

DOCUMENT RESUME

ED 421 524

TM 028 849

AUTHOR Parshall, Cynthia G.; Stewart, Rob; Ritter, Judy
TITLE Innovations: Graphics, Sound, and Alternative Response Modes.
PUB DATE 1996-04-00
NOTE 21p.; Paper presented at the Annual Meeting of the American Educational Research Association (New York, NY, April 8-12, 1996).
PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150) -- Tests/Questionnaires (160)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *College Students; *Computer Assisted Testing; *Educational Innovation; Graphic Arts; Higher Education; Interaction; Psychometrics; Questionnaires; *Responses; Sound Effects; *Test Construction; Test Format; Test Items; Testing Problems
IDENTIFIERS Partial Credit Model

ABSTRACT

While computer-based tests might be as simple as computerized versions of paper-and-pencil examinations, more innovative applications also exist. Examples of innovations in computer-based assessment include the use of graphics or sound, some measure of interactivity, a change in the means in which examinees responded to items, and the application of computer-scored partial credit models. A set of items was developed in conjunction with a college-level introductory computer course and field tested with 93 students. Item types were evaluated on three dimensions: (1) the technological functioning of alternative features; (2) reactions from examinees to the innovations; and (3) the psychometric performance of the items in comparison with existing paper-and-pencil assessments. The computer test consisted of four sections, each containing four items. Features under investigation included innovations in item stems and response modes. Innovations in item stems involved the use of sound or graphics, and alternative response modes involved having examinees select multiple responses, click on a graphic, or play sounds before selecting an answer. The investigation found generally positive results. For the most part, the technology worked as expected, and examinees were largely positive about the computer examination. The incorporation of sound was the most radical change, provoking positive reactions and genuine concerns. The psychometric functioning of the various item types appeared adequate. Results suggest that a continuing development process that uses and evaluates the items on the test administration platform should be the best guarantee of success in construction of computerized tests. An appendix contains the student survey. (Contains two tables and four figures.) (SLD)

* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *

Innovations: Graphics, Sound, and Alternative Response Modes

Cynthia G. Parshall

Rob Stewart

Judy Ritter

Institute for Instructional Research and Practice
University of South Florida*Abstract*

One of the many growing areas of computer applications is that of computerized assessment. While computer-based tests might be as simple as computerized versions of paper-and-pencil exams, more innovative applications also exist. Innovative, computer-based items provide features not typically available in paper-and-pencil tests. Examples of assessment innovations include: the use of graphics or sound, some measure of interactivity, a change in the means by which examinees respond to items, and the application of computer-scored partial-credit models. This session will include a demonstration of innovative computer-based items, together with a discussion of the developmental process. Issues in evaluating the quality of new forms of assessment will also be addressed.

PERMISSION TO REPRODUCE AND
DISSEMINATE THIS MATERIAL HAS
BEEN GRANTED BY

Cynthia Parshall

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)

1

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

- This document has been reproduced as received from the person or organization originating it.
- Minor changes have been made to improve reproduction quality.
- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Paper presented at the annual meeting of the National Council on Measurement in Education, April 9-11, 1996, New York.

Innovations: Graphics, Sound, and Alternative Response Modes

There are many forms which testing or assessment might take. These methods of assessment can be conceptualized along a continuum, with multiple-choice items at one end and performance tasks at the other. Various item types or test formats may fall between these two extremes. In general terms, those forms of assessment closer to the “multiple-choice” end of the scale will have potential advantages such as high reliability, broad content coverage (because more multiple-choice items than performance tasks can be administered in a given time period), and low-cost. The accompanying disadvantages will be the risk of a decontextualized assessment, and an emphasis on information that is easy to assess, rather than important.

Assessment methods approaching the “performance task” end of the scale will have opposite advantages and disadvantages. These assessment tasks have the important advantage of a higher potential for relating closely to the real-world skills of interest. However, they may also have problems with low reliability, excessive dependence on a narrow range of content, and may be relatively expensive to develop, administer, and score.

An ideal form of assessment would include as many of the relevant measurement advantages as possible, while retaining few of the disadvantages. Within the last few years, a great many efforts have been underway to develop new and relevant forms of assessment. Quality concerns for these developments include an emphasis on measuring important skills, developing appropriate scoring models, and augmenting the diagnostic information obtained.

One area in which promising work is occurring is that of computer-based innovative items. Using the idea of the continuum presented above, it is possible to consider computerized assessments at both extremes. There are computer-based tests that consist entirely of discrete, multiple-choice items, and others that provide computerized performance assessments.

The majority of computerized assessments in current use consists of traditional, multiple-choice, text-based items. As is often found when a new technology first becomes available, the initial applications look very similar to the processes they are superseding. In many cases, computer-based tests are developed entirely from existing standardized paper-and-pencil exams. (This description of computerized testing does not address the issue of computer *adaptive* tests.

Theoretically, adaptive administration of items could occur using either multiple-choice or performance items.)

Towards the other end of the scale, computerized performance tasks include applications such as direct measures of office skills (e.g., word-processing and key-punching). At the outer edge of performance assessment on computer, come computerized simulations. Examples of this include flight simulators for assessing pilots, on-screen engine mock-ups for testing the operators of large machines, patient-management software for testing medical personnel, and architectural design for assessing architects. The “simulation-based” exams tend to be developed in specialized fields, take a large developmental effort to produce, and require extensive scoring rules. The number of these applications is growing, but relatively few of them are currently operational in comparison to the more traditional item types.

Between these two scale end-points fall what may be termed *innovative items*, the topic of this paper. This type of item provides some feature not typically available in paper-and-pencil tests and is also delivered through and scored on computer. These innovative items do not include full-blown simulations and will typically involve less development time and more limited scoring rubrics. Ideally, these measures will retain the quality measurement attributes of reliable, inexpensive scoring while incorporating features that increase the validity and utility of the assessments.

Computer-administered items may be termed innovative for a number of reasons. Innovations might include the use of graphics or sound, some measure of interactivity, a change in the means by which examinees respond to items, or the application of computer-scored partial-credit models. These items may be innovative through features included in the item stem or through alternative response modes required of the examinee. In every case, the rationale for these innovations is improved measurement.

Some innovations provide examinees with a better context for assessment. An example of this added “context” might be a test that provides on-line information that a student can refer to and utilize when responding to an item. Another example is an item that prompts an examinee to indicate a sequence for a set of events. When this type of item is computerized, the computer can display a reordering of options, based on the examinee’s response.

Other innovations reduce the likelihood that an item can be answered correctly through guessing. For example, a math item might require the examinee to type in a response, rather than select from 4-5 given options, or a reading item might prompt the examinee to select a word or phrase from all possible phrases within a reading passage, rather than from a limited set of options.

Still other innovations increase the information obtained per item. This might occur by having the computer keep track of the process an examinee goes through to produce a product. For example, the set of steps taken by an examinee in a science activity could be scored, using a partial-credit scoring model. In these and other innovative applications, the additional features should improve measurement in a substantive way, rather than simply adding glitz to a traditional test.

Purpose

The purpose of this study was to investigate several computer-based innovative item types. A set of items was developed in conjunction with a college-level introductory computer course and was fieldtested on 93 of the course's students. The item types were evaluated on three dimensions: (1) the technological functioning of alternative features, (2) reactions from examinees to the innovations, and (3) the psychometric performance of the items in comparison to existing paper-and-pencil assessments.

Descriptions of Innovations

The computer-based test consisted of four sections, each containing four items. A single item was displayed on a screen at a time. Within a section, an examinee was free to page back and forth between that set of items, but the examinee could not return to a preceding section.

The features under investigation included innovations both in item stems and in response modes. Innovations in item stems involved the use of sound or graphics not easily provided in standardized paper-and-pencil testing. Alternative response modes included requiring examinees to select multiple responses, to click on a screen graphic, and to play one or more sounds before selecting an answer. All of the items were scored dichotomously (e.g., either correct or incorrect),

although possible adaptations using partial credit may be considered for future versions and additional items.

Although this exam was designed for a computer class, and thus for students who had been exposed to a variety of computer applications, it was still considered desirable to limit the amount of “learning” necessary to take the exam. A decision was therefore made that each section of the exam would cover a specific area of course content and would also be limited to a single mode of responding. The first two sections consisted primarily of items adapted from the current paper-and-pencil examination and items in the remaining sections were primarily created for computer administration.

Section 1 addressed educational applications of computers. This section consisted of text only; however, it was designed so that examinees could select more than one of the response options available (i.e., “Select all that apply”). (See Figure 1 for a sample item). Section 2 measured the topic of CD-ROMs and multimedia applications. This section included graphics that related to text in the item stems. Examinee responses were made by clicking on a box next to one of the response options listed (Figure 2). Section 3 covered the topic of databases, used on-screen graphics, and required the examinee to select a response by clicking on part of that graphic (Figure 3). Finally, Section 4 addressed the use of sound in computer applications. Each item in this section contained buttons that the examinee clicked to hear sounds. After listening to the sounds (music, beeps, or voice, depending on the item), the examinee indicated a response to the item by clicking on a box (Figure 4). At the conclusion of the items, an on-screen survey was presented to examinees. The survey addressed examinees’ reactions to the computer administration of the exam, as well as to the innovative features of the items (Figure 5).

Methods

The computerized innovative items were fieldtested on a number of volunteers. In late November, 1995 the computer exam was taken by 93 out of approximately 300 students who were completing a college-level introductory computer course. All examinees were volunteers, who received course credit for their participation; however, their performance on the test did not affect their course grade.

The computer exam was designed to address content covered in the second half of the course, and was partially comprised of items adapted from the course's second examination. The computer administration took place approximately two weeks before the related paper-and-pencil exam was given. No counter-balancing could be carried out due to the fact that in this course, immediately after an exam is administered and the answer sheets are collected, an oral review of all items is conducted. Since approximately half of the items on the computer-based exam were close adaptations of items on the paper-and-pencil exam, it seemed to be too problematic to attempt administering the computer exam after this review. One way around this problem was a planned comparison of the performance of those students who took both the computer and paper-and-pencil exams, to the performance of the remaining course students who took only the paper-and-pencil exam. (For purposes of analysis, the paper-and-pencil only group consists of those students who completed the course, who did not participate in the computer-exam study, and who earned a final course grade of D or better.)

Results

Technological Issues

There were three primary areas of interest in the evaluation of this assessment. The first related to technological issues. The goal here was to isolate (and correct) any problems which might arise due to the use of sound and graphics. Possible problems included poor quality display of graphics or reproduction of sound on test administration computers. It was also a concern that the addition of these elements could make the computer file size prohibitively large or cause the program to run at an unacceptably slow speed. These technological questions were considered as the computerized exam was developed, and during the field test.

The computer-based items were developed using the program Authorware. The final computer test file consisted of 59 screens and was 1.8 megabytes in size (i.e., larger than would fit on a diskette without compressing). Of these 59 screens, 10 were devoted to instruction and practice items and 18 pertained to the concluding survey. The test included 18 sound files (.WAV), that ranged in size from 5 kilobytes (a half-second burst of laughter) to 134 kilobytes (a 6-second musical piece). Many of the graphical images were created within Authorware (e.g., green

background, directional arrows, etc.); others were imported as bitmap files (.BMP) and pasted onto the appropriate screens. Improvements in efficiency are probably possible, as no particular effort was made to be memory efficient in the development of the computerized exam. However, even in its current form, the computer file ran without dragging or delaying.

One unsurprising conclusion of this study is that a developer must standardize on some minimal level of computer hardware and software. For some computerized tests, this could mean a 286 processor with a black-and-white, text-based monitor, and no sound capacity. A Windows-based, 386 computer with an SVGA monitor and sound card was the standard computer used in this study. Based on this platform, no problem was found with any graphical display. Unexpectedly, a few of the sound files had too much static when played on some test administration computers. This may have resulted from sound files with lower sampling rates, and/or computers with poorer quality sound cards. This problem would need to be corrected before operational testing occurred.

Examinee Reactions

The second evaluation issue pertained to examinee reactions to this form of assessment. At the conclusion of the items, an on-screen survey was presented to examinees. This survey addressed examinees' reactions to the computer administration of the exam, as well as to the innovative features of the items. Appendix A contains a list of the survey questions, along with the number of examinees who made each selection.

As responses to the survey show, almost equal numbers of examinees rated themselves as having entered the course with "very little" (n=48) or "some" (n=44) computer experience. For this computer oriented class, a majority of the students (n=60) indicated a preference for a computerized test rather than a paper-and-pencil version. For other courses, that number dropped (n=37), and the number of students preferring paper-and-pencil testing increased (n=44).

The survey was structured so that examinees who indicated they had a problem (or suggestion) were routed to another screen where they could type in additional information. A majority of the examinees (n=50) responded "no" to every item that asked if they had problems in taking the exam. No problems were noted by any examinees in the use of the mouse or in the use of the *Previous* and *Next* navigation buttons.

Some problems were identified for each of the four exam sections. The intention of the survey questions was to isolate difficulties examinees may have had understanding test directions or using the computer test software. Based on a misunderstanding by some examinees as to the purpose of the survey, many of the responses were actually related to the course, or to the examinees' confidence in their own knowledge level, rather than to the computer innovations. For example, 25 examinees indicated they had a problem when taking Section 1. However, many of these problems turned out to be a variation on "I did not remember what everything meant.", "not remembering some of the information from class", or "wasn't sure of a few answers". Other examinee comments are too ambiguous to be helpful. Examples of ambiguous responses included "unknown", "not familiar", "just a little uncertainty", and "I did not understand what some of the questions were asking". (Did the examinee who provided this last statement have difficulty with the items or with the directions?)

Two pertinent responses to Section 1 addressed the format of items in that section, in which examinees were prompted to "Select all that apply" (e.g., "I had a problem answering the questions knowing that there was more than one answer. I always get confused in these situations.").

For Section 2 (which incorporated graphics into the item stems), far fewer problems were noted. Of the six examinees who indicated a problem with this section, most commented about problems with their own knowledge (e.g., "I wasn't sure of the capacity of a cd rom"). One examinee instead appeared to indicate difficulty with the directions ("I was not sure what I needed to do.").

Of the nine problems noted for Section 3, only one was clearly related to taking the examination. The examinee indicated "after going to the next question I was fine". Items in this section required examinees to respond by clicking directly on a graphic, and it appears that this examinee required a second example of this item format before that method of responding was clear.

Only five problems were noted for Section 4, most of which were directly related to the incorporation of sound, which distinguished these items. Two examinees expressed concerns about being able to hear the items. (One wrote, "It was hard to hear some of the sounds". The second indicated, "I am hard of hearing and I find it a little hard to hear some of the sounds. I feel that in

an actual test it would greatly influence my ability to successfully complete the test.”.) Another examinee indicated difficulty with this section, “Could not get sound to work for the first three questions”. (This problem was noted during the field test for a few examinees, all of whom had neglected to *take* the practice items in the instruction screens. An obvious correction to this problem is to structure the practice screens so that examinees are required to respond appropriately before proceeding.)

Finally, general comments were provided by 23 examinees. Again, some of these applied to the course rather than to the exam. Those that applied to the computer exam tended to be positive. (they also tended to be at least as much a reflection of the examinees’ reaction to the computer mode as to the innovative features used in this instance. Several comments were similar to the remarks “I felt that a computer test might be intimidating, yet it was not; it’s actually fun!” and “I enjoyed taking this test”. In a more discriminating vein, one examinee stated, “I think the use of the computer in testing might help clarify the question (sic) in this domain. Sometimes visualizing can be difficult. It should make testing some concepts more practical.” While another examinee suggested a concern, “Taking tests with paper/pencil allows me to change my answers as often as I need to. I have had a course where the tests were administered by computer. It was okay, but making a mistake was costly.” Finally, the issue of sound was re-addressed with praise “The audio portion of the exam was great.” and concern “I feel that a computerized testing procedure is a great idea except for the sound portion which I feel may hinder some of us with hearing disabilities”.

Psychometric Functioning

The final evaluation considered in this study concerned the psychometric functioning of these items. Because the participants in this study were volunteers, it seemed reasonable to compare their performance in the course to that of the nonparticipants. In Table 1 presents the means for these two groups on the paper-and-pencil test (Exam 2) and on the course as a whole (Course Total). A visual inspection of the table indicates that the volunteers are roughly comparable to the nonvolunteering students in terms of course material mastery.

Table 2 provides all the item p-values for the computer-based innovative items. Where those items were adapted from paper-and-pencil items, p-values on the paper-and-pencil versions

are also provided, both for those students who had taken the computer test, and for the students who took only the paper-and-pencil exam. Examinees' responses to those items that were presented in both modes can be compared directly.

Inspection of the item p-values reveals a difficulty, apparently related to a time effect. The computer exam was administered first, and was administered approximately two weeks prior to the paper-and-pencil exam. Although the students who volunteered to take the computer-based exam appeared to make every effort to do their best, they probably had not studied prior to the exam. By the time the paper-and-pencil exam was administered (effecting the course grade for all of the students), it appears that much further studying and preparing had occurred. Thus, the largest effect apparent in Table 2 is the improved performance on the paper-and-pencil version of the exam. Consideration of this effect in light of examinees' comments such as "I couldn't remember..." suggest that this effect is more likely related to preparation than to mode of administration.

For those students who took both the computer and the paper-and-pencil exams, further analyses of the items were conducted. The objective of the item analyses was to investigate item performance, as compared to an existing criteria. However, it was not necessarily desirable that the computerized assessment produce results identical to other evaluations of student learning (or extremely high correlations). Rather, appropriate functioning of the items and item types would be supported by a general positive relationship between the different modes of assessment.

First, correlations between the items that appeared in both modes were computed across mode. The resulting phi coefficients were all positive. About half of the coefficients were quite modest ($r < .10$), with the remainder ranging from $r = .14$ to $r = .34$. Next, point biserials of all of the computer items to the examinees' numerical score on the course as a whole (Course Total) were calculated. These results also showed a positive trend (a single negative correlation of $r = -.07$ was found). Six of the point biserials fell between $r = .11$ and $r = .20$, and the 3 strongest correlations were .24, .27, and .41. The strongest relationships were found between items in Sections 2 and 3 and the Course Total, a not surprising result, given the content of those sections (Graphics and Databases) and the relative weights these topics assumed in the course total.

Most of the items adapted from the paper-and-pencil exam are presented in Sections 1 and 2 of the computer exam. The items in Section 1, although adapted from existing items, contained

some important differences. The computer format for these items is “cleaner”, with a much simpler set of instructions. The paper-and-pencil format for these items provides a certain amount of cueing, not present in the computer format. The lack of counter-balancing in this study makes more detailed analysis impossible, but these format changes may yield improved measurement, and seem worthy of further investigation.

The mean score for the 4 items in Section 1 was 1.27, making it the most difficult of the computer test sections. (This increased difficulty may have been related to the content, to the item type, or simply to the fact that it was the first section.) For Section 2, the mean score was 2.25. As compared to Section 1, the items were more similar to their paper-and-pencil counterparts, including a graphical representation of each item’s topic, but (unlike Section 1) requiring examinees to select only a single “best” answer.

For the most part, the items in Sections 3 and 4 of the computerized test were not present in the paper-and-pencil exam (and, in the case of Section 4, could not be). The item p-values for Section 3 suggest that these items were fairly easy (with a section mean of 3.06). Aside from the novelty of the item response format (clicking on a graphic of a database), the items might be expected to be easy since they assessed the most fundamental database topics covered by students in this course (e.g., search, sort). Since examinees demonstrated an ease and comfort with this item type, items designed to tap more difficult content could easily be developed.

In Section 4, most of the items have very high p-values. The mean for this section was the highest, at 3.37. Again, the content tapped by these items was fairly general, although the interface for this section was the most difficult (requiring examinees to read information on the screen and listen to selected sound files before responding to an item). The item with the lowest p-value in this section was one that used speech; a sentence fragment could be played, as could four sentence completions. To correctly answer the question, an examinee needed to identify the option that was a *poor* completion. Although the sound files could be played repeatedly, this interface may have made the item more difficult than it would have been in written form. Despite its apparent difficulty in this instance, it is an appropriate application for tests of dictation or listening in second language assessment, and possibly in other applications.

Discussion/Summary

This investigation into a few item innovations found generally positive results. For the most part, the technology worked as expected. A continuing development process which uses and evaluates the computerized items on the test administration platform should prove to be the best guarantee of success in this area.

Examinees were largely positive about the computer exam. They had few complaints about using the test software or about most of the innovations. The incorporation of sound into the test proved to be the most radical change, resulting in some very positive examinee comments, along with some genuine concerns. While improvements to the audio quality are possible through the use of headsets and of better sound files, the more critical issue is appropriate use. Inclusion of sound may be beneficial for some content areas (e.g., second language, music) and can provide an aid to examinees with certain disabilities (e.g., visual problems, poor reading skills), but should certainly not be used in a context where it is not appropriate and/or where it hinders examinees with hearing problems.

The psychometric functioning of the various item types appeared adequate. Examinees displayed no difficulty responding to items in Section 2 (where they selected a single best response by clicking a box) and in Section 3 (where they indicated a response by clicking on a graphic). A few minor problems in Section 4 (where examinees needed to play sound files before responding) could be corrected by improvements to the instruction and practice screens. Further investigation of the item type used in Section 1 (where examinees were instructed to “Select all that apply”) might focus on the effects of guided instruction (e.g., “Select the best 3...”) and of partial-credit scoring.

The development of appropriate forms of assessment is critical, and an essential component of the development process is the evaluation of those assessments. While it seems evident that we need to expand the types of items and forms of measurement we use, it is equally critical that we investigate how well the new forms work. As we creatively develop new procedures, we need to ask: what is the important construct or skill that should be measured? will the new assessments measure that construct better than traditional measures? will they measure a construct or skill that

cannot be measured through traditional means? and finally, how do the new assessments compare to traditional methods in terms of convenience, cost, student preference, and time required to conduct and score? As we ask these questions, we will find ways to improve and build on our efforts.

Appendix A

Computer-Based Exam Survey (with frequency responding to each option)

1.	What was your level of computer experience before you began this course?	
	• very little	48
	• some	44
	• a lot	1
2.	For this class , which type of test would you prefer to take?	
	• computer test	60
	• don't care	16
	• paper-and-pencil test	17
3.	In general , what type of test would you prefer to take?	
	• computer test	37
	• don't care	12
	• paper-and-pencil test	44
4.	Did you have any problems with the Section 1 (educational computing) ?	
	• no	68
	• yes	25
5.	Did you have any problems with the Section 2 (graphics and images) ?	
	• no	83
	• yes	10
6.	Did you have any problems with the Section 3 (databases) ?	
	• no	81
	• yes	12
7.	Did you have any problems with the Section 4 (sound) ?	
	• no	88
	• yes	5
8.	Did you have any problems with the mouse ?	
	• no	93
	• yes	0
9.	Did you have any problems with the Previous/Next buttons ?	
	• no	93
	• yes	0
10.	Do you have any further comments or suggestions?	
	• no	70
	• yes	23

Note: Each "yes" response routed examinees to a screen where they were prompted to type in more details about problems or suggestions.

Table 1

Mean Scores on Exam 2 and Course Total by Group

	Computer & Paper-and-Pencil Examinees	Paper-and-Pencil Only Examinees
<hr/>		
Exam 2		
Mean	63.72	60.38
S.D.	6.56	8.52
Course Total		
Mean	269.93	256.72
S.D.	12.43	19.75

Note: For the Computer and Paper-and-Pencil examinees, N=93; for the Paper-and-Pencil Only examinees, due to some missing responses, the N per item ranged from 173 to 176. *Exam 2* score is reported as number correct out of 80 items. *Course Total* is reported as number of points out of a possible 300 (and, for the Computer-examinees, includes 6 points extra credit).

Table 2

Item P-values for Computer-Based Items, in Computer and Paper-and-Pencil Modes

	Computer Test		Paper-and-Pencil Test	
	Computer & Paper-and-Pencil Examinees (n=93)	Computer & Paper-and-Pencil Examinees (n=93)	Computer & Paper-and-Pencil Examinees (n=93)	Paper-and-Pencil Only Examinees (n=176)
I1	.22		.62	.63
I2	.45			
I3	.18		.72	.65
I4	.42		.84	.67
I5	.48		.86	.77
I6	.35		.62	.45
I7	.66		.77	.77
I8	.75		.92	.80
I9	.49		.86	.81
I10	.61			
I11	.97			
I12	.99			
I13	.94			
I14	.62			
I15	.87			
I16	.94			

Note: Some of the computer-based items were adapted from items appearing on the paper-and-pencil exam. Where that occurred, p-values for those paper-and-pencil items are provided, by group.

In this section, items may have more than 1 correct answer.
Please select all correct options.

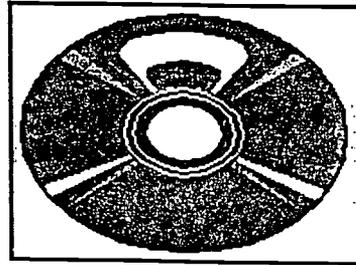
3. Which program(s) listed below are most efficient for developing and presenting slide-show type presentations?

- Hyperstudio
- Power Point
- Linkway Live
- Storyboard Live
- Authorware

◀ Section 1: Screen 3 of 5 ▶

BEST COPY AVAILABLE

Please select the one best option.



2. Which of the following is **not** an advantage of a laser disc?

- It is very durable.
- It takes very little storage space.
- Its signal can be fed directly into the computer.
- Random access to each individual frame is available.
- It can be stopped on a single picture frame for an indefinite period of time.

◀ Section 2: Screen 2 of 5 ▶

Please select the answer by clicking on the appropriate area of the screen image

- 2. This database has been sorted in ascending order. Click on the name of the field used for the sort.

Table: Students

Student ID	First Name	Last Name	Major	Class	Gender	Age
323-44-1871	Martina	Boulet	Engineering	Senior	F	25
202-75-9921	Marion	Jackson	Fine Arts	Senior	M	23
671-88-3266	Hannah	Kirchner	Education	Junior	F	21
567-43-5116	Phii	Leguin	Fine Arts	Junior	F	20
134-76-8933	Patrick	Lenter	Education	Junior	M	21
432-15-5567	Albert	Ramirez	Engineering	Junior	M	19

Record: 1 of 6

BEST COPY AVAILABLE

Play the sounds indicated, then select the answer by clicking on a box.

1. Click on the box next to the sound that provides the most appropriate feedback to a correct response in a computerized lesson.

<input type="checkbox"/>	Sound 1
<input type="checkbox"/>	Sound 2
<input type="checkbox"/>	Sound 3
<input type="checkbox"/>	Sound 4
<input type="checkbox"/>	Sound 5



U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)



TM028849

REPRODUCTION RELEASE

(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: <i>Innovations: Graphics, Sound, & Alternative Response Modes</i>	
Author(s): <i>Parshall, C G, Stewart, R, & Ritter, J</i>	
Corporate Source: <i>NCME</i>	Publication Date: <i>April 1996</i>

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic media, and sold through the ERIC Document Reproduction Service (EDRS). Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following three options and sign at the bottom of the page.

The sample sticker shown below will be affixed to all Level 1 documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

1

Level 1

Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g., electronic) and paper copy.

The sample sticker shown below will be affixed to all Level 2A documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE, AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY, HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

2A

Level 2A

Check here for Level 2A release, permitting reproduction and dissemination in microfiche and in electronic media for ERIC archival collection subscribers only

The sample sticker shown below will be affixed to all Level 2B documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

2B

Level 2B

Check here for Level 2B release, permitting reproduction and dissemination in microfiche only

Documents will be processed as indicated provided reproduction quality permits.
If permission to reproduce is granted, but no box is checked, documents will be processed at Level 1.

I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries.

Sign here, → please

Signature: <i>Guthrie Parshall</i>	Printed Name/Position/Title: <i>C G Parshall Psychometrician</i>
Organization/Address: <i>HMS 401, USF, Tampa, FL 33620</i>	Telephone: <i>813/974-1256</i> FAX: <i>813/974-5132</i>
	E-Mail Address: <i>parshall@seaweed.coedu.usf.edu</i> Date: <i>5-12-98</i>



seaweed.coedu.usf.edu (over)