

International Association of Medical Science Educators



Web Seminar
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“Moving from Paper-Pencil to Electronic Exams: What it Takes to Get it Done “

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Scott Elliott



Scott Elliott is an Instructional Designer and programmer by trade. He is currently Director of computer-based testing at the Carver College of Medicine at the University of Iowa, housed in The Office of Consultation and Research in Medical Education (www.medicine.uiowa.edu/ocrme). Scott has 20 years of experience in developing multimedia instructional and assessment programs. He currently directs a group of multimedia software developers involved with multimedia instructional projects, patient simulations, exam databases (itembanking), and designing and programming testing and analysis software.

Scott started the development group (of one, now four) in 1995 by delivering on-line exams to several clerkships. The success of the initiative has spawned widespread growth of computer-based testing within the medical curriculum. Currently the group manages over a dozen courses and clerkships while delivering hundreds of exams successfully each year. Recently a laptop computer technology initiative was implemented allowing the delivery of exams to large groups of students in one simultaneous sitting (up to 170 students).

Among his accomplishments are the design and programming of the computer software for delivering exams and patient simulations. Scott was recently awarded The University of Iowa President's Technology Award.

Session Description

In this presentation, Scott Elliott will discuss the benefits and drawbacks of computer-based testing (CBT), and what it takes to make CBT successful. Computer-based testing has potentially wide applications in undergraduate, graduate and continuing medical education. An early step in evaluating CBT is to be sure that the exam format is measuring the examinees' knowledge and not their comfort level with the technology. It is, therefore, important that the CBT reproduce or accommodate traditional test-taking behavior. CBT also provides for a number of enhancements not easily achieved with traditional paper and pencil exams. These include easier control and editing of exam items using and itembank, better incorporation of testing into the learning environment using specific feedback, and enhancing exam questions by incorporating multimedia. In addition to traditional multiple choice and true-false questions, CBT can also offer different item styles including simulations, intelligent continuation, and long-menu, non-cueing question types. Storing exam items (itembanking) in intelligent databases is becoming more popular. Itembanks exist to help get exam items organized, hierarchically and statistically, and to eliminate "out-dated" and "haphazard" storage methods of the past. Trends in itembanking now include features that track item and exam performance and provide a statistical prediction as to how an exam might perform. Statistical analysis of exams is very important to ensure acceptable item performance and exam reliability and validity. As for resources, knowledgeable people who are committed to the success of the CBT program are critical. Many different skills are necessary for successful CBT deployment, including database technology, instructional design, statistical expertise, and computer and networking expertise.

Moving from Paper-pencil to Electronic Exams: Challenges and Opportunities

IAMSE 2006

Computer-based Testing (CBT): Challenges and Opportunities

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Moving from paper-pencil to electronic exams: Challenges and Opportunities

- Ingredients for Successful CBT Implementation
- CBT Advantages
- CBT Disadvantages
- Products
- Options for CBT Delivery
- Exam Operation & Infrastructure Issues
- ItemBanking: The Glue That Holds It All Together
- Item Analysis and Report Generation
- Beyond MC tests: New Test and New Item Styles

Moving from paper-pencil to electronic exams: Challenges and Opportunities

- My intention is to provide you with an outline of the topics of importance along with some resources you may investigate further.
- Please feel free to contact me offline

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Moving from paper-pencil to electronic exams: Challenges and Opportunities

Ingredients for Successful CBT

- Itembanking (exam databases)
- Exam driver software
- Exam administrative software
- Secure, reliable SQL servers
- Secure, reliable network
- Reliable client computers
- Dedicated people

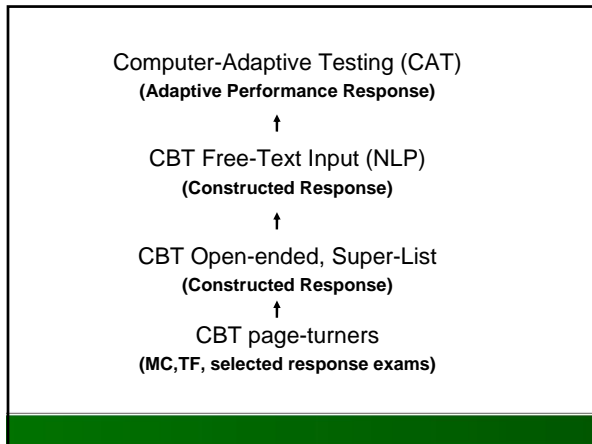
CBT Products Section

- Angel
- Blackboard
- Desire-To-Learn
- Home-Grown Products
- Perception
- TestWare-AnyWare
- Web CT
- There are many, many more. Try Google – Computer-based testing

CBT Goal

The goal of CBT ought to be the use of new and innovative items to successfully measure the proper construct of learning.

If you are using CBT to just deliver converted paper-pencil MC exams, you ought to consider other opportunities.



**Computer-based Testing (CBT)
Challenges and Opportunities**

**CBT Advantages
Section**

- Advantages of CBT**
- Embed multimedia to enhance realism
 - Immediate grading and feedback for students
 - Ease of developing exams from a database
 - Comfort and preparation for the students (for certifying and accrediting exams)
 - Practice and real exams
 - Organization: test questions stored in electronic data base (ItemBanks) rather than "MS Word" files. ItemBank efforts assist in the creation of "better" (reliable) exams.
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Advantages of Computer-based Testing

- CBT allows alternative question formats
- Equivalent exam forms
- Computer Adaptive Testing (CAT)
- More details later...

Computer-based Testing (CBT) Challenges and Opportunities

Barriers to CBT
“Strengths can also be weaknesses”

Barriers to Computer-based Testing

- Cost
 - \$15k – \$100,000k
 - Computers, maintenance, software costs and upgrade fees
- Cultural shifts and change (+/-)
 - Rethink the way Paper-Pencil testing is done now
 - Variables: space, time, technology, student anxiety
 - New methods of item/exam storage and delivery
- Technology
 - More to go wrong during run-time
 - Pencils “breaking” are different than networks going down

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Barriers to Computer-based Testing

- Facilities/Space
 - Dedicated or shared testing facility?
 - Can it support class size?
 - Shift testing?
- Scheduling
 - **Can be more complex; Competing resources**
- Infrastructure
 - Network, servers, client computer reliability
- Personnel: More people are needed
 - Staff support for set-up/tear-down
 - Information Technology support
 - Reliable and dependable
 - Vested in success of computer based testing venture

Computer-based Testing (CBT) Challenges and Opportunities

Options for CBT Delivery Section Exam Operation

Options for CBT Delivery

“Fixed” desktop computer testing center

- Advantages
 - Seating \geq medical school class size
 - Simplicity
 - Can control hardware/software on machines
 - Security
- Disadvantages
 - Seating $<$ medical school class size
 - Efficiency issues of space utilization
 - Multiple “testing shifts” or venues required
 - Wasteful of staff time; students require much of day off from other classes
 - Security concerns
 - Item leakage

Options for CBT Delivery

“Take-home” Exams

- High-Stakes or Low Stakes?
- Advantages
 - Less personnel costs (no proctoring)
 - Distributed hardware costs (students can take exams on their own or university computers)
 - Does open book format mimic real world environment?
 - Timed **questions** can reduce/discourage those who might be “less than honest”
- Disadvantages
 - Risk of technical problems due to non-standardized hardware and software packages. This is becoming less of an issue.
 - No proctoring, no security
 - Screenshots or copying questions

Options for CBT Delivery

Virtual “Travelling” Testing Center:

Lecture hall with collegiate owned/maintained laptops.

- Advantages
 - Can test entire class at once
 - Efficient for staff time
 - Efficient for student time
 - Increased security
 - Easy to troubleshoot
- Disadvantages
 - Set-up/take down of equipment

**Computer-based Testing (CBT)
Challenges and Opportunities**

**ItemBanking:
The Glue
That Holds It All Together**

ItemBanking

- If you do nothing else, get started with electronic item-banking.
- Why?
Because electronic itembanking helps develop and maintain Evidence Driven Exam Databases (EDED) for sound instruction and testing initiatives.

Good performing exams are designed from a pool of "good" items.

Maintaining Evidence Driven Databases for Sound Instruction and Testing Initiatives

- **Benefits of Modern Itembanking**
 - Organization
 - Hierarchical, content-based organization
 - Help create more valid and reliable exams
 - Create and publish exams quickly
 - 24/7 access, anywhere, anytime
 - Flexible query strategy for finding questions and retrieving previous exams
 - Forecasting: IB can estimate exam performance
 - Save yourself work ("Where did I put those questions?")
 - You owe it to yourself and the curriculum

ItemBanking Example

- Web-based itembanking
- Faculty/staff can access 24/7
- Organized through content hierarchies
- ItemBank drives the exam through modern web-database connectivity.
- With M/C exams, items are preselected
- With CAT, appropriate items are dynamically selected based on a users skill level.

Maintaining Evidence Driven Databases for Sound Instruction and Testing Initiatives

- Modern, electronic ItemBanks (IB) are value-driven databases that are statistically catalogued.

- IB maintains question and exam statistics

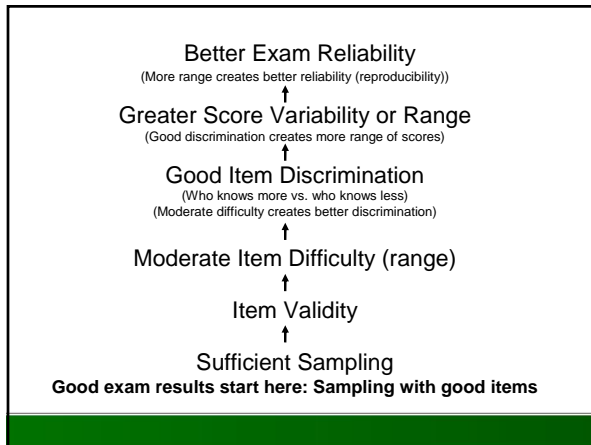
Degree of Difficulty

- Acceptable degree of difficulty (classroom exams) 0.4-0.8

Discrimination

- How well a question discriminates between students who do well and those who do poorly on an exam. Acceptable degree of discrimination (classroom exams) >0.3

Frequency counts for individual responses



Validity of test questions

- Acceptable Validity

Validity can be confirmed by correlating lecture objectives and question objectives through the use of an exam table of specifications.

- Exam Table of Specifications

Helps to assure exam validity (content specificity; test over what is taught) which can in turn help with exam reliability (reproducibility).

Displays correlation between content and skill type that students will be tested at.

Helps display what content is emphasized, forcing you to make sure that the material tested is covered in readings, lectures, and learning activities.

Item Analysis and Report Generation

Sample Statistics output

- N of Items 80
- N of Examinees 163
- Mean 65.239
- Std. Dev. 5.512
- Kurtosis -0.389
- Minimum 49.000
- Maximum 78.000
- Median 66.000
- Alpha 0.683
- Mean P 0.815
- Mean Biserial 0.312
- Max Score (Low) 61
- N (Low Group) 45
- Min Score (High) 69
- N (High Group) 50

Item Analysis and Report Generation

Item Statistics

Seq. No.	Prop. Correct	Disc. Index	Point Biser.	Prop. Alt.	Prop. Total	Endorsing Low	Point High	Biser. Key
19	.71	.28	.21	1	.01	.02	.00	-.07
				2	.26	.38	.12	-.22
				3	.71	.58	.86	.21
				4	.02	.02	.02	.03
				Other	.00	.00	.00	
20	.44	.35	.33	1	.01	.04	.00	-.22
				2	.04	.07	.00	-.11
				3	.42	.44	.26	-.22
				4	.44	.31	.66	.33
				5	.09	.13	.08	-.03
Other	.00	.00	.00					
21	.69	.33	.29	1	.04	.04	.04	-.01
				2	.00	.00	.00	
				3	.26	.42	.12	-.28
				4	.69	.51	.84	.29
				5	.01	.02	.00	-.11
Other	.00	.00	.00					

Computer-based Testing (CBT) Challenges and Opportunities

New Tests and New Item Styles Section

New Tests and New Items

- Why use innovative test styles?

Such exam styles attempt to go beyond the capabilities of multiple-choice exams, which in most cases are recall and knowledge based.

Such exams attempt to avoid pure recall type questions, e.g. - use of higher order thinking skills

- Comprehension
- Discriminative thinking
- Problem solving skills
- Synthesis and application skills

New Tests and New Items

- Patient simulations
- Script Concordance
- Animated FLASH graphics questions
- Clinical vignettes
- Free text input questions, natural language processing scoring algorithms
- Computer Adaptive Tests (CAT)
- Open-ended, short answer, super list questions
 - Good for problem solving questions
 - Short simulation, clinical vignette questions
 - Good for graphical intensive applications
 - Dermatology
 - Histology
 - Ophthalmology
 - Pathology

- **New Test and New Item Styles Advantages**

Designed to measure the proper construct of learning

Items may be easier to write than MC

Tend to be more creative and more related to clinical practice (construct)

For example, a patient simulation

- Non-prompting interface
- There aren't the magical "5" choices (MC)
- Requires students to type in questions
- Adapts to the students decision making

- **New Test and New Item Styles Disadvantages**

- Software tend not to be "off-the-shelf"
- Special development expertise
- Special scoring expertise
- More development time
- More sophisticated exam interfaces

New Test and New Item Styles

Walk-in Testing utilizing CAT technology:

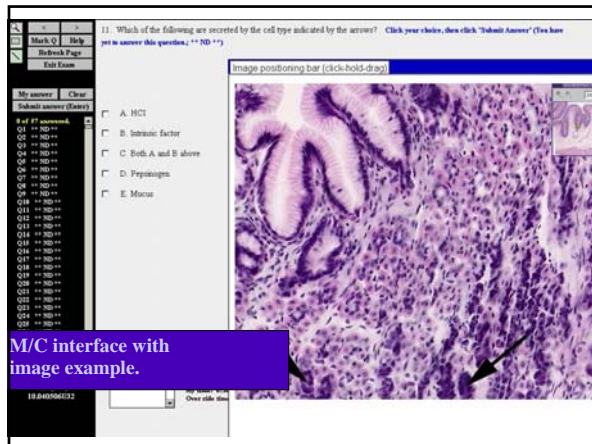
- **Advantages**
 - Students can walk-in and take an exam during a "window" of time
 - Measures a students skill level with less exam questions than a traditional MC exam
 - Less exam questions = less exam time
 - Efficient utilization of space for staff and student time
 - Greater security
- **Disadvantages**
 - Requires sophisticated CAT technology
 - Many test packages do not support this technology
 - Requires a large exam database (itembanks) of tried and true exam items
- This option ought to be the ultimate goal.

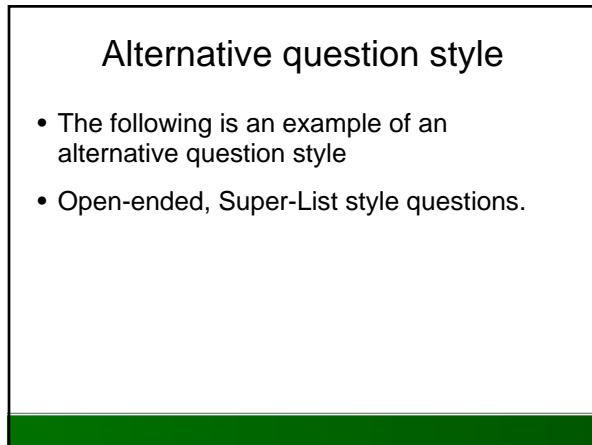
Computer-based Testing (CBT) Challenges and Opportunities

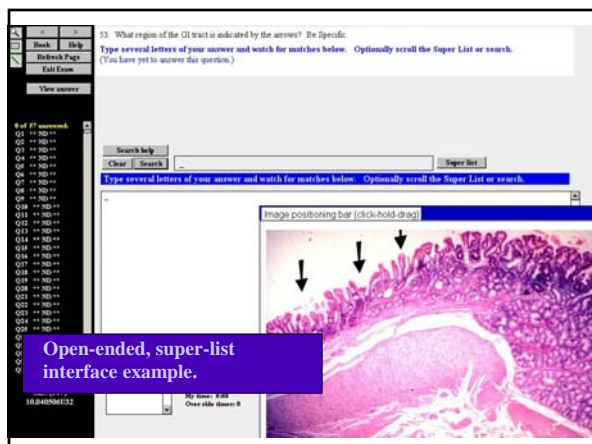
Exam Operation and Infrastructure section

Exam Administration

- Exam programs must have a control panel
- Allows you to set exam parameters
 - Date, time, exam time length
 - Pre-enrollment, user authentication
 - Monitor exam performance real-time
- Security software
 - Programs to monitor what other software might be activated by a student (CyberCop)
 - Programs used to detect exam collusion
 - <http://integrity.castlerockresearch.com/>







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