AC 2012-4757: TAKING MATTERS INTO YOUR OWN HANDS: IS CREATING AN E-TEXTBOOK FOR YOU?

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Abstract

As higher education evolves, one instructional tool, the classic textbook, is undergoing various transformations. Textbooks, once viewed as the cornerstone to instruction in higher education, are now often seen as outdated. Some instructors are opting out of published textbooks and instead designing content for their courses on an as-needed basis by creating electronic class readings from an array of digital resources. While the limitations of textbooks are not new, today's technologic advances afford many alternatives to print-based books. Furthermore, certain fields, by their very nature, dictate the need for timely, current resources and the course described in this paper is one such course for it covers alternative energy sources. This upper-level course in the emerging field of energy engineering focuses upon conceptual analysis and inter-related science, engineering, and economic aspects. Teaching any class with a strong component of theory, abstract thinking, and real-world applications, requires making tradeoffs. The new professor teaching this class is juggling not only experimenting with new pedagogies to empower students to be responsible for their own learning and to encourage their ability to synthesize information, but he is also adapting to the considerable effort needed to create a course reference from a diverse range of sources. This paper takes a closer look at his efforts to create a non-traditional textbook and the myriad of instructional issues that arise when a standard textbook isn't employed.

I. Introduction

In many of today's classrooms, the textbook sets the stage. Accordingly, textbooks guide instructional planning and classroom activities "by making content available, organizing it, and setting out learning tasks in a form designed to be appealing to students." [1] Whether or not to use a textbook in a college level class is a decision that may or not fall to the individual instructor. Some courses, particularly those that are required of all undergraduates in a major, often use a "standard" text selected by the department. Other courses may allow for more flexibility and a professor can decide whether or not to require a textbook as well as select the textbook. Researchers have advocated a variety of approaches to textbook selection, but in practice, the process is often based on personal preference and may be affected by factors unrelated to pedagogy.[2, 3]

The selecting of a textbook is given significant emphasis by most faculty because of its instructional role in providing preparatory reading that is integral to learning.[4] While there are different methods for textbook selection, there are common benefits ascribed to using a textbook as noted by Parish:

- It assures a measure of structure, consistency, and logical progression in a class;
- It minimizes preparation time for teachers;
- It allows learners to review material or preview other lessons;

- It meets a learner's needs or expectations of having something concrete to work from and take home for further study;
- It provides novice teachers with guidance in course and activity design;
- It may provide multiple resources: tapes, CDs, videos, self-study workbooks etc.[5]

To suggest, however, that textbooks are not undergoing scrutiny would be inaccurate. There are numerous reasons why traditional textbooks are being questioned by professors and students. Of major concern is their affordability since average prices rose 186 percent between 1986 and 2005 and are expected to continue to rise faster than the rate of inflation.[6] Nonetheless, a textbook is costly whether it is in print or in an E-textbook format. Cost aside, a major issue is how much students actually use course textbooks. While many factors may influence whether or not a student reads the textbook, there are some common indicators on whether or not a student will read. For starters, students tend to complete required work and may think of reading as supplemental. There is research that suggests, "Students have not figured out for themselves that reading is a potentially useful intellectual endeavor." [7] When students' reading skills are lacking as they begin higher education, there is a strong negative impact on their ability to learn from textbooks[8] and a correlation exists between students' reading habits in general and their tendency to read textbooks during their studies.[9]

Despite the body of evidence suggesting that students do not read textbooks as intended, there are indicators that students expect textbooks in their courses. A study of engineering students revealed that despite their rather basic reading skills and minimal amount of time they allocated for reading textbooks, most of these students attributed importance of textbooks to their success in a course.[8] Some research indicates that students find textbooks easier to read than primary source material.[10] Two recent studies of higher education students found a strong preference for hardbound copies of textbooks since these enable them to flip quickly between chapters, to write in the margins, and to highlight passages.[11] Although as new software applications become more readily available, students may find that electronic resources allow them many of the affordances found in standard textbooks.

In this paper, we offer our experience creating a non-traditional textbook and the myriad of issues that arose during our attempt. We will share what we have learned about this ongoing process and hopefully it will help to illustrate considerations to address when contemplating creating a unique textbook. We will share our insights regarding fundamental questions including the following: how reasonable of an expectation is it for faculty to create course specific textbooks? In particular, is a new professor, steeped in the demands of tenure a good candidate for this type of undertaking? Beyond considering the amount of time and effort involved, how does the lack of a traditional textbook influence course design and delivery?

II. Background

Our decision to create a unique textbook is based on several important factors. To begin with a particular course, Fuel Science 451, Energy Conversion Technologies, with unique attributes prompted our looking at alternatives to traditional textbooks. Alternative energies (wind, solar, biomass, geo-thermal) have emerged in the spotlight in recent years. New technologies and

materials have the potential to bring about their large-scale introduction, supplanting traditional energy sources and their use. To capture these technologies educationally and more broadly prepare undergraduates in the emerging field of energy engineering, the Energy and Mineral Engineering Department created the undergraduate major of Energy Engineering. A key course in this sequence is Fuel Science 451, Energy Conversion Technologies, an upper-level course, with a substantial component focusing upon conceptual analysis and inter-related science, engineering and economic aspects. The course goal is to expose students to the principles of chemical and nuclear reactions that underlie most major energy conversion processes, particularly with reference to the conversion of energy resources such as fossil and nuclear energy to fuels and electric power.

Teaching any class with a strong component of theory, abstract thinking and real-world applications, requires making tradeoffs. Compromises are made between introducing theory and demonstrating the utility of theory in practical applications. One way to solve this dilemma is to augment traditional instruction in theory with student-centered discussions and projects that empower students to be responsible for their own learning, enables them to gain knowledge that goes beyond the short term, encourages their ability to synthesize information, and to engage in peer-to-peer collaborations. In order for students to be able to be actively involved in this type of a learning format, engaging and adaptive course resources need to be readily available. Furthermore the course structure highlights the need for student access to content on current emerging energy sources and related technologies as well as the ability to maintain a solid reference for future use.

Yet there is no one such site or source of such information. Textbooks for these topics have not been written, given that information for such is emerging from research laboratories to applied commercial interests. For these "new" energy sources, their economics, scalability, technological readiness, are highly debated. In order for our students to work adeptly with concepts and calculations, they must hinge their knowledge of the current technological limitations with unknown science hurdles. For many their job will be to engineer solutions, a task which presumes a working knowledge and understanding of past and present concepts, contexts and engineering approaches or underlying technologies.

Given these parameters, the professor decided to create a current text or compilation of materials to serve as both a course text as well as provide a future reference for students. Foremost in this process is the intention to create materials to actively engage students, both in and outside of the classroom, with the latest in-depth information on emerging energy sources.

III. Instructional Considerations

Although the professor believed that a textbook creation process to be a worthwhile and reasonable undertaking, he did not contemplate undertaking this task alone. He was already seeking assistance from Penn State's Schreyer Institute for Teaching Excellence (SITE) in considering how to enhance his instructional approaches. Linking classroom revisions to the development of an electronic textbook seemed like a natural fit and so he teamed with an instructional consultant from SITE. Their conversations discussing the existing materials and the feasibility of whether or not this process would be beneficial to the professor and the students led

them to their first assertion; if this task is going to be successful, additional resources are needed. A new professor does not have the time needed to locate and organize extensive timely class resources, but would have the time to guide someone in doing the bulk of the legwork.

Realizing that an additional person would be instrumental to the success of this project highlighted the need to clearly delineate tasks and responsibilities. Thinking through the development process and ways to organize the material lead to many questions not only about the actual end product, but also about how it will ultimately be put to use. Spending initial time by "beginning with the end in mind" helped to clarify not only expectations, but allowed for the extraneous to be eliminated.

Identifying who could best assist in this project was relatively simple. That is, an undergraduate student who has taken the course would be an ideal candidate provided they have adequate literature review skills and are comfortable with locating, reading and systematically reviewing resources. While this position sounds relatively straight forward, it proved somewhat problematic to identify such a student. More on this will be discussed later in the paper. Discussions, however, lead to a realization that additional funding would be needed for the amount of student assistance would merit the need to hire a student for a semester. Fortunately the department annually makes available small amounts of money for instructional development projects.

Fuel Science 451 was an appropriate course for an e-textbook creation because of the evolving nature of its content and the fact that no textbook exists. When contemplating creating an e-textbook is imperative to begin with a thorough search of what is available and to identify that there is a need to have a textbook tailored to meet your particular approach and scholarship. There are, of course, options besides buying a traditional textbook or creating your own (print or digital). Open-source textbooks are an alternative that are coming into wider acceptance. Open education resources, a broad category, includes e-textbooks, courses, videos, recorded lectures, software and other resources that are free to the public. With "openness" the sharing of copyright and contract law promotes adapting materials to meet your students' needs. These four main types of activities are enabled by openness:

- Reuse – use the work verbatim exactly as you found it;
- Revise – alter or transform the work so that it better meets your needs;
- Remix – combine the work with other works to meet your needs;
- Redistribute – share the verbatim work, the revised work, or the remixed work with others.[12]

Rather than pursue the development of an original e-textbook, it is wise to consider what is currently available for adaption through an open-source textbook model.

IV. Seeking Resources

The proposal to the department identified the need for the construction of a reference from a diverse range of sources: scientific journal articles, general science magazines current news articles, technical websites, government, educational, commercial, and technical reference

literature. This seeming panoply reflects the originality of information, innovativeness of technologies, high societal, political and commercial interests in light of an unconcluded path. The professor noted that remarkably many of the ScienceDaily articles that are of academic origins turn into peer-reviewed journal articles, but a year later, further highlighting the present-day status and accurate targeting of this particular source. Yet expecting students to locate, read and keep current with these types of references is unrealistic. We requested funding to design a multi-media format to organize and easily distribute these references to the students for current and future use.

With the whole being greater than the sum of its parts, this course resource reference intends to be more than a simple compilation; its diversity of sources and contemporary nature provides a text like no other. Several unique aspects will include the following:

- currency to technologies and needs today;
- counter posed analysis of technology, goal, use and benefits (energy or economics);
- diversity of topics;
- technical depth;
- linked science, engineering technology and economics;
- real-world relevancy;
- multi-media format.

Funds were requested and awarded for an undergraduate student to work in the summer and continue through the fall semester to download and translate web-based items, search, gather and compile journal and technical articles, summarize data from printed texts and reference books, record video clips and format these into standard electronic media. The College of Earth and Mineral Sciences has a recently developed multimedia center with the latest IT that was utilized for these efforts.

Integral to the success of this proposal was how it illustrated that its student-centered approach aligns with the Department's educational goals that "seek to inspire students to become technically proficient, adaptable learners by developing skills in problem-solving, team-building, and communication." Fuel Science 451 provides students with current, relevant instructional resources and restructured class activities to promote their critical thinking skills through analysis, discussion, and project creation. We began this project with the intention that the E-textbook would be designed to promote "loosely cooperative styles of learning in which the learner often takes the initiative in deciding the best step forward."[13]

V. E-Textbook Creation and Format

We decided that an initial listing of course topics would serve as the preliminary guide. While the structure of the course will naturally evolve, it is expected that student projects and discussions will be aligned with these listed topics as they fundamentally outline the course topics based upon today's energy landscape. Such student activities will naturally contribute additional materials to the reference thereby expanding its depth and maintaining its currency.

As we began this process our intentions were to create a course text to overcome current textbook limitations and:

- Aid present-day classes;
- Provide contemporary knowledge;
- Provide a foundational reference for understanding the evolving context of new energy sources or technologies in forthcoming years.

With these intentions firmly guiding our process, we set out to hire an undergraduate student who possessed at least minimal requisite subject knowledge and basic computer skills. Finding such an individual during the summer proved to be beyond our abilities and so we lost fruitful development time.

VI. Assessment Plan

Essential to the success of this effort has been formative (ongoing) and summative evaluations. The following two formative assessment steps ensured that selected instructional materials are appropriate and timely:

- A checklist with the criteria identifying material's acceptability as a guide for the hired undergraduate student;
- A questionnaire that assesses student use of and perceptions of the instructional materials.

The formative data helps us to address concerns and make necessary modifications in an ongoing fashion. Given that the class incorporates active learning techniques (i.e., discussions and projects), a mid-course evaluation was administered. A summative evaluation is underway to appraise whether the proposal was successful as measured by the following:

- The number of times the resource was accessed by the students;
- Student responses to an end-of-course questionnaire on the course resources and instructional approaches;
- Overall rating of the course and instruction on the course.

VII. Lessons Learned

Obviously there is considerable time and effort involved in creating an e-textbook. We have found several issues need to be addressed upfront that can help make this process manageable and efficient.

Timing

Time is needed by the professor to actually read/skim the articles to not only verify clarity of topic (otherwise students are lost and one could potentially be besieged with questions or trying to "amend" the perspective of the article). Given an expectation of perhaps 50-100 articles, this is best accommodated in summers, but not normally viable in a fall or spring semester. In this case, it is of particular value as one can identify discussion topics and such articles provide ready fodder for homework calculations.

Pre-organization
It is critical that an outline for intended topics and subtopics be formulated in advance. This outline serves as a guide for identifying articles in the correct topics and for the purpose intended. Given that there is a tremendous wealth of related material, without a calibrated approach, first glance can appears to be "good" and in reality, be sorely lacking. In other words, a screening approach or "filter" must be carefully defined.

A second interconnected aspect is that one's expectations as to topics or views may not exactly match that of the field or the literature that is available electronically. If one's views differ highly from that of the norm, then readjustment as to the filter or article requirements must be made. One's own variances then may serve as a springboard for discussion.

Course Design
Good course design requires the crafting of student learning objectives that are aligned with assessments. While the use of the outline for the articles was instrumental in arranging and organizing content, it sometimes caused the focus to be on topics versus learning outcomes. Writing objectives and aligning assessment and learning activities is not an easy task for most teachers and in particular, a new professor may not be ready for a more complicated instructional development endeavor. Having an instructional consultant to "tag team" the instructional planning and help support the e-textbook creation proved to be necessary.

Monetary Considerations
With the support of a small departmental grant, we were able to hire a student assistant. We believe the ability to pay for this type of dedicated assistance was what made this type of project feasible. In many settings, such funds may not be available, we advocate finding some means with which to get help. For example, consider having a student assist that can be paid through a work studies option or offering an internship. A new professor's time is precious and there are many labor-intensive aspects to this process that can be appropriately offloaded to someone else.

Many of the more deserving current literature articles in periodicals such as American Scientific, Discover or National Geographic will not be available through the University Library and personal subscriptions generally are for paper, not the electronic version which would of course provide access to the PDF. E-subscriptions are reasonable, but do need budgeting.

Articles will have copyrights, but most large universities have services that can sort out or at least check on waivers for academic use of the article. It is the author's experience that printed commercial copy services will also assemble the PDFs together and print a paper copy for readability. This approach brings up a subtle, but critical point. The electronic text is intended to capture current knowledge or state-of-the-art in the present economic and political framework. It is not strictly intended to replace paper with e-copy, as a strong case is readily made for the educational value of printed text allowing for ease of markup, etc.

Particular Examples
Pertaining to relevancy, many examples exist from this present day. The United States is on the cusp of an energy revolution. Advances in hydraulic fracturing and horizontal drilling have

unlocked tremendous reserves of natural gas. American energy supply of fossil fuel has literally doubled. Coal-to-liquids, as a replacement for foreign oil, deemed likely in 2005 gave way in the two to three year time period in light of the natural gas discoveries in shale formations as related to its now recoverable status. As an indicator, natural gas exploration and production companies are shifting towards oil given the bottoming of the natural gas price (reflecting supply versus demand). In less than two years natural gas has decreased by nearly four-fold. As a commodity it is not as profitable. Tremendous environmental issues are at stake with regards to the water use and its cleanup. None of this has reached textbooks and the media is fraught with headlines, but lack details and factual information. Moreover many reports are moderately misstated given lack of technical training and hence share skewed expressions of the relevant science and engineering.

Another prime example is electric vehicles. Sure they can get 150 – 200 mile per gallon, but the added energy comes from somewhere and with economic and environmental costs. Hardware is complex, not fully offset by (huge) rebates/subsidies and relative to either traditional liquid fueled combustion or all electric plug-ins, beg the question as to where we are going. Current data to obtain perspective is NOT found in any one place, but best gathered from the manufacturer's site, publications by the National Academies and technical journal articles with detailed engineering analyses. In short an amalgam is needed to provide an encompassing and true analysis and assessment, hence the suitability as an e-text chapter!

VIII. Conclusions

Although a new professor has many demands on his time, developing a course specific electronic textbook can be worth the time and effort invested. Benefits and payback are manifold, pending initial investment. We found these benefits worth mentioning:

- Students become interested when informed it is free. Should you opt to make copies of the resources, the cost is not a deterrent since a ~ $50 the price cannot be beat;
- Students become motivated when shown the relevancy to what they have heard recently;
- Students are excited when information is shown connected to their future;]
- Students become engaged when the e-textbook is used as springboard for classroom discussion;
- Students can actively participate by having them contribute to an evolving text, finding complimentary, supplementary or contradictory articles.

References

1. Schmidt, W. H., McKnight, C.C., & Raizen, S.A. (1997). *A Splintered Vision: An Investigation of U.S. science and Mathematics Education.* Boston/Dordrecht/London: Kluwer Academic Press.
2. Skierso, A. (1991). Textbook Selection and Evaluation. In M. Celce-Murcia (Ed.), *Teaching English as a Second Foreign Language*, Boston: Heinle and Heinle, pp. 432-453.
3. Robinson, D. (1994). Textbook Selection: Watch Out for 'Inconsiderate' Texts. In Prichard and McLaren (Eds.), *Handbook of College Teaching: Theory and Application*. Westport, Conn: Greenwood, Press, pp. 23-44.
4. Fitzpatrick, L. & McConnell, C. (2009). *Student Reading Strategies and Textbook Use: An Inquiry into Economics and Accounting Courses*, http://www.aabri.com/manuscripts/09150.pdf, accessed January 5, 2012.
5. Parish, B. (2004). *Teaching Adult ESL: A Practical Introduction*. NY, NY: McGraw Hill.

6. Young, J. R. (2010). *To Save Students Money, Colleges May Force a Switch to E-Textbooks*, http://chronicle.com/article/The-End-of-the-Textbook-as-We/125044/, accessed December 19, 2011.
7. Cummings, K., French, T., & Cooney, P. (2002). *Student Textbook Use in Introductory Physics*, http://www.compadre.org/PER/items/detail.cfm?ID=4374, accessed January 4, 2012.
8. Dada, M., Lansard, M., Cano, C. & Salzano, C. (2006). *Synergies between Formal and Non-formal Education: An Overview of Good Practice*, http://unesdoc.unesco.org/images/0014/001460/146092E.pdf, accessed January 4, 2012.
9. Pundak, D., & Maharshak, A. (2004). *Employing a Marketing Approach to Create a Learning Environment for Engineering Students*, http://www.aabri.com/manuscripts/10452.pdf, accessed January 4, 2012.
10. Besser, D., Stone, G., & Nan, L. (1999). Textbooks and Teaching: A Lesson From Students, *Journalism and Mass Communication Educator*, 53(4), 4-18.
11. Foderaro, L. (2011). *In a Digital Age, Students Still Cling to Paper Textbooks*, http://www.nytimes.com/2010/10/20/nyregion/20textbooks.html?pagewanted=1&_r=1, accessed January 5, 2012.
12. Willey, D. (2007). *Open Education License Draft: Iterating Toward Openness*, http://www.earlham.edu/~peters/fos/2007/08/david-wiley-drafts-new-open-content.html, accessed March 5, 2012.
13. O'Neill, R. (1982). *Why Use Textbooks?* http://textbookuse.pbworks.com/f/Why+use+textbooks.pdf, accessed January 9, 2012.