COMPILATION: whiteboarding - identifying the model

Date: Mon, 10 Jan 2000
From: "Lou C. Turner" <TurnerLou@WRA.NET>
Subject: Whiteboard Presentations

I have not done a good job over the years in asking students to identify the model used when they are explaining homework problems in their presentations. This is partly because I have felt that having a student say "This is a problem about the constant acceleration model" did not advance one's understanding to any great degree, especially when we are in the midst of studying constant acceleration.

I have just started to ask my presenters to do three things at the beginning of their presentation.
(l) **Identify the model**(s) you will use to solve the problem.
(2) **Justify your use of the model.** That is, how do you know that this problem can be used to solve the problem.
(3) **Explain how you will use the model** to solve the problem. (This idea came from Fred Reif's book, "Understanding Basic Physics," chapter 6.)

For example, in a constant acceleration problem, I would expect my students to say things like
(1) I will use the constant acceleration model to solve this problem.
(2) I know I can use this model because...the object of interest is a falling body, and our picket fence experiment showed that falling bodies have a constant acceleration...or the object of interest is rolling down an incline and we have done an experiment which shows that the ball has a constant acceleration...or the problem says the acceleration is constant.
(3) I will use the algebraic representations associated with the constant acc. model... or I will use the graphical representations of constant acceleration to describe the motion of this object.

(1) is the easy part. My students have difficulty with both (2) and (3), but I hope with practice they will improve. I consider this to be a valuable enough exercise that I will use it on a consistent basis.

Date: Sat, 19 Feb 2000
From: Jane Jackson <jane.jackson@ASU.EDU>
Subject: What's on a good whiteboard?

I watched some old videos of Malcolm Wells. The videotaped paradigm experiments are for units 3 (constantly accelerating particle - descriptive model) and unit 4 (model of a particle subject to a constant force; the lab on Newton's 2nd law).

I noticed in these tapes that NO data tables are on whiteboards of students who are presenting paradigm labs.

I'm not familiar with the modeling curriculum in detail; I've never had the chance to use Modeling Instruction in the classroom. So I asked David Hestenes why Malcolm's students' whiteboards didn't have any data tables.

David told me that **usually a data table shouldn't be on a whiteboard.** Why? Because, he said, you don't look at the numbers; you look at the SHAPE OF THE CURVE on the graph. The numbers don't reveal the model, usually. (Occasionally the numbers may reveal a pattern, for example if your data points are 2, 4, 8, 16, ... In that case a data table would be of use on the whiteboard, he said.)

I noticed also that on Malcolm's students' whiteboards:
-- there were **no equations**; they had no numbers; just PROPORTIONAL RELATIONSHIPS.
-- their **graphs had no numbers**; just SYMBOLS on the axes and the CURVE SKETCHED IN.

RESPONSES IN LATER YEARS:

From: Glenn Wagner <GWAGNER@UGDSB.ON.CA>

Lou Turner's suggestion of asking the students to identify and explain the model they are using is worth further exploration. For example, the 100 m dash is a nice experiment for combining 2 models: const. velocity and accelerated model. The mathematical relationship is very complex when both motions are brought together. I plan to use 100 m dash data and have them use the models they know to describe the motion. If anyone is interested, I have d-t data of a Carl Lewis run. The first part of the run is constant acceleration and the second part is constant velocity.

Date: Wed, 20 Sep 2000
From: Fran Poodry <FPoodry@AOL.COM>

If you caught the "Olympic Science" on the Discovery Channel the other week, it very nicely showed the strategy of the world's fastest man. He uses a different strategy for the 100 m that involves a later acceleration, so that he is accelerating when most of the other runners are at constant velocity. I was fascinated, and I am showing it to my 9th graders this week. If you do Active Physics, it would fit perfectly with Sports Chapter 1.

Date: Mon, 25 Sep 2000
From: Glenn Wagner <GWAGNER@UGDSB.ON.CA>

Due to the overwhelming demand for the Carl Lewis 100 m dash (1987 world championships) I thought I'd post the data for all. Here it is, BUT READ MY COMMENTS at the end!!!

d(m)	t(s)	d(m)	t(s)
0	0	20	2.96
1	0.54	30	3.91
2	0.78	40	4.78
3	0.97	50	5.64
4	1.13	60	6.50
5	1.28	70	7.36
6	1.42	80	8.22
7	1.55	90	9.07
8	1.68	100	9.93
9	1.80		
10	1.92		

Since split time data is given at 10 m intervals I had to interpolate the data from 1 to 9 m using the actual mathematical model of the 100 m dash (see TPT, March 1998, p. 144). The model as applied to Lewis is very accurate so I have great confidence in the data from 1 to 9 m even though is not experimentally determined. The remainder from 20 to 100 m is experimental.

Remember that humans are not the same as carts going down an incline. The theory clearly shows for small times the acceleration is constant. In this case, the time interval from 0 to 6 m the students can model according to d = A*t^2. Now between 7 and 20 m things get a little fuzzy and the students may stumble onto some confusion about what math model to apply. However, from 20 m to 100 m the motion is essentially constant (40 to 100m more clearly so).

Date: Wed, 31 Jul 2002
From: Leslie McClinton <ljmcclinton@JUNO.COM>

Jane Jackson writes:
"I asked David Hestenes why Malcolm's students' whiteboards didn't have any data tables.

David told me that usually a data table shouldn't be on a whiteboard. Why? Because, he said, you don't look at the numbers; you look at the SHAPE OF THE CURVE on the graph. *The numbers don't reveal the model, usually*. "

Hi Jane,
Good point. You have pinpointed one of the questions which came up more than once during the Quarknet Modeling conference at Notre Dame University last month. As you know the teachers were working in "student mode" and we did the whiteboards in response to specific graph and force-diagram questions.

Most groups of teachers, at first, tended to put everything on their whiteboard including data tables and hard copies from the printer! Our group was the exception, in that we answered the question and did not put extraneous details on the whiteboard. Both Tom Todd and Gregg Swackhamer pointed out that *we were only to graph and/or display the force diagrams which in themselves were enough to fully answer the question [i.e.,reveal the model]*. In fact, this would be counterproductive: if as a teacher you are trying to get through class period and allow the student groups to first post their results and have adequate time to discuss them, then you would need to keep the whiteboards streamlined.

So perhaps teachers have to be diligent, and the leader in keeping students on task as it relates to answer a question and not dress up the whiteboard with data tables etc.

Date: Thu, 1 Aug 2002
From: Brenda Royce <brroyce@ATTBI.COM>

The following comment was made regarding whiteboard content: "Our group was the exception, in that we answered the question and did not put extraneous details on the whiteboard."

I also have fought the battle against getting too much stuff on the board in my classroom (due to time constraints mostly), and interestingly have found the same tendency in teachers in modeling methods workshops I've taught. Data tables seem particularly difficult for people to let go of, as well as feeling they must show every step of the algebra.

One way that has helped me get the 'streamlined' idea across is to encourage them to **think of a whiteboard as a 'billboard'**. If a 5-10 second look (like driving by a billboard on a freeway) is not enough to communicate the main idea, it's too busy. Keep only the parts needed to communicate. The students pretty readily agree that diagrams, graphs, and a clearly written equation or a few words are the most effective. In their presentation they can add detail if needed. The whiteboard is only a visual support for explaining what they did and found.

Date: Fri, 2 Aug 2002
From: Larry Dukerich <dukerich@ASU.EDU>
Subject: Whiteboards should be spare

I thought I would amplify what Jane had to offer regarding what should be on whiteboards. She wrote:
>David told me that usually a data table shouldn't be on a whiteboard. Why? Because, he said, you don't look at the numbers; you look at the SHAPE OF THE CURVE on the graph. The numbers don't reveal the model, usually. … >

I am constantly reminding my students not to put tick marks on the axes and not to plot each and every point with great fidelity. *The graphs should have the variables and the units on the axes and the general shape of the curve.* **Whiteboards are really meant to serve as props to help support the story told by the presenters**; they are not meant to tell the entire story themselves. A whiteboard filled to the max is so cluttered that you can't get the main idea.