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Transformation at Scale: The Experience of Developing No Cost Learning Material for Database-Related Courses

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TRANSFORMATION AT SCALE: THE EXPERIENCE OF DEVELOPING NO COST LEARNING MATERIAL FOR DATABASE-RELATED COURSES

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ABSTRACT

The high costs of textbooks have put a big financial burden for many college students, and may become a roadblock for students' ability to complete their education. In addition, many textbooks are outdated at the publication date, given the dynamic nature of the technology field. In this study, our team of investigators took a collaborative effort to select, organize, and integrate publicly accessible information, and transform those resources into instructionally rigorous learning materials on a series of database related courses in the IT curriculum. The authors also designed and conducted several experiments to evaluate the educational effectiveness of the developed no-cost-to-students learning materials. Our team-oriented and systematic approach on development of cost free course material could be beneficial to our colleagues in the academic community who strive to make higher education more affordable to the students.

KEYWORDS

Higher education, no-cost-to-students learning material, curriculum development, open educational resources.

INTRODUCTION

According to the Institute for College Access and Success (2015) project on the student debt report, Georgia ranked 24th in the nation with \$26,518 average debt per student in 2014. Since then, the average debt per student in Georgia increased 73 percent from \$15,354. College affordability is determined by several factors, including textbook cost. The textbook price index, as shown in figure 1, has been tracked by the Bureau of Labor Statistics (2015) since 2001 (base period with index=100), rose from 115 in 2004 to 210 in 2014.

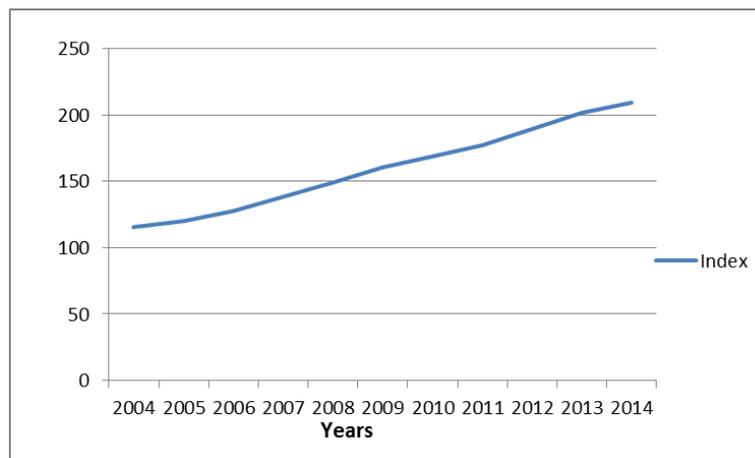


Figure 1. Consumer Textbook Price Index - All Urban Consumers (adapted from Bureau of Labor Statistics (2015))

The College Board (2015) estimates a yearly textbook cost of \$1,298 for a full time undergraduate student in a four-year public university. A single book, especially in technical disciplines might cost more than \$300. It is clear that the large cost textbooks created a financial burden for college students.

Another problem with the hardcopy textbook is the content. Publishers often release new editions, which make it difficult to buy cheaper books from the used textbook market. Moreover, these new editions might have minimal changes. On average, new editions are available every four to five years, but in computing, they are released more often. For example, the textbook used in the introduction to databases course has three editions in the past five years:

- Modern Database Management, 10th edition, ISBN: 0136088392 was published July 2010
- Modern Database Management, 11th edition, ISBN: 0132662256 was published July 2012
- Modern Database Management, 12th edition, ISBN: 0133544613 was published July 2015

The authors developed a systematic approach to transform a series of database courses using no-cost-to-students learning material while maintaining the equivalent educational effectiveness. In the paper, the experience gained from the development and assessment of the transformation process is reported. The paper is organized as follows.

The next section reviews the history and characteristics of open education resources. Our systematic approach and assessment plan is introduced in the research method section. The research results present the evaluation of no-cost learning material on one of the database courses. The discussion section summarizes our experience and discusses the implications of our approach.

LITERATURE REVIEW

The Open Education Resources (OER) Commons defines OER as “teaching and learning materials that you may freely use and reuse at no cost.” One of the earliest repositories of such materials is the MERLOT (Multimedia Educational Resource for Learning and Online Teaching) project, which was created by The California State University in 1997. The movement “aims to break down ...barriers and to encourage and enable freely sharing content.” (OECD, p.3)

OERs are descendants of open source software general public licenses and Creative Commons. (Nguyen, p.109) Since the inception of online education and open courses, there has been much discussion about quality and sustainability. (Werry) Just as with tangible resources, OER requires creation and updating, which takes a substantial amount of faculty time. (Harvey, p.151) Faculty may require institutional (Algers, p.42) or even consortial (Baker, p.31) support. After a thorough review of the literature, Annand (p.3) states that “OER development continues to rely almost completely on government and philanthropic funding.” Dholakia’s suggestion in 2006 (p.22) was for user-centric approaches to OER sites. This seems to have borne out well if you look at sites which have continued to exist since then. The Internet Archive and Ibiblio, which Johnstone mentioned in 2005 (p.18), are still available in addition to many others. (Okamoto, p.279)

The primary motivating factor for creation of OERs is students’ decreased cost and time needed to obtain a degree. (Baker, p.30; Fischer, p.159) Although it’s easier than ever to locate used textbooks, even those are prohibitively expensive. (Buczynski, p.172) Textbook prices continue to rise as much as “more than four times the rate of inflation.” (Okamoto, p.268) The price of textbooks is now leading students’ course decisions. (Parry, p.A22)

After the analysis of thousands of students’ completion of courses, class achievement, and enrollment intensity at multiple institutions, Fischer, et al found “statistically significant differences between groups, with most favoring students utilizing OER.” Research shows that there is a positive correlation between teacher’s creation, value, and the use of OER. (Algers, p.41) Other benefits include increased stature in the academic community and awareness of “how someone in a different discipline approaches the same material.” (Johnstone, p.15) (OECD, p.11-12)

With a mandate toward recruitment, retention, progression, and graduation, the University System of Georgia (USG) began funding grants to the faculty in their institutions to “promote student success by providing affordable textbook alternatives” via their Affordable Learning Georgia (ALG) program. The subject of this paper is one of the successful Textbook Transformation Grants to develop OERs from 2015.

RESEARCH METHOD

As illustrated in figure 2, the authors took a collaborative and systematic approach to develop no-cost-to-students course material in this project. For the four database related courses in our IT curriculum, the authors believed that it is totally feasible to replace the expensive textbooks with free learning material that has an equivalent educational effectiveness. The database related learning materials are widely available on the World Wide Web today. Many of these resources are publicly accessible, free, or with an open license to use. These materials include open and free tutorials, books, videos, labs, test banks, software, and services. For example, major database vendors such as Oracle and Microsoft published abundant tutorials and examples of their products on their websites. Oracle provides VMs with preinstalled Oracle DBMS (current version 12c).

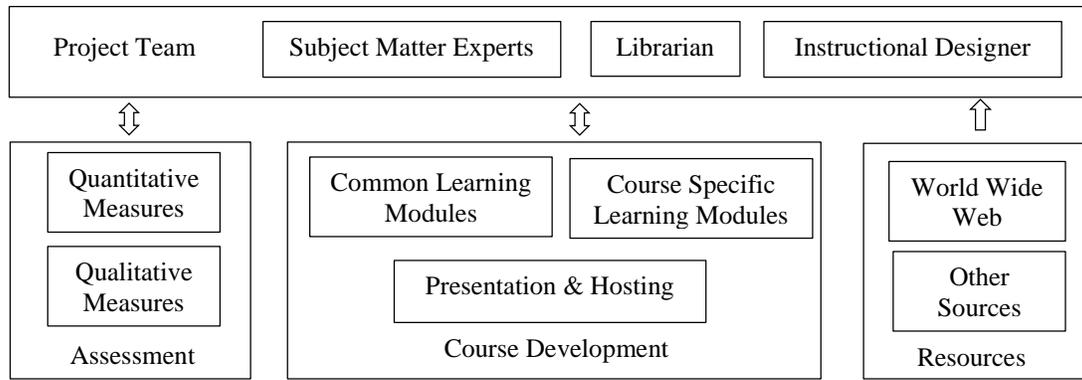


Figure 2. Research Approach for Development of No-cost-to-Student Learning material

Compared to traditional textbooks, the Web resources have many benefits: 1) the Web resources are generally free to use; 2) they are constantly being updated and always reflect the latest trends and industrial development; 3) the materials from the Web are also more dynamic and interactive. The pitfalls of Web resources are that they are often disorganized and may contain inaccurate information. The authors took a coordinated approach to transform the four database related courses and made sure that the new learning material has consistent presentation style and quality control. Common database modules such as the ER model and SQL were shared in different courses to improve the efficiency.

Our project team was formed with members that have complementary skills to promote the collaboration. Our team was composed of four subject matter experts, one librarian and one instructional design expert. All subject matter experts worked together on shared common learning modules while working on course-specific modules independently. All subject matter experts followed the same standard and procedure when searching and integrating available Web resources. In addition, the authors tapped into other available sources such as free licensed books, government-funded educational projects, etc. Some custom material was developed when it was necessary. When developing the new learning material, the authors made sure they were aligned with not only the learning objectives of each individual course, but also the learning outcomes at the program level. The librarian in our team provided support in searching learning material, and handling license and copyright issues of the learning material. Our instructional designer expert helped with instructional design and learning material hosting. Our experience showed that our team-oriented approach worked very well.

While it is important to develop no-cost-to-student learning material to reduce students' financial burden, it is more important that such material offer equivalent or higher educational effectiveness than using regular textbooks. Our assessment plan was twofold: 1) to collect student performance data in sections with the regular textbooks and use this data as the baseline for comparison. 2) to compare student performance in the sections with the cost-free material. In addition, the authors developed a survey and distributed it to students at the end of the semester. In the survey, students' satisfaction and feedback on the learning material was collected. In summary, the authors evaluated the effectiveness of the alternative free learning material qualitatively and quantitatively by comparing students' performance data in related courses and analyzing their feedbacks on the learning material. The detailed assessment plan is shown in table 1.

Table 1. Assessment Plan

Source	Description
Student performance measures	This data is from the overall class performance is based on the grading of student work. Metrics include: <ul style="list-style-type: none"> • Class average, grades distribution, pass rate for each grading item. • Overall letter grades distribution, pass rate, withdraw rate, and fail rate. • Percentage of students meeting or exceeding the learning outcomes
Specific survey on no-cost learning materials.	The survey will be distributed at the end of the semester to collect student feedback. It consists of a mixture of quantitative and qualitative measures including: <ul style="list-style-type: none"> • Student perception and attitude toward no cost materials • Quantitative ratings of the no cost materials used in this course • Qualitative comments and suggestions
Student evaluation of the instructor	Formal student evaluation of the instructor can also provide information about teaching effectiveness using no cost materials. This evaluation is based on standardized forms for every course.

ASSESSMENT RESULTS

It is a critical step in our approach to evaluate the educational effectiveness of the no-cost learning material. The development phase was completed for all four courses in our project. An upper elective graduate course was evaluated using our assessment strategy and is referenced to as database course A. A different survey was used in the first required database course, called course B. The other courses will be assessed in the future semester.

Course A was taught using one hundred percent of developed no-cost learning material. At the end of the semester, the authors compared students’ performance data with ones from the previous course taught using a traditional textbook. The overall performance in the course (letter grade) and individual grade items were compared. There is no significant difference in both performance categories (detailed student performance data available upon request). In addition, the two course A sections were taught by the same instructor following similar course structure. In summary, students perform equally well in a course setting with developed learning materials as in a setting where a traditional textbook was used.

Additionally, a web-based questionnaire was administrated to students who used the no-cost learning material. The survey result is shown in table 2. 87.5% of the nine participants thought the developed learning material is well selected and organized. 75% agreed the learning material is clear and helpful. Majority of the participants (75%) stated that the open source learning material can better assist students' learning than the traditional textbook. 50% of participants would prefer to use an open source learning material while 25% stay neutral. In general, a large portion of students reacted well to the open source learning material. Student performance is reported on figure 3

Table 2. Student Survey Results of an Upper Elective Graduate Database Course

Statements	Strongly Disagree & Disagree	Neutral	Agree & Strongly Agree
Overall, compare to a potential paid textbook, open resource learning materials provided in this course offer well-presented and rich content to assist learning.	12.5%	12.5%	75%
Overall, compare to a potential paid textbook, open resource learning materials provided in this course offer better delivery format.	25%	25%	50%
I support using the selected open resource learning materials than a paid textbook in this course.	12.5%	37.5%	50%
I would use open learning materials rather than a paid textbook for learning.	25%	25%	50%

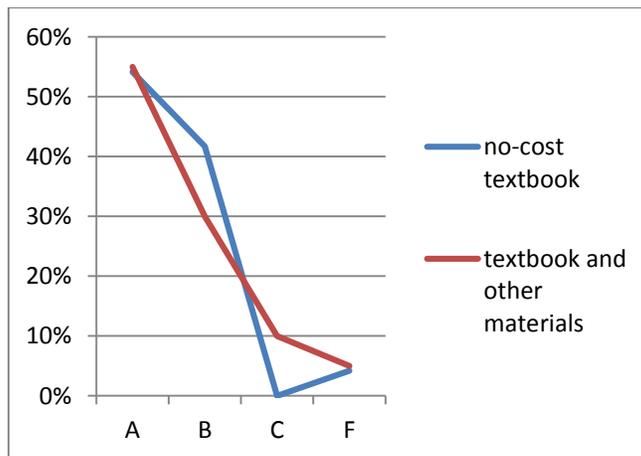


Figure 3. Student Performance in an Upper Elective Graduate Database Course

The participation rate in the course B survey was higher, 86% (31 out of 36). A different set of questions was used to accommodate undergraduate students for whom this course might be the first one where they did not use a textbook.

Table 2. Student Survey Results of a Required Undergraduate Database Course

Statements	Strongly Disagree & Disagree	Neutral	Agree & Strongly Agree
I would have preferred having a textbook for the course.	58%	13%	29%
I liked not having to buy a textbook and instead used the materials that were provided and free	7%	13%	80%
This is the first time I have taken a course using free materials instead of a textbook	48%	3%	49%
Overall, compared to a potential paid textbook, open resource learning materials provided the necessary assistance to learn the material	10%	13%	77%
I support using selected open source/free learning materials rather than a paid textbook for this course	6%	10%	84%
I would take another course that uses open/free learning materials	6%	10%	84%

As it was expected, half of the students used the no-cost textbooks for the first time. The overwhelming majority of the students (84%) support the use of no-cost textbooks and would like to take another course that uses no-cost textbooks. A word of caution is that, our sample size is small due to the limitation of class size. The results would be more convincing once more data is collected in the future from other participating courses.

CONCLUSION AND DISCUSSION

The outcomes of the project include reduction in textbook cost for students, possibility of customized content for each course, opportunity to reuse the created materials in other courses, and higher student performance in the class (e.g. course grade average rose from 3.3 to 3.42 in course B).

In spite of the fact that database related learning materials are widely available on the Internet, requiring students to use more than one source of online materials creates confusion. Organizing available open resource learning materials and complementing them with customized materials for each course helps students to achieve course outcomes without the use of a required textbook.

The impact of our transformation efforts will be profound. By our estimates, 400 to 500 students will benefit from the no-cost learning material each year. An estimated cost savings for expenses this academic year will be over \$35,000 with almost \$12,000 already saved. Because of the savings due to not having to purchase textbooks, students may be able to take a few more courses each year and graduate sooner. Having a series of database courses adapting no-cost-to-students material not only offers better and more consistent learning experience to students, but also makes our renowned IT program more affordable. As a result, our IT program could recruit more students and produce more qualified IT professionals that Georgia needs. Our experience gained in this transformation project could be useful to other programs or departments who want to lower the cost of the education to their students. In summary, the authors believe the proposed project will have a positive impact in students' retention, progression, and graduation at program, department and institution level.

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