Beyond Clickers:
Web-based Wireless Interactivity for the Physics Classroom

Dean Zollman & N. Sanjay Rebello

Kansas State University

Zdeslav Hrepic

Fort Hays State University

Physics Education Research Group
Kansas State University

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&

Office of the President, Fort Hays State University

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We were beyond clickers before clickers existed

- Classtalk – 1990s
- Designed & Built by Better Education Inc.
  - http://www.bedu.com/
- Had many features which have been lost in the clicker generation

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Classtalk Hardware

- Hard wired proprietary network
- Macintosh Server
- Hewlett-Packard Hand-held *DOS* computers
  - Full QWERTY keyboard
  - Limited but readable text screen

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Classtalk Software
### Designed & Written by Fred Hartline

- Sent questions to handhelds
  - Full questions appeared on each student's screen
  - All types of questions possible
    - *Not* limited to multiple choice
  - Sets of questions could be sent
- Provided analysis & individual responses for instructor
  - Could point at a location in a seating chart and see that student's answer
  - Could send different messages to different students depending on their responses
- Allowed a variety of answers
  - Up to four individual students could log on to each handheld
  - Alphabetic & numeric responses possible

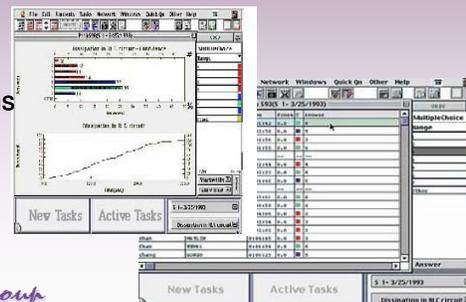*Physics Education Research Group*
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Classtalk Software

Includes seating chart with ability to click on a seat and see the student's name, picture and response.
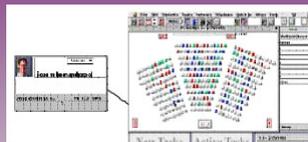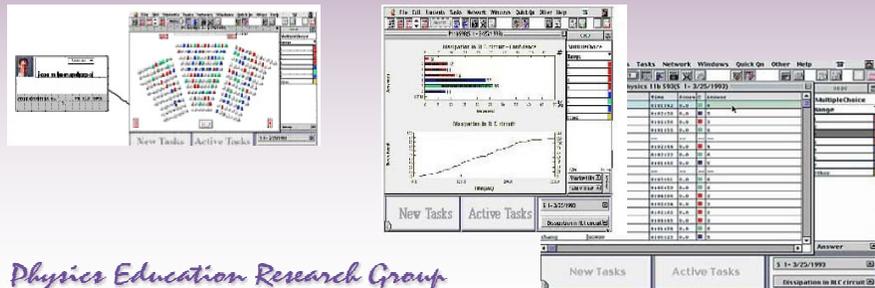
Analyses include

•Parsing for short answer questions

•Binning for numerical responses

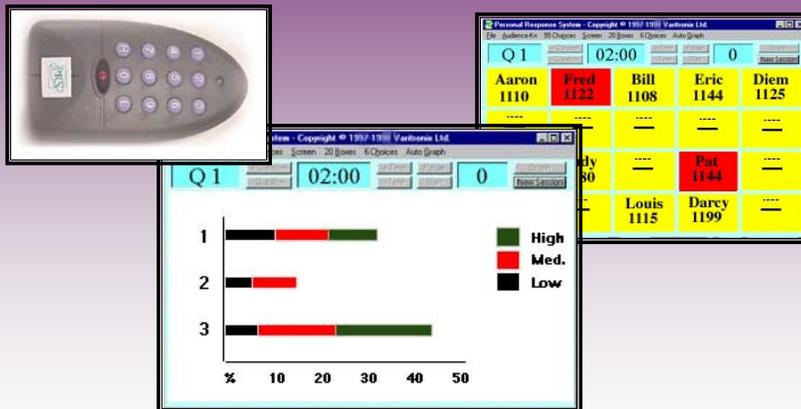•Histograms for multiple choice

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Better than any software for later systems

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Typical Clicker and Software

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Beyond Clickers

- **Personal Data Assistants (PDAs)**
  - **Aka Pocket PCs**

- **Tablet PCs**

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Personal Data Assistants (PDA)

- Wireless Internet
- Full "keyboard" available
  - No limits on types of responses
- Web-based software
  - Can run in browser
    - Not all functions of desktop browsers
  - Any Web-based question-response system can work
- Expensive
  - Thanks

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Tablet PCs

- Wireless Internet
- Full keyboard available
    - Plus ability to draw and write on the screen
- Web-based (browser) software
- Full notebook computer with drawing and writing capabilities
- Limited handwriting recognition
- Even more expensive
    - Even more thanks

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PDA Limitations

- **Browser**
    - **Flash is flaky but works**
    - **Multiple windows or tabs are coming now**
        - **Firefox beta**
        - **Opera – not free**
    - **Java is really flaky**
- **Hardware Interface**
    - **Possible but not well tested**
    - **Sensors can work but takes extra equipment**
- **Writing and Drawing**
    - **Limited**
- **Screen size small**
- **On-screen keyboard small**
    - **Text entry is slow**

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Ideas for Classroom use

- Neighboring students receive slightly different questions
  - Same topic
  - Required to discuss with each other after answer
    - Consider similarities and differences in situation and responses
- Graphical questions
  - Point to a place on the picture that ...
- Students use PDAs as measuring tools
  - E.g. Really expensive stop watches
  - Add sensors
    - E.g. Temperature profile in the classroom
- Web as a reference source
  - Have students look up concepts
  - Peer comparisons of results
- Peer to peer collaboration through out the classroom

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Ideas for Classroom Use

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Very Expensive Clicker

http://aa.uncw.edu/numina/srs
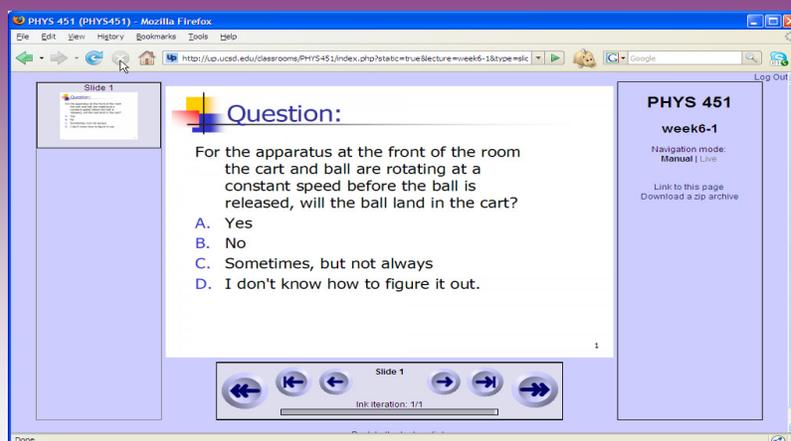
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Really expensive clicker

Ubiquitous Presenter http://up.ucsd.edu
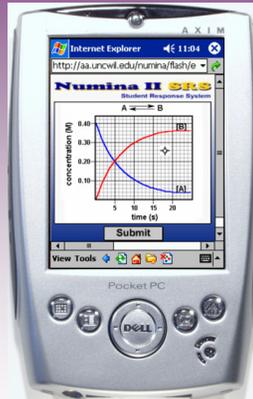
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Beyond clickers with other types of responses

| Variable Response | Graphic Response | Graphic Response |

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Correlated sets of questions

- Variety of questions types
  - Multiple choice
  - Ranking
  - Scaling
  - Open-ended
  - Can include graphics
- Branching based on previous answer
- Grouping of questions

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Page 2

Question 2 *** required ***
For the circuit at the front of the room will the lamp turn on when the switch is closed?
- Yes
- No
- I don't know.

Question 3

1 - Just guessing | 2 - Not quite a guess | 3 - Moderately sure
4 - Almost certain | 5 - Certain that it is right

	1	2	3	4	5
3.1 Rank your confidence in your answer.	○	○	○	○	○

Question sets with open ended responses

Q.4 Acceleration

When a ball is thrown straight up, at the highest point the velocity and acceleration are (A. both positive, B. both negative, C. both zero, D. velocity positive and acceleration zero, E. velocity positive and acceleration negative, F. velocity negative and acceleration positive, G. velocity negative and acceleration negative, H. velocity zero and acceleration postive, I. velocity zero and acceleration negative

Please select your answer
A both positve
B both negative
C both zero
D velocity positive and acceleration zero
E velocity positive and acceleration negative
F velocity negative and acceleration positive
G velocity negative and acceleration zero
H velocity zero and acceleration positive
I velocity zero and acceleration negative

Q.5 Explain

Please explain your answer to the previous question.

Please type your answer.

Next Question

Beyond Question
http://www.erskine.edu/bq/

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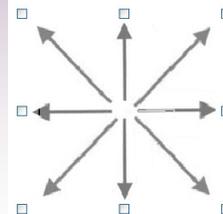Kansas State University

Variations within one question

• Each students sees a picture of a diver after she has left the board

•Three students sitting next to each other will have different pictures

   •On the way up

   •At the peak

   •On the way down

•They select vectors to indicate each force acting on the diver.

•Subsequent peer-to-peer discussion addresses the "force in the direction of motion" issue.

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What are directions of the forces acting on the diver this position?
Consider all forces individually; not the net force.

Select as many different directions as needed to describe all of the forces. Then tap the SUBMIT button.
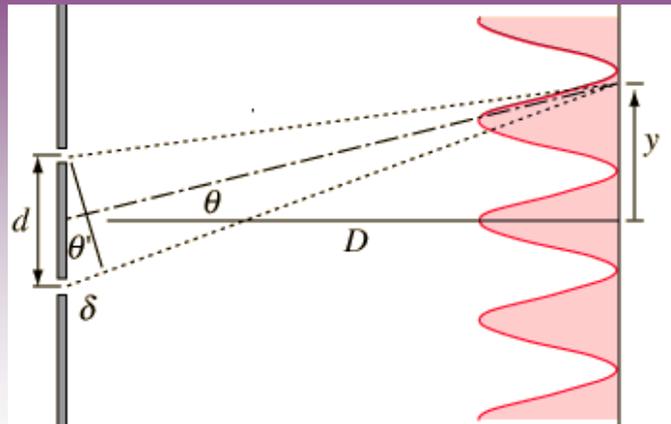
Group problem solving
with submission to instructor

**Real time discussion of different
approaches to the same problem**

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Student annotation of presentations

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Group experimental investigation with collaboration across groups

Wiki for creating the lab report

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Instructor's Screen
For monitoring students' progress

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Limitations for Tablet Input

- No easy way to put open-ended responses in a histogram
  - Scan through them
  - Pick out interesting ones
- Cannot parse a graphic
- Monitoring the real time work of 100 students is essentially impossible

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In the end pedagogy counts
Research-based

- Interactive engagement classes
  - large, medium & small
- Collaborative learning & teaching
  - Problem solving
  - Experiments
  - In class discussions
- Force students to predict the results of a demo
- Real-time feedback to instructor & students
  - Deal with issues now
  - Students see that others have difficulties similar to theirs
- Improved attitudes of everyone

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Research
Lots of it

- Richard Hake review on PHYSLRNR
- PDAs improved learning over clickers
  - KSU NARST paper
- Interactive demonstrations
  - Thornton & Sokoloff
- Interactive Engagement in general

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For more information

KSU Tablet & PDA Projects	FHSU Tablet Project
http://web.phys.ksu.edu/HP_project	http://www.fhsu.edu/~zhrepic/
Classroom Presenter	Ubiquitous Presenter
http://classroompresenter.cs.washington.edu/	http://up.ucsd.edu
Beyond Question	DyKnow
http://www.erskine.edu/bq/	http://www.dyknow.com
Numina	Group Scribbles
http://aa.uncw.edu/numina/srs	http://groupscribbles.sri.com/