

The "Red Pen" Worksheet



An excerpt reprinted with permission from Nelson, C. E. 2009 (in press). *Want brighter, harder working students? Change pedagogies! Examples from biology.* In B. J. Millis, Editor. *Cooperative Learning in Higher Education: Across the Disciplines, Across the Academy.* Pp. XXX. Sterling, VA: Stylus Press.

Using Pre-Class Worksheets and Whole-Period Cooperative Learning to Foster Critical Thinking in Courses, Large or Small

My first attempts at cooperative learning were inspired by Judith Hanson. In a traditional lecture room with 150 students, she and one graduate assistant gave each student a preparation grade (based on a pre-class worksheet) and a participation grade (based on the roles they manifested, not on the details of what they said). Students liked these discussions, which lasted the entire period. When I combined this worksheet-structured discussion technique with approaches based on Perry the students liked the changes so much that they secretly arranged for me to receive a campus wide teaching award.

Critical Aspects of the Approach

Four aspects of my approach now seem central.

1. I assigned **cognitively complex material** for pre-class reading, material where cooperative learning would noticeably advance most students understanding.
2. The worksheet **required step-by-step analysis** of the assigned material using a specified critical thinking framework.
3. In class, I **assigned the students to groups** of about five, usually by having them count off ... I used different ways of grouping on different days so that the students couldn't predict the group they would be in.
4. And, I **marked the worksheets on preparation effort**, not on having the material completely correct. Indeed, if most students are likely to get the material essentially correct on the worksheets, it may be a bad idea to use extended discussion techniques.

The Marking Technique

The minimal-effort marking requires explanation. Pre-class papers or in-class quiz answers were written in any color *except* red or pink. As the students arrived, I handed them a cheap red pen with no cap (not a good thing to put in a purse, pocket, or briefcase.). Pens were handed back at the end of class. Students were responsible for changing their own papers in red to reflect any improvements or clarifications that arose during the discussion. I then graded only on whether or not the initial answers (the ones before the red pens) showed sufficient effort in preparation. Grading was credit or no credit and required a fraction of a minute per paper, even on a complex worksheet.

Marking for participation was done while observing the groups in class and focused on having each student participate usefully but not, typically, equally. A key move was making participation a group responsibility. Every student in the group and I could tell at a glance whether each student had filled out the worksheet. If a student's paper showed that the work was done but the student was not participating usefully, everyone in the group lost points unless they were collectively asking that person what she or he had written down. Prepared students invariably participated when asked.



Know Students' Names

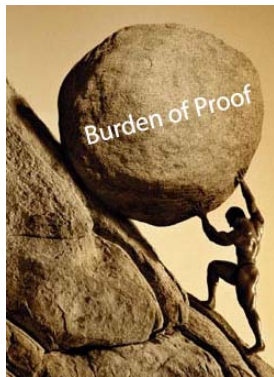
Marking for participation required knowing the students' names. In larger classes, I took the students' pictures and used the photos as flashcards until I knew the names and faces. I also practiced names in the classroom while the students were writing or discussing. I have found this practice to be essential in large classes. [Note: An alternative could be insisting students update their Moodle profiles with pictures; instructors can view all Students in their courses within the Moodle course shell that is automatically populated with all enrollees.]



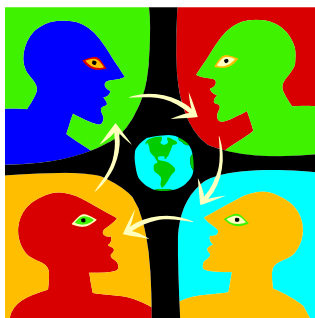
Structure of the Worksheet

The structure of the worksheet was important for supporting the students' learning of critical thinking. The critical page had four columns that guided the student through an elementary decision theory analysis of the reading (it took most students several tries to learn to do this analysis successfully):

- Summarize the author's argument.** List each main point separately. State it as if you were the author (not "the author thinks ..." or "she says ..."). Use complete sentences.
- Evaluate the strength of evidence.**
 - List the factual claims relevant to each main point separately. Evaluate each (very solid, solid = normal science, suggestive, plausible, improbable, or very improbable). Explain (Quality and quantity of data? Other support?)
 - Evaluate the strength of the overall argument (Internal consistency? Alternative hypotheses addressed? Overall probability?)
- For each main point and for the overall argument: Burden of Proof:** Accept until shown to be probably false OR Reject until shown to be probably true? WHY? (Positive and negative consequences, applications and societal impacts?) *And Level of Proof:* Normal as in basic science (5%), Stronger or Weaker? Why?
- Decisions (For each main point and for the overall argument):** Compare the strength of evidence to the level of proof to decide whether you should accept or reject.



Identifying Roles



At the end of the period the students marked on a checklist the roles (positive and negative) that they had played individually and the ones they had observed in their small group. To help them remember, note, and use the positive roles,

a header on each workshop page focused attention on key positive roles: "TRY: Encouraging, Stating Uncertainties, Pausing, Listening, Contrasting, Summarizing, OR Timekeeping."

Suggested Related Readings from Dr. Craig E. Nelson:

- Bonwell C. C., & Eison J. A. (1991). *Active learning: Creating excitement in the classroom*. Washington, DC: ERIC Clearinghouse on Higher Education, George Washington University.
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- Duit, R. (2009). Bibliography – STCSE: Students' and teachers' conceptions and science education. Retrieved April 25, 2009, from www.ipn.uni-kiel.de/aktuell/stcse/bibint.html
- Grossman, R. W. (2005). Discovering hidden transformations: Making science and other courses more learnable. *College Teaching*, 53(1), 33-40.
- Hake, R. R. (1998). Interactive-engagement vs. traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics*, 66, 64-74.
- Hake, R. R. (2002). Lessons from the physics-education-reform effort. *Ecology and Society*, 5(2), art. 28. Retrieved December 8, 2008 from <http://www.ecologyandsociety.org/vol5/iss2/art28/>
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- Nelson, C. E. (2008a). Teaching evolution (and all of biology) more effectively: Strategies for engagement, critical reasoning, and confronting misconceptions. *Integrative and Comparative Biology*, 48, 213-225.
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