

Small Whiteboards (SWB): Updating an Old Technology with New Pedagogies



This material is based upon work supported by the National Science Foundation under DUE Grant 0837829.

Elizabeth Gire, Kansas State University
Corinne Manogue & Leonard Cerny, Oregon State University

www.physics.oregonstate.edu/portfolioswiki

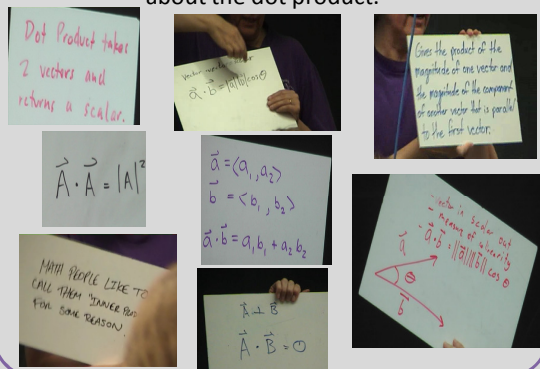


Abstract

Updating the old technology of classroom "slates," we will discuss how individual-sized whiteboards can be used to increase student interactivity in small-enrollment courses. These "small whiteboards" can be used to invite classroom participation from each student (like electronic classroom response systems in large-enrollment courses) and they also allow for students to respond with multiple representations or even multistep calculations. Small whiteboards are particularly relevant for upper-division physics courses where small numbers of students wrestle with geometric reasoning, multiple representations, integrating new ideas with their lower-division understandings, and increased mathematical sophistication

Examples of Student Responses:

"Write down something you know about the dot product."



Types of SWB Questions

Review

Ask students to write down what they already know about a topic

"Write down something you know about the dot product."

- Produces a good review discussion that is anchored in what students already know
- Often brings up notational issues
- Chance to highlight multiple representations

Recall

Ask students to recall a specific formula

"Write down the formula for the electric potential everywhere in space due to a point charge not located at the origin."

Good for highlighting sense-making strategies like:

- Fleshing out an iconic formula
- "What kind of a beast is it?"
- Checking dimensions
- Limiting cases
- Symmetry

Compute

Ask students to perform a short calculation

"Find the determinant of matrix: $A = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 3 & 2 \\ 2 & 1 & 5 \end{bmatrix}$."

- Can highlight a particular technique, but can also bring out multiple ways of calculating a quantity.
- Works well when students are working in a notation they're not familiar with (like Bra-Ket or tensor notation).

Apply

Formative assessment to see if students have understood what you've just presented

"In cartesian coordinates $\vec{r} = i + j + k$. Write in \vec{r} spherical coordinates."

Translate

Ask students to express something in a new representation

"Write down expressions of normalization, orthogonality and completeness of the S_z basis in Dirac notation."

- Encourages representational fluency
- Brings up notational issues

Next Step

Ask the students to do the next step in a derivation

- Helps with pacing
- Communicates to students that derivations are something they can do and should pay attention to

Facilitation Issues

"Safety"

- "?" for "I don't know"
- "I see a lot of boards that look like this."
- Fading Board Anonymity

Fluidity

- Scaffolding professional language
- Responding to unexpected questions
- Developing PCK

Comparison of Classroom Response Technologies

	Logistical				Pedagogical					
	Equipment & Cost	Keeping a Record of Responses?	Optimal Size Classroom	Preparation	Spontaneity	How many students participate?	How do students participate?	Representation of Responses	Feedback for Students	Student Anonymity
Socratic Questions	None no cost	difficult	Small (more awkward with larger class sizes)	Prepare questions	Prepared or spontaneous	One to several	Students supply an answer to question posed by the instructor	Verbal	Students hear instructor's response to supplied answers	None
Flashcards	Paper with multiple choice options; low cost	difficult	Small to Large	Prepare questions, distribute flashcards	Prepared or spontaneous	All	Display an individual's answers to multiple choice questions	Multiple choice	Instructor can estimate distribution of answers	Students typically anonymous
SWB's	Boards, pens, erasers; low cost	difficult	Small (more awkward with larger class sizes)	Prepare questions, distribute boards	Prepared or spontaneous	All	Write on individual boards	Multiple Representations	Boards displayed, Instructor can estimate distribution of answers, Compare & contrast boards	Anonymity can be faded
Clickers	Transmitters, receivers, analysis software, computer, electronic slides (PPT); mid cost - some cost typically offloaded to students	easy	Large (more awkward with smaller class sizes)	Prepare PPT slides, sync with software, distribute/register transmitters	Prepared; spontaneous difficult	All	Use transmitter to submit an individual's answer	Multiple choice	Distribution of responses displayed	Students typically anonymous
Ubiquitous Presenter	Internet connection (wireless), transmitting devices (laptop, cell phone, PDA), computer, UP software, electronic slides (PPT); high cost	easy	Large (more awkward with smaller class sizes)	Prepare PPT slides, sync with software, distribute/register transmitters	Prepared or spontaneous	All, groups	Students submit responses electronically working individually or in groups	Multiple Representations	Particular submissions can be displayed	Anonymity can be faded