

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

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Supported by



**Hewlett Packard
Technology for
Teaching Grants**

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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

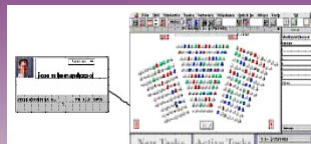
- Sent questions to handhelds
 - Full questions appeared on each student's screen
 - All types of questions possible
 - *Not* limited to multiple choice
 - Sets of questions could be sent
- Provided analysis & individual responses for instructor
 - Could point at a location in a seating chart and see 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

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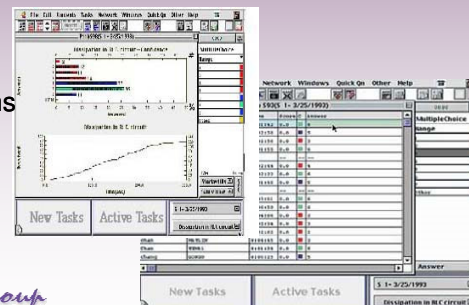
Classtalk Software

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



Analyses include

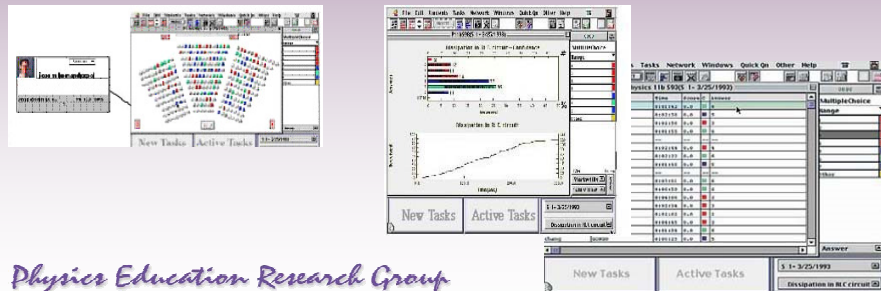
- Parsing for short answer questions
- Binning for numerical responses
- Histograms for multiple choice



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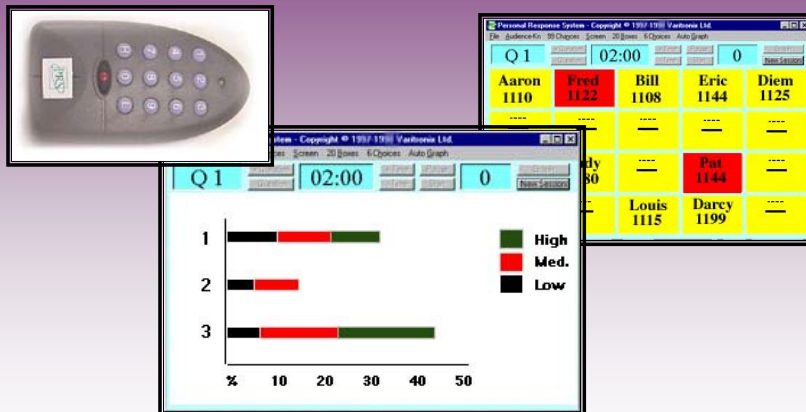
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Better than any software for later systems



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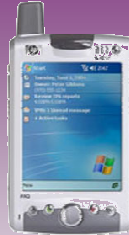
Typical Clicker and Software



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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

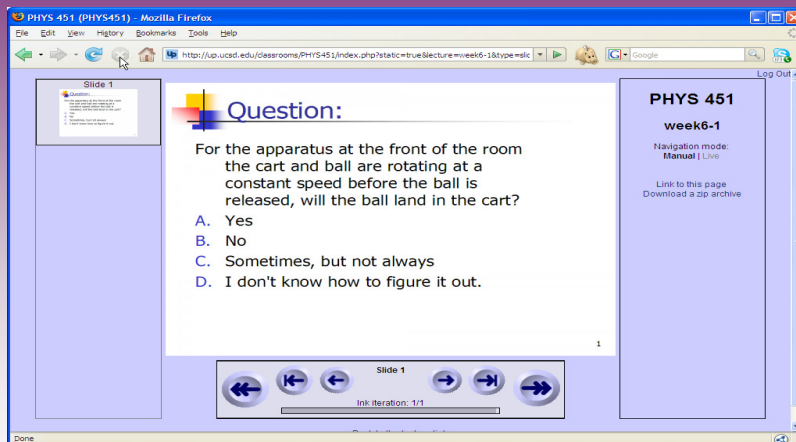


<http://aa.uncw.edu/numina/srs>

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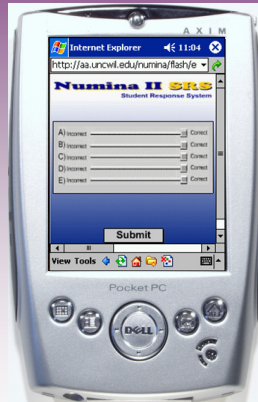
Really expensive clicker



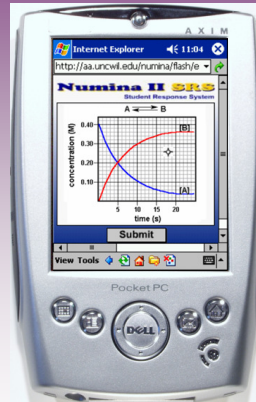
Ubiquitous Presenter <http://up.ucsd.edu>

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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.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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 positive, I. velocity zero and acceleration negative)

Please select your answer

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 positive

I. velocity zero and acceleration negative

Q.5 Explain

Please explain your answer to the previous question.

Please type your answer.

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

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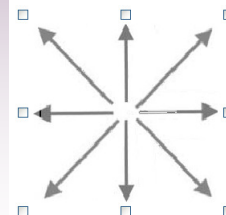
Variations within one question

- Each student 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.

What are directions of the forces acting on the diver at 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.



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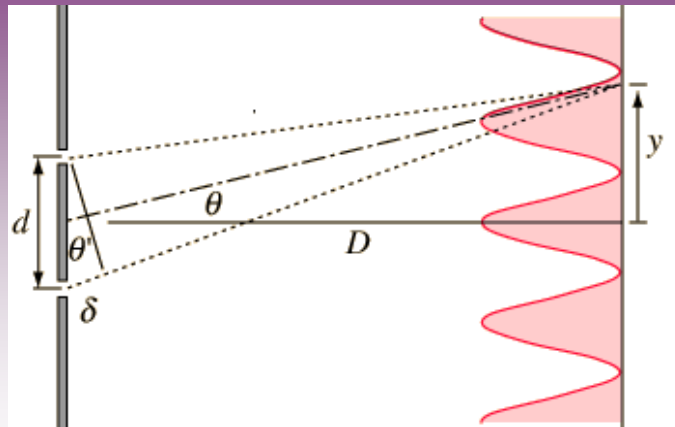
Group problem solving with submission to instructor



**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

Example 2.6
(Close the book)

- According to O – how long does it take for the rocket to pass a particular point on the platform?
- What is the rest length of the rocket?
- According to O' – what is the length of the platform D ?
- According to O' – how long does it take for the rocket to pass a particular point on the platform?
- According to O' , do ends of the rocket simultaneously line up with the platform – as they do for O ?
If not what is the time between the two lining ups (front-front and back-back)

Diagram: A rocket moving to the left at $0.8c$ relative to a platform D of length $D_0 = 65\text{ m}$. The rocket's rest length is L_0 . The time interval between the front and back of the rocket lining up with the platform is $\Delta t = \gamma \cdot t_0$.

Equations:
 $t = \frac{d}{v}$
 $L = \frac{L_0}{\gamma}$
 $\Delta t = \gamma \cdot t_0$

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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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"I love using these hand-held computers. I really like how it provides feedback directly to the teacher. I plan on getting one of these, for my own personal use."

"The best thing about the hand-held computers is that they provide useful feedback to the instructor about whether or not we understand"

"They are really easy to use and with the questions and response method it is easy to participate in class. It seems to really show the weak areas of the class to the professor."

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Finally, students feel good when they can check up on the instructor



I fixed the problem with the online grade book.

No, you didn't. I am looking at it right now.



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For more information

KSU Tablet & PDA Projects

http://web.phys.ksu.edu/HP_project

FHSU Tablet Project

<http://www.fhsu.edu/~zhrepic/>

Classroom Presenter

<http://classroompresenter.cs.washington.edu/>

Ubiquitous Presenter

<http://up.ucsd.edu>

Beyond Question

<http://www.erskine.edu/bq/>

DyKnow

<http://www.dyknow.com>

Numina

<http://aa.uncw.edu/numina/srs>

Group Scribbles

<http://groupscribbles.sri.com/>

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