Why Write the Book, and, Why Release it for Free?

by Jeffrey W. Schnick

While investigating how best to implement active learning in the classroom, I found that among the various active learning methods I looked into, the critical commonality was the reading of the textbook by the students, prior to the classroom session on the material of the reading assignment. So whichever active learning method I decided on (I chose Eric Mazur's Peer Tutoring method), the question of paramount importance was, "How do I maximize the timely readership of the textbook?" Ideally, each student would read each reading assignment prior to the classroom session on the material of that reading assignment. So another way of posing the question would be, "What must I do (aside from starting each classroom session with a quiz on the reading assignment) to encourage the students to most closely approach that ideal?"

In attempting to answer the question at hand, I took advantage of the fact that it didn't seem like it had been all that long since I was a student. Here are the characteristics I think each reading assignment would have to have in order to maximize the likelihood that, if I were the student, I would do the reading assignment for a class, just prior to the class, for each and every classroom session:

> 1. "It must be short. Above all else it must be short. I've got problems to solve and laboratory reports to write up and besides that I'm taking four or five other classes. If you expect me to carry out three separate reading assignments each week you better make each reading assignment as short as possible. I don't need you to start off each reading assignment with a story to get me interested in it. I'm already motivated to find out what I need to know. Just tell me what I need to know. Oh, and don't try to entertain me with pictures that are at best peripherally related to what you are writing about. Include only pictures that promote the understanding of what you are supposed to be helping me understand. Also, don't tell me what you are going to write about, and then write about it, and then summarize what you wrote about—just write about it once. I'll find out what you were going to write about by reading it, and I'll summarize it myself. If you keep it short enough in the first place, there is no reason for all that. Don't give me all the banal learning objectives. I know I want to be able to apply the concepts to answer thought-provoking questions and to solve physics problems. You don't have to keep writing that over and over again. If it's not going to be on the test, don't make me read about it. I hate it when I struggle mightily to understand some concept in the reading assignment, and, failing to do so, go to you for help only to be told that I don't have to worry about it because it won't be on the test. If it won't be on the test, that means that you don't consider it important, so why make me read it? Keep it short! And listen, you don't have to put each and every thing you want me to learn in the book. Save some of it for the classroom and the laboratory. I can only read so much in one week. How about if you ask me to read the essential facts and explanations of concepts in the textbook and save some of the applications,

elaborations, and caveats for class? If you try to do everything with the textbook, it will make it too long. I really want you to keep it short!"

2. "Make it understandable. Be aware that jargon that is as familiar to you as your own name is brand new to me. Don't bandy it about as if it were old hat for me. Write in clear plain English. If you have to use jargon, spell it out clearly when you first use it. And don't be afraid to repeat a definition if it's been a while since you last used it. No, this is not a contradiction to my 'keep it short' mantra. If I have to look up the definition it will take me longer to do the reading assignment than it would have if you had reminded me of the meaning. When I say, 'Keep it short!' I mean, write it so that it takes me as little time as possible to read and understand it."

3. "Don't make me keep searching for equations and figures appearing earlier in the text. Each time you do that, I have to take the time to find the equation or figure to which you are referring and then, after I read the equation or look at the figure, I have to find my place in the textbook again. It not only wastes my time but it reduces my understanding of what you are writing about because it interrupts the flow of the text. Would it kill you to just copy it down again for me right there at the point in the text where you want me to look at it? Once again, I need you to understand that when I say, 'Keep it short!' I don't mean, minimize the total number of pages; rather; I mean, write it so that it takes me as little time as possible to gain the understanding that you were hoping I would gain by reading what you wrote."

Okay, that's enough of me trying to remember how I felt about physics reading assignments when I was a student. I am going to put my professor's cap back on. In trying to create the kind of reading assignments (in textbooks in existence before I wrote mine) that I think that I the student would have been most likely to actually carry out on time, I kept running into a conflict with one of the most important goals of the course as a whole, namely, "to maximize the students' understanding of a selected set of physics concepts and the capability of the students to apply those concepts to answer thought-provoking questions and to solve physics problems." These goals ("maximize on-time reading" and "maximize learning") should be in concert with each other. Let me give you an example of one such conflict:

Based on my experience in learning and teaching physics, I have found that it is important to order the topics from familiar to abstract. As such, the traditional ordering of the first semester (starting with kinematics followed by Newton's second law) is appropriate but if adhered to strictly results in the application, by students, of Newton's 2^{nd} Law followed by the application of one or more of the constant acceleration equations, in the solution of problems for which the acceleration is not constant (e.g. problems involving springs, problems involving the universal law of gravitation, and problems involving the application of Coulomb's law). I have found that if one precedes the kinematics with some brief experiences for the students in applying conservation laws, then students tend to use conservation laws more often when they are called for. If one starts the course with the conservation laws, then the most appropriate reading

assignments in a textbook with a conventional ordering of topics will involve terms and concepts, assumed known to the student from earlier chapters in the textbook. Textbooks using a "momentum and energy first" ordering tend to go way beyond the "brief initial experience with conservation laws" that I am striving for. Traditional customizable books do not solve the problem—moving chapters around is not sufficient or advisable in the case of physics because of the way later material builds on earlier material. My order is consistent with a spiral approach to learning as students study the conservation laws in more depth later in the course, but you don't need to agree with my conclusions on the best ordering of material to see my point. The point is that a conventional textbook does not allow for the flexibility needed to achieve both "maximization of on-time reading" and "maximization of learning."

So what I needed was a fairly conventional physics textbook that I could easily edit to make the "maximization of on-time reading" support the goal of "maximization of learning." I searched for one on the internet. I didn't find what I was looking for so I wrote one myself. I wanted it to make it so that the next person who was looking for an introductory physics textbook that would be easy to edit would find what they were looking for so I released the book for free.

One of the titles I considered for the book was "Starting Point Physics." The title was to have three different equally valid interpretations: The obvious interpretation is that it would be the book for the first college physics course taken by a student and as such the *starting point* for the student's study of physics. The second interpretation that I had in mind is that experienced teachers of physics would use it as the *starting point* for their own physics textbook. In this interpretation, a physics teacher would rearrange the chapters, add a chapter here, remove a chapter there, change a variable name here, add a new equation, there, thoroughly revise an explanation here, delete a long derivation there, etc. until the book was perfectly suited to the course taught by the teacher the way the teacher liked to teach it. The third interpretation involves the new teacher of physics. The selection, ordering, and depth of coverage of topics, as well as the clarity of explanation are, in my opinion, of course (otherwise I would have made them different) excellent. As such, the book would, in my biased opinion, be an excellent choice as the *starting point* textbook for a new teacher to use the first time that new teacher teaches a calculus-based physics course. With experience, the teacher could customize the book to take better advantage of the teacher's own strengths and the academic background of the students enrolling in the teacher's course.

It might be a pipe dream, but I envision *Calculus-Based Physics* being edited and used by physicists. After doing the hard work to make the book perfect for one's own course, I would imagine that a physicist would like to share one's own version of the book with the world by posting it to the internet. I am hoping that after several years, a physics professor who decides to adopt the book for her or his course will have several options from which to choose.

Another reason behind the *free* release of *Calculus-Based Physics* is the capacity it gives me for immediate correction of mistakes. At one time I was surprised by the prevalence

of errors in physics textbooks. Now I recognize it as a natural byproduct of the demands of the marketplace for frequent new editions. I see it as a result of the release of a newer version of a book before there has been time to work out all the bugs in the older version. My plan is to make a correction to the on-line version of the book as soon as possible after I have been made aware of an erratum. The intension is to have *Calculus-Based Physics* progress toward perfection.

I cannot claim the rising costs of textbooks to have been a major reason behind the writing and free release of *Calculus-Based Physics*. I consider the no to low cost of *Calculus-Based Physics* to be a side benefit but I am not convinced that the textbook publishers are out to get the consumer. I do understand the concern with the fact that the folks footing the bill for a textbook are not the ones who are making the decision on what will be purchased but I think that this aspect of the textbook market is just the nature of the beast and that student advocacy groups (do an internet search on "Make Textbooks Affordable" to see what I'm talking about here) are having an impact. I think that market forces are responsible for things like the blossoming of color photographs, new editions, encyclopedic coverage, and multitudes of problems, exercises and examples in physics textbooks today. Authors and publishers put them in there, at substantial cost to the publisher, because it makes the textbooks sell. I think that authors and textbook publishers are doing an excellent job of responding to research into how humans learn physics and creating and promoting textbooks and ancillary materials that incorporate the results of that research. I think it would be a mistake for a physics professor to adopt a poor textbook over a good textbook simply on the basis of cost. Despite the fact that a savings of a hundred dollars to an in-debt student could mean a substantially greater savings over the lifetime of the loans taken out to meet college expenses, the cost of a poor preparation in the foundations of physics, due to the selection of the wrong textbook by a professor, to a person's science or engineering career could be much greater. But I do think it is important to evaluate textbooks and, if they are found to be equal or nearly equal in terms of the expected impact on a student's educational experience, to make cost a serious consideration in the professor's selection of the textbook for the course. A reduction in the cost of the textbook can make additional costs such as web-based homework assignment systems or audience response transceiver rentals (yes, these items can be obtained independently—you don't have to adopt the book with which they are sometimes packaged to take advantage of them) more bearable to the student and thus more viable for the course taught by a professor who believes they will increase learning. I want physics professors to adopt *Calculus-Based Physics*, not because of the savings to the student, but because, in each case, the physics professor considers *Calculus-Based Physics* to be the best textbook for the course, the one that will enable the student taking the course to gain the most physics-related knowledge and skill.

The irony about releasing a book for free (Calculus-Based Physics is free in electronic form, either as a pdf file or a zipped Microsoft Word™ Document, but one must pay the cost of production, $9.98 for volume I and $11.48 for volume II at the time of this writing, and shipping to get it in black and white paperback form) is that it might not reach as wide an audience as it would if it were released at a substantially higher cost.

There is the assumption that low or no cost means low quality. I think folks that read the book will discover the fallacy of that argument.

The bottom line is that I wanted a book that would be ideally suited to my own calculus-based physics course and I wanted to make it available to physics professors in a way that would allow them either to either use it as is or to easily edit it to create a book ideally suited, in the case of each professor, to their own physics course, a book that they could, if desired, release to the public to provide another starting point for the cycle. That's why I wrote it, and that's why I released it for free. I hope you find it useful.