

Guest Comment: Only the student knows

“STUDENTS!

“We have a problem that only you can help us with. We have been writing this textbook, off and on, for twenty-five years. Over that time we have become accustomed to relativity and can no longer see what is wrong with the text. Only you, coming fresh to the subject, can recognize where the text fails to help your understanding. In this you are a world-class expert! Will you help us with your expertise?”

“As you read the text, please have a blank sheet of paper next to you. Note down difficulties as they appear, with text page number. If you cannot figure out what is wrong, tell us that too! If something later clears things up, just add that to the comments. Do not erase anything or cross it off: both entries are useful. At the end of each chapter, note down general difficulties you have and questions you would like answered. Do not revise or recopy your notes; it is very important that they be spontaneous, written down at the very minute you are reading.

“Here is the right attitude: If you do not understand something, it is OUR fault. Help us to pinpoint where the text falls short.

“Turn in the notes on each chapter on the day the reading assignment is to be completed. The instructor will respond individually to each reading memo.

“Parable of the Blind Carpenter. We are like a carpenter who has spent twenty-five years building a house. During that time the carpenter has gradually gone blind, now cannot see the house at all, and must rely on the occupants of the house to report what is wrong: “We need more cupboards in the kitchen,” or, “Water is leaking into the bedroom.” Even though blind, the carpenter is still a competent worker and can fix most things, even some things the occupants do not fully understand, such as exactly where the roof leaks. But the blind carpenter cannot fix things without being alerted by the occupants.

“Will you help us finish this house? Thank you.”

This appeal in various forms has gone to students in relativity classes for the past few years as John Archibald Wheeler and I worked through many desktop-published drafts of the second edition of our text *Spacetime Physics* (scheduled for final publication this spring). The result has been a revolution in my understanding of students, teaching, and textbooks. It also leads to suggestions for the *American Journal of Physics*.

STUDENTS AND TEACHING

That golden moment when a student first sits down (CD player blaring), opens the textbook, and begins to read—on this moment we lavish hundreds of thousands of dollars for book production and promotion and endless hours of effort by the poor author. Yet about this golden moment we know almost nothing. Why not? Because the student does not tell us. Why not? Anxiety about being exposed, fear of complaining to someone with the power to grade, self-blame for not understanding, belief that textbook writers and professors know everything, undervaluation of his or her irreplaceable insight into what aids and does not aid comprehension. Also, we do not ask.

Students cannot be forced to confide in us, but they can be strongly rewarded for doing so. Students in my classes earn the increase of a full letter grade for the semester if they turn in every reading memo (described above) on the day that reading assignment is due. (The increased grade depends only on promptness and the *number* of reading memos submitted, not their content.) I read each memo, respond individually in writing, and return them the following class period. A significant portion of this second class is spent discussing the difficulties that students report.

Ask—really ask—students to tell you what they think, then fasten your seat belt! Detailed comments on the text pour in, mixed with judgments on lectures, demonstrations, and grading. Occasional expressions of resentment, frustration, and rage recall our own time as students. Unguarded comments make it clear that many students follow their own intellectual pilgrimage, not ours. Often they march off at ninety degrees from the path along which we lead, listening to their shouting inner voice rather than to our distant mumble. Our reaction? The instructor’s written response is no place to express hurt feelings or even evaluative judgments. It must be invariably positive and concerned, showing the encouragement of a mentor and the gratitude of someone honored with a personal confidence.

Yet with this opening teaching can begin! First, individual questions receive individual answers in letter-writing privacy. Second, the personal but anonymous “some of you are having difficulty with...” mediates a classroom discussion among students in which the instructor speaks for the silent, monitors how general a particular difficulty may be, and—with students as fellow explorers—searches out the pass through the mountains to understanding. Third, we are awash in data, up against sad and stimulating reality, able to judge—in my case for the first time—whether there is any year-by-year progress in text, classroom, laboratory, demonstration, computer aids.

How do students feel about reading memos? Here are results of an end-of-semester anonymous questionnaire from a typical class:

The reading memos encouraged me to do the reading ON TIME.

strongly disagree	1	2	3	4	5	strongly agree
number of answers →	7	1	6	13	24	average: 3.9

The reading memos increased the personal nature of my relationship with the instructor.

strongly disagree	1	2	3	4	5	strongly agree
number of answers →	3	1	13	11	20	average: 3.9

Classroom discussion of difficulties reported in the reading memos was

not helpful to me	1	2	3	4	5	very helpful to me
number of answers →	3	2	14	14	16	average: 3.8

Anecdotal evidence reveals other benefits to the student. Many have remarked that they read the text with a new intensity, others that writing down questions helps them to understand the material. As one student put it, “One oddity about it that I’ve noticed is that by WRITING questions ... one tends to have a clearer conception of what’s going on. Typically, I start to write my question down, and by the time I’ve got it worded clearly enough I’ve solved it myself.”

Not a single one of these benefits requires the instructor to be author of the text used in the class. Indeed, I request reading memos in whatever class I teach. Reading and responding to them takes a lot of my time—three to four hours for a class of 50 students for each reading assignment—but brings all the benefits to which students witness. With reading memos, every teacher who reads this editorial can enlist his or her students as treasured colleagues with an acknowledged role in shaping the education going on inside and outside the classroom.

TEXTBOOKS

For the textbook author the flood of detailed raw material generated by reading memos is breathtaking—and humbling. Students point out, explicitly or by their perplexity, many places where the argument is wrong, irrelevant, or simply incomplete. Double meanings, omissions, awkward phrases, archaic terms, typographic errors, inconvenient page layouts—no turn goes unstoned. Again and again an incoherent cry of pain leads to close examination and fundamental clarification. Occasionally a direct suggestion transforms a section or even a chapter.

Not all pedagogic difficulties are overcome by reading memos. Relativity is still formidable. Students still struggle to view the same world from different reference frames. Convincing them of the relativity of simultaneity remains nearly impossible. These are fit subjects for formal education research!

Can reading memos influence the major physics textbooks? That depends upon the grace and receptiveness of their authors. We know that introductory texts, at least, are under continual revision. My class at MIT used Hans C. Ohanian's introductory physics text. With student permission we sent him several batches of reading memos. His response was enthusiastic: "I am very glad that your students are providing me with all this help in tracking down unclear and misleading statements." Imagine students all over the world transformed from passive recipients to participants active in improving their textbooks!

SUGGESTIONS FOR *THE AMERICAN JOURNAL OF PHYSICS*

Our journal occasionally publishes "post-use" reviews of textbooks, reviews done by teachers who have used the new text in a class. Henceforth, could "use" include student reading memos to be excerpted, with student permission, in the review itself?

I have systematically gone through 20 years of articles in the *American Journal of Physics* looking for exercise ideas in relativity. A treasure trove in relativity and many other subjects! Yet, although the main idea of each article is clear enough, details often elude comprehension. I spent hours

puzzling over a "two-line" derivation of the Doppler shift, finally writing to the authors who replied that their argument relies on a "prior understanding that ... at the time seems to have been submerged in our consciousness!" More than one contacted author had a similar response. Student reading memos could have uncovered these difficulties in days, if not minutes. Apparently a typical AJP author has a bright idea for an article, writes it up, and submits it for publication. Validation of its effectiveness with students, if any, evidently takes place in lecture, where students are accustomed to being polite and passive.

Could the Editor accept results of student reading memos as one optional piece of evidence that the "new approach" described in a regular article achieves its goals? Can such evidence be convincing? Would this use pervert the essentially intimate nature of reading memos? We need a more universal experience with this tool before we can answer such questions.

We dance 'round in a ring and suppose,
But the Secret sits in the middle and knows.

—Robert Frost

The student sits in the middle. The student knows. Why not ask, then learn ourselves—from the only person who can teach us?

ACKNOWLEDGEMENTS

The basic idea of required reading memos came from Professor Steven Cornell, who says it was "in the air" of the Sociology Department at Harvard University. In addition to regular classes, electronic-mail courses brought a flood of reading memos from students around the world. Richard C. Smith of the University of West Florida originated, organized, and administered these E-mail courses. He also suggested improvements in this editorial. So did my relativity class at Harvard University Extension School—by writing reading memos on reading memos!

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