

ICSA 723/512

Interactive Courseware: 2002

Issue 1: INTERACTIVITY

One of main differences between computer-based instruction and other delivery mechanisms is the control over the quality of interactivity and the systematic nature of the interactivity. For example, an instructor may be equally (more?) capable of interacting with an individual student. However, instructors get tired, fatigued, have "bad" days, have limited time to devote to individuals, etc. Therefore, the quality varies from teacher to teacher and from day to day. However, the computer affords us the opportunity to create interactions that are (a) well-planned and (b) predictable. The computer does not tire; it does not have bad days.

Defining Interactivity

You can skim my article "A Structural Definition of Instructional Interactivity" to get a sense of some of the basic issues in interactivity, and to get a sense of how we will use the term in this course. You can find the article at www.it.rit.edu/~may

The Cost of Interactivity

The good news is that the computer is capable of thorough, well-designed interactivity. The bad news is that someone has to actually design it and program it. This, therefore, makes the design of highly-interactive CBT fairly expensive. It is no wonder that a lot of WBT/CBT that you see is just "electronic page turning." It gets costly to develop much else.

You will also find, paradoxically, that the interactivity that is so costly to build into computers, is fairly cheap and easy to provide with humans. All but the most "troll-like" human beings are capable of interactivity in the sense of posing questions, responding, communicating in natural language. So the question is not a "John Henry" question, of whether the machine or the human is better. Rather the question is whether or not the consistency and predictability is worth the cost of the computer versus the ease but lack of control of the human instructor.

Common Forms and Functions of Interactivity

Two types of interactions are typical of tutorials (discussed later).

- Questions
- Generative Activities

These two types of interactions serve several instructional functions.

- First, they allow for student *assessment* at a variety of spots in the instruction. Generally, an interaction is the basis for some form of system adaptation--it makes choices depending upon how a student responds.
- Second, interactivity can help with *retention*. Although there is some debate about the exact effects of interactivity, in general, active responding is seen as a favorable feature in instruction because it forces deeper cognitive processing of material.
- Finally, interactions can be used to *transfer* skill with a variety of practice exercises.

Frequency of Interactions

Novice developers often ask, "How often should I have interactivity within a tutorial?" While there is no simple answer, most research suggests that more frequent meaningful interactions seem to support learning. There is still some debate on exactly what constitutes "meaningful interactivity," but, in general, *more is better*.

Questions

One type of interaction is called an embedded question. An *embedded question* is a temporary "pause" in the instruction to find out whether or not the student has comprehended the instruction to date. Embedded questions may often appear as a group of questions that quickly review what has been just shown to the student. It is expected that students will perform correctly on an embedded question--if they don't, then the developer realizes that the students need additional instruction.

Embedded questions are used to monitor a student's processing of information. In a classroom, an instructor might ask, "Do you understand this?" or the instructor might look for quizzical looks on student faces. Since these types of interactions are not possible with the computer, instead, the system monitors information processing by asking for a re-statement or application of material (see figure 1).

An embedded question is:

- a) something that makes you sleep
- b) a question designed to get knowledge that is deeply embedded in a student's mind
- c) an opportunity to check what the student knows at a point in a lesson
- d) any question delivered via the computer

Figure 1: Example of an embedded question

In the same way that embedded questions are used to monitor information processing, they can also be used to monitor a student's skill acquisition. Component skills can be assessed as the lesson progresses.

On some occasions, it is desirable to build skill with a short set of embedded practice items. These are (technically) not used to monitor comprehension, but rather are used to build skill in the learner. However, a crafty developer could monitor these practice exercises and make inferences about a student's learning from the student's demonstrated ability.

Judging Responses

All embedded questions require answer judging. This is probably one of the more difficult aspects of developing questions. Judging a response requires some degree of predictability from the content and the students.

Student responses can be thought of as one of the following:

- correct
- generally correct but not perfect
- partially correct
- wrong
- common error
- cannot understand answer

Think of a student response to the following question:

What is the name of the state in which you live?

POSSIBLE ANSWERS	Answer Judging
New York	correct
new york, new yerik, NY, New york	generally correct but not perfect
York	partially correct
Alabama	wrong
Rochester, Brighton, United States	common error— <i>city</i> or <i>country</i> rather than <i>state</i>
Sdrutenfljdjlfjslj	cannot understand answer

As you can see, there is one "correct" answer, but many generally correct but not perfect answers. These include many possible spelling errors or typos. In some circumstances, these can be treated as "totally wrong." However, in dealing with younger children, or with populations in which language is difficult, it would be de-motivating to be told that your answer is wrong, when it merely contains a small capitalization or spelling error.

Feedback

When a student makes an error, we must provide feedback. Feedback is the name for information supplied to a learner about the correctness of his or her behavior or response; there is a range of feedback options.

We can think of four feedback types:

- adequacy/ KR
- KCR
- diagnostic
- corrective

Adequacy feedback/KR simply reveals to the student whether or not the performance was acceptable. You can think of this as "right or wrong" feedback. Some researchers refer to this as *knowledge of results* (KR) feedback. In each case, the learner is told that the response is not acceptable, but is not told why. Adequacy feedback should be considered as the minimum feedback provided for students.

Knowledge of correct results (KCR) occurs when a student is told that the performance is incorrect and is provided with the correct answer. In some cases, the correct answer is enough feedback. Often we assume that students can determine on their own what they did right or wrong--this is not always the case.

Diagnostic feedback is used to point out (in particular) what parts of the student response were incorrect. For a student learning a volleyball serve:

"Your arm position is perfect, but your weight is on the wrong foot."

Corrective feedback is similar to what others call explanatory feedback. Generally it provides knowledge of results, the right answer (if there is one) and an explanation of why the student performance is incorrect, and advice on how to do better the next time. In essence, corrective feedback tries to provide additional instruction on the spot. To the same volleyball student:

"Your arm position is great but your feet are all wrong. Start with the weight on your back foot and at the same time you swing your arm, rock forward on the other foot."

General Rules of Feedback

Extensive reviews of feedback research lead to the following conclusions:

Any feedback is better than none. Although we intuitively believe that there should be major differences between types of feedback, research has not been able to demonstrate consistent performance improvement associated with any particular type of feedback.

However, in all cases, the use of feedback is consistently superior to the absence of feedback.

Too much feedback may destroy motivation. It is possible that excessive knowledge of behavior may inhibit one's willingness to perform. We can all no doubt think of a situation in which feedback on performance was interpreted (by us or others) as criticism or brow-beating. Students differ in their ability to profit from differing types of feedback. As a developer you must be careful to encourage performance while correcting it.

Too little feedback may create frustration. Performing for an extended period of time without knowledge of results is very confusing for some students. It is likely that students will become apprehensive if they are not told "how they are doing" at regular intervals. Again, this varies with student experience, maturity, motivation, and subject matter.

Generative Activities

Generative Activities are opportunities for a student to respond in a manner in which he or she relates newly learned material to idiosyncratic knowledge that the student already possesses.

Huh?

This means that not all answers have a "right or wrong" response. And that sometimes, we ask a student to respond to make him or her "think."

When teaching primarily verbal material, we can check for comprehension of material by asking students to *paraphrase* the material (or more accurately, to *recognize a paraphrase* of the material). However, deeper processing of material is facilitated by requiring a student to relate new knowledge to previous knowledge. Cognitive psychologists believe that knowledge is stored in an associationistic manner; relating new knowledge to already stored knowledge helps to store new information in memory.

A generative question asks a student a question that is not likely to have a "judge-able" right answer. For example, one could study the rise of the Nazi party in Germany in the 30's and 40's. A recall question might ask for a list of major events and associated activities. A generative question might ask:

How would you have felt if you were a German but not a member of the Nazi party? What do you think you would have done?

Have you ever done anything in which you didn't approve, but went along with the crowd? What made you do it—what forces were at play that you might not have realized at the time?

Typically, this type of question is very open ended, and there are no right or wrong answers. A computer is generally not able to "judge" such a response; consequently, any answer is treated as a correct answer. A generative question is designed to make the student "think" rather than respond correctly. It provides a mechanism for integrating new knowledge with old.

Because the responses cannot be judged, there is some question as to whether or not such questions have much utility in computer based instruction. (Clearly, they may not help much in terms of adapting instructional methods.) Much depends upon the maturity of the learners and the motivation levels of the students.