Hence, different types of feedback would make less of a difference. Therefore, we feel that the hypothesized model used as the theoretical perspective for this study is still logical and valid based on theoretical support from information processing theory, partial support from this study, and support from previous research (Anderson, 1967, 1970; Annet, 1964). In light of all these, the major implication for practice is that any kind of feedback is better than no feedback on student errors. With respect to type of feedback, providing hint feedback is, if not best, just as good as providing other kinds of feedback.

Further research is needed to investigate the results found in this study. Using a larger sample size would improve the power of the study. Using computers as the means of delivery would be more appropriate and more controllable as far as the number of frames and length of time are concerned. More practice items ought to be provided in the lesson, since we want to investigate the power of feedback. Another very important aspect for future research is to investigate if different models are needed for different task levels, i.e. remember-a-generality, remember-an-instance, and use-a-generality.

Footnotes

1. This was an error on the researcher's part that random assignment was not used in Class III. In order to filter out differences between classes, scores from a standardized test on letter and sound was used as a covariate when analyzing data.

2. The Stanford Standardized Letter and Sound Test is a standardized test to measure early school achievement.

Table 1 Summary of Means & Standard Deviations

$F(3,43)=4.64$ $p=0.007$

Group	n	Mean	SD	
Hint group	12	63.8	19.3	*
CA group	14	59.3	23.7	*
R/W group	11	48.7	20.3	
Control Group	10	36.0	21.6	

* shows the results of post hoc Duncan pairwise comparison.

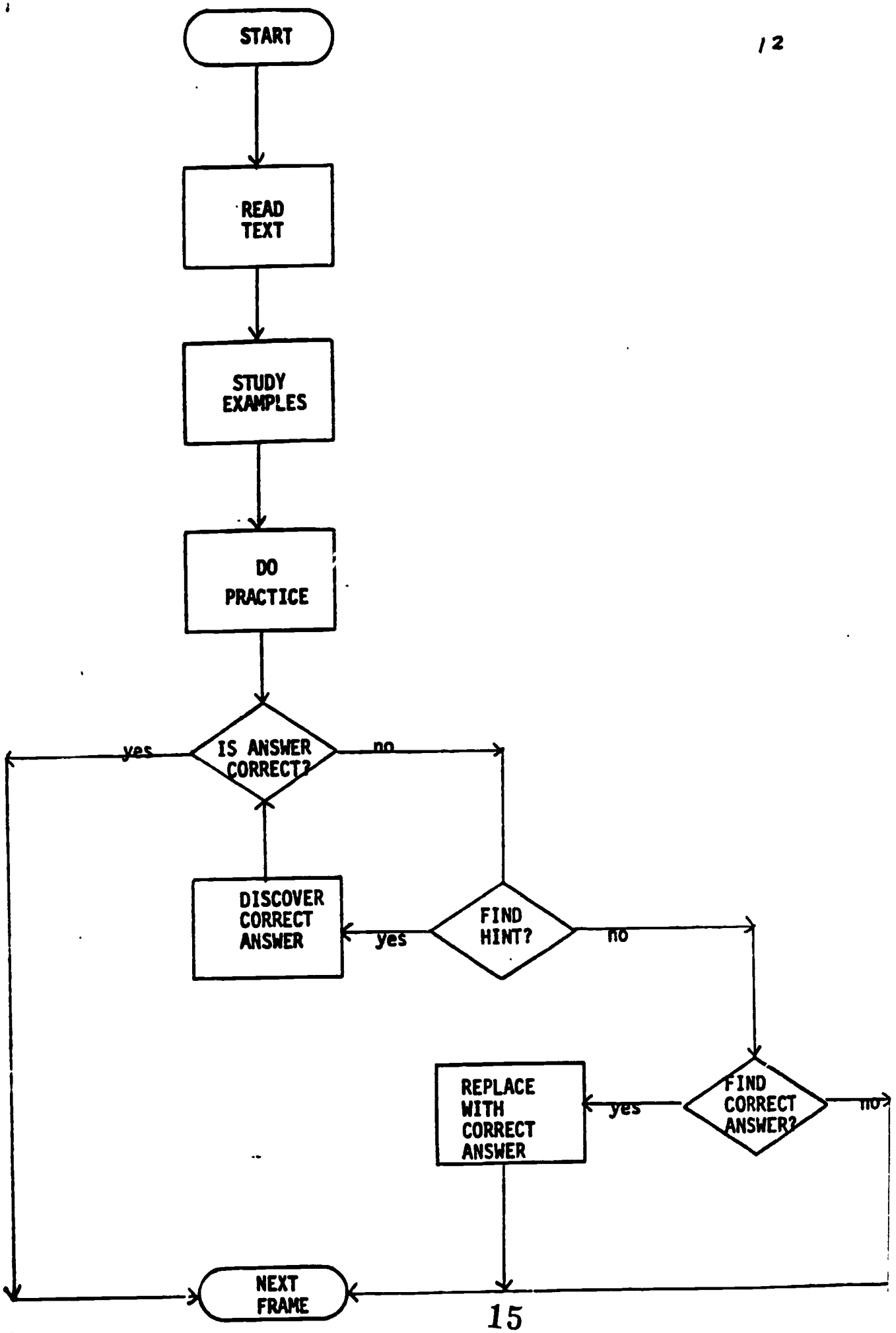

Figure 1 : Hypothesized model of relationship between different forms of feedback.

Figure 2 Samples of Generality and Examples

A solid has a definite size and shape.

For example :

Wood has a definite size and shape.

So,

Wood is a solid matter.

Solid can be hard or soft.

For example:

Wool is soft, but has a definite size and shape.

So,

Wool is also a solid matter.

Figure 3 Samples of Practice Items for Each Treatment Group

CA group

A cat is	
1) a solid matter	'Excellent'
2) a liquid matter	You are wrong. The correct answer is 1.
3) a gas	You are wrong. The correct answer is 1.
4) a kind of energy	You are wrong. The correct answer is 1.

Hint group

A cat is	
1) a solid matter	'Excellent'
2) a liquid matter	A cat has a definite size and shape.
3) a gas	A cat has a definite size and shape.
4) a kind of energy	A cat has a definite size and shape.

R/W group

A cat is	
1) a solid matter	You are right.
2) a liquid matter	You are wrong.
3) a gas	You are wrong.
4) a kind of energy	You are wrong.

Control group

A cat is
1) a solid matter
2) a liquid matter
3) a gas
4) a kind of energy

Figure 4 Samples of Test Items

1. Bicycling is an example of
   a) a solid matter
   b) a liquid matter
   c) a gas
   d) a kind of energy

2. Sugar is an example of
   a) a solid matter
   b) a liquid matter
   c) a gas
   d) a kind of energy

3. Glue is an example of
   a) a solid matter
   b) a liquid matter
   c) a gas
   d) a kind of energy

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