

Open Educational Resource Learning Impact on Students from Poverty

Dr. Michael R. Williamson, Indiana State University

Dr. Michael R. Williamson earned his Bachelor and Master of Science degrees in civil engineering with a focus in transportation from Southern Illinois University Edwardsville and obtained his Ph.D. in Civil Engineering with a focus in highway safety from Southern Illinois University Carbondale. He is an Assistant Professor and program coordinator of Civil Engineering at Indiana State University. He has been instrumental in transportation research sponsored by the Illinois Department of Transportation, Illinois Tollway Authority, and Federal Highway Administration where he developed a Highway Incident Management Training guide for first responders that received the Illinois Center for Transportation's "High Impact Project Award" and the American Association of State and Highway Transportation Officials Research Advisory Committee's "Top Sweet 16 High Value Research Projects Award". Dr. Williamson has published eleven journal articles and has presented research over 40 research papers at conferences in the areas of transportation engineering, incident management, transportation safety and other related fields. Dr. Williamson's transportation safety research has been included for use with the Federal Highway Administration Crash Modification Factor website in the form of 182 prediction factors created by modeling crash data that is now used worldwide to decrease the number of fatal and injury crashes through improved highway designs and traffic signal timing. Dr. Williamson's current research focuses include: studying factors that affect transportation safety utilizing a state of the art driving simulator located at Indiana State University, improving the transportation options for older adults and underrepresented groups, identifying factors that will improve the safety on roadways through crash data modeling, and improving traffic flow through the use of Intelligent Transportation System Technologies.

Dr. Neslihan Alp P.E., Indiana State University

Dr. Neslihan Alp is the Dean of the College of Technology at Indiana State University since August 2018. She has received her Ph.D. in Engineering Management from the University of Missouri-Rolla. Her teaching and research interests are in the areas of project management, decision making, optimization, quality control, six sigma, lean systems, and operations management. Dr. Alp has numerous of publications in national and international conferences and journals. She is a registered Professional Engineer in the State of Tennessee.

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Introduction

Teaching with open educational resources can greatly reduce the cost of education to students. Textbooks commonly cost between \$125 and \$175 with some specialized course textbooks costing even more. This study highlights the open educational resource program at Indiana State University through the conversion of existing engineering courses. At the time of publication, the program at Indiana State University has saved students \$3,008,743.00 by converting classes to open educational resources and eliminating textbook requirements. Open educational resources are available for most topics in a wide variety of teaching materials including assignments, textbooks and course lecturing materials.

The University began a pilot program in 2015 providing faculty the opportunity to convert courses using textbooks to open educational resource materials in hopes of increasing the success of students, many of which come from impoverished backgrounds. This change has resulted in a difference in student success at the University. Students with low incomes now have access to the materials they need to be successful in their coursework on the first day of class. This study focuses on Civil Engineering students at the University in courses that were converted to open educational resources. A comparison of course completion rates and course grade point averages using a before-and-after approach that sought to identify the impact that open educational resources are having on student success at the University was conducted. A survey was also distributed to students identified acceptance rates of switching a course away from a traditional textbook for a comparable experience using free-use materials. Ninety-five percent of students indicated financial benefit from free materials and wide acceptance of the learning experience. The overall findings suggest that student completion rates increased by forty percent with grade point averages increase by thirty-one percent due to the use of open educational resource materials, thus increasing the number of students who graduate in four years, an institutional goal.

Literature Review

Open educational resource (OER) courses can greatly reduce the financial burden on students who are seeking a degree in higher education. Student success can be directly linked to preparation for classes including the reading of assigned chapters in a textbook, taking lecture notes, reviewing classroom materials and frequent attendance. A common problem at many higher education institutions is that students from impoverished backgrounds have limited funding and frequently do not purchase textbooks or other supplemental material due to the need for the allocation of limited finances to more pressing things. Indiana State University has a high percentage of students from impoverished backgrounds with 50 percent of the currently enrolled students receiving Federal Pell Grants [1]. Additionally 55 percent of the current students at the University are first generation and have little or no guidance from family regarding educational success strategies. Graduation rates for students are as low as 6 percent in some programs of

study, far below the national average. The recent four-year graduation rate for students coming from poverty was between 7 and 8 percent, while the overall institutional four-year graduation rate for students from the same cohort ranged between 26 and 29 percent. This graduation rate difference is of great concern warranting further study.

OER's consist primarily of educational materials that are located in the public domain within certain licensing allowing their use for educational purposes. There are different levels of licensing under Creative Commons [2] including reuse, retain, revise, remix, and redistribute. The limits of each licensing are defined in table 1. Ideally, the materials found for use falls under the redistribute licensing so that alterations can be made to match a courses outcomes.

Table 1: Creative Commons 5 Key Areas

Reuse	Content can be reused in its unaltered original format
Retain	Copies of content can be retained for personal archives or reference
Revise	Content can be modified or altered to suit specific needs
Remix	Content can be adapted with other similar content to create something new
Redistribute	Content can be shared with anyone else in its original or altered format

A recent study [3] sought to identify the current awareness and use of OER materials in classrooms throughout the United States. Higher education compacts in the Midwestern, New England, Southern, and Western areas where surveyed; the findings suggest that each area shows an increased use of OER material in classrooms. The study also found that only 44 percent of faculty are aware of OER materials, with an increasing trend of 17 percent over a five-year period. Faculty participating in the survey were also asked if they would consider the use of OER material in the next three years. The findings suggest that 8 percent would begin using OER material, 61 percent of faculty will consider the use of OER material, 11 percent would not use OER material and the remaining 21 percent are unsure.

The University's OER Program

Indiana State University [4] has taken an interest in providing an affordable education by promoting the use of OER materials. Many faculty have converted course content to include free use materials that mimic the textbook experience.

A strategic goal of the University is to improve access to higher education, a goal that is being realized by the use of OER materials. Nearly 500 sections using OER materials have reached over 14,000 students.

Students at the University who participated in OER classes have been found to be more successful. Students show increased grades, and decreased drop and failure rates. Textbooks commonly cost between \$125 and \$175 with some costing more in particular disciplines. Over the period between 2014 and 2020, the OER program at the University has saved students \$3,008,743.00 by removing the requirement to purchase textbooks in OER courses [4].

Training

Faculty must complete 55 hours of training modules [5] on using OER materials. The purpose is to help faculty identify teaching materials and develop a course website. Faculty are given a monetary incentive to compensate for time spent converting the class to OER materials of \$3,000. Faculty are required to understand the following learning objectives by completing a series of learning modules. The training includes obtaining OER materials for use in the course and identifying the copyright on the materials. Library staff assess the materials to ensure use is within the copyright laws pertaining to academia. The training is broken in to the following five modules.

Module one offers an overview of the purpose of teaching with OER materials by defining what an OER is. The participants then learn how to assess the value and limitations common with OER materials. Content analysis and objective alignments with course outcomes assessment are also covered.

Module two covers copyright laws including creative common materials, public domain, fair use, and permission use documents. The training provides clear ways to search for material that is free use and identify the copyright status of all materials that can be found both web-based and printed.

Module three provides details on searching for and locating OER materials for use in courses including assessing the credibility of the source. Sources ranging from the public to the private domain are covered.

Module four addresses aligning OER materials with course objectives for accreditation proposes and accessibility issues pertaining to student needs. When replacing a textbook, it is important to keep the course material in compliance with the learning outcomes dictated by the accrediting organization.

Module five covers implementing the OER in terms of appearance, structure, and navigational best practices. A web design team assists in the creation of the web based learning environment by offering tips that help with the easy access of the materials.

Course Content

OER's can be in many forms. The most common forms include journal articles, conference papers, websites, and open access textbooks. The development of course materials must only include free use materials or material from sources that have granted permission for use in academia. There is an abundance of free use materials on Civil Engineering topics. Material used in the development of the OER courses at Indiana State University predominantly came from governmental design manuals created with tax dollars which require the material to be open access. Course topics and the OER materials used in the course are listed in table 2. Each source was identified to be open access and provide knowledge in the course topic area. Most courses require multiple OERs to address all the learning outcomes in each topic area. It was

discovered during the development of courses that most Civil Engineering textbooks use material from the same OER sources.

Table 2: OER Material for each Course

Course Topics/Names	Course OER Material Sources
CAD Application for Civil	Manual on Uniform Traffic Control Devices Indiana Department of Transportation Design Manual Illinois Department of Transportation Design Manual
Highway Design	Highway Safety Improvement Program Manual Indiana Department of Transportation Design Manual Illinois Department of Transportation Design Manual
Traffic Engineering	Traffic Signal Timing Manual Manual on Uniform Traffic Control Devices
Hydrology for Engineers	Urban Drainage Design Manual Indiana Department of Transportation Design Manual Illinois Department of Transportation Design Florida Department of Transportation Design Manual

Survey on Class Content

Students were asked to complete a short survey when taking a class taught with OER materials instead of a textbook. Overall, students have shown a positive response to exclusively using OER materials. Ninety-five percent of students felt that the course content was comparable to courses taught with a textbook and that subject matter was appropriate for the course and comparable to what would be found in a textbook. All students surveyed responded in favor of reduced costs by eliminating the need to purchase a textbook. In the Civil Engineering Program there are four courses currently taught with OER materials, resulting in a savings of \$600 per student in their junior and senior years. The results of the survey can be found in figure 1.

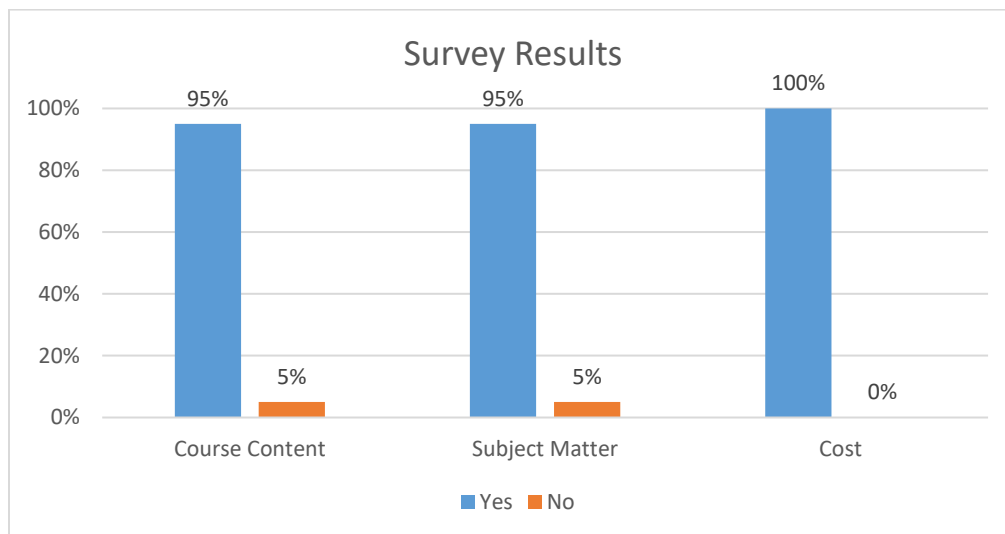


Figure 1: Survey Results

Data Analysis

A before-and-after analysis focusing on the success rate of students taking a course that had been converted to OER materials was conducted considering factors that could have affected the results. The teaching method and delivery method were unchanged and a course website was used in both before and after periods that provided students with course lecture materials. Students in the before period relied on a textbook to complete assignments, students in the after period had access to assignments using OER materials. A factor contemplated to have a possible impact on the study's results was the cohort of students. The analysis recognized there could be differences in different students cohorts, specifically related to college readiness. Students overwhelmingly showed an improvement in terms of final course grade and course pass rates. Data for students was analyzed for an engineering hydrology course that were recently converted to use OER materials. The average course grades increased from sixty-two to ninety-three percent, with pass rates increasing from sixty to one hundred percent. By observations, the findings suggest that the success of course completion by students in the after period and the improved course grade is attributed to the use of open access to course materials, which provides all students regardless of income access to the necessary course materials. It was also observed that in the before period that one in four students attempted to take the course without purchasing the required course textbook, leading to low assignment scores, commonly resulting in an overall failure of the course. Another observation was that students frequently waited several weeks into the semester before purchasing the textbook, causing their initial course grade to be low during the interim reporting period, resulting in a lower final course grade. The analysis results are shown in figures 2 and 3.

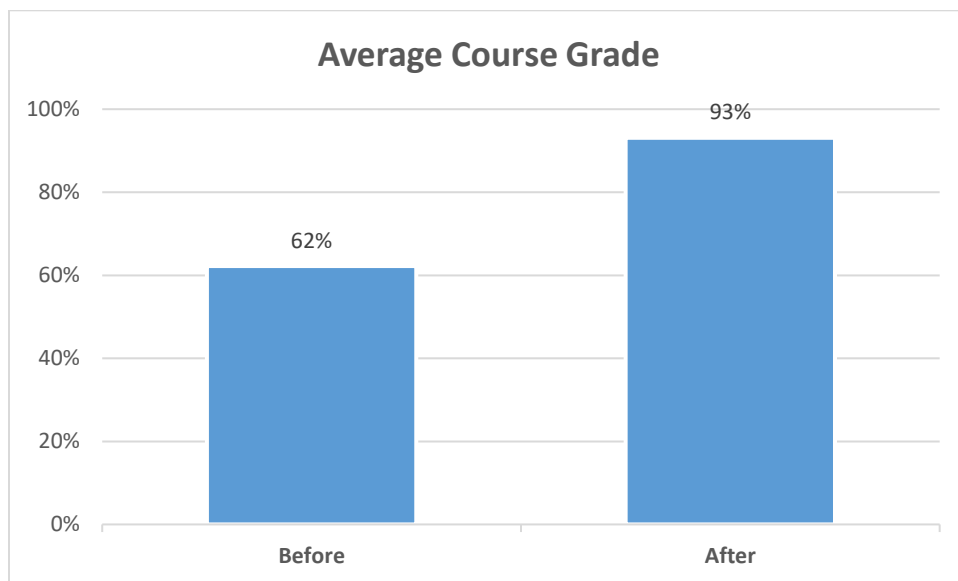


Figure 2: Average course grade in engineering hydrology

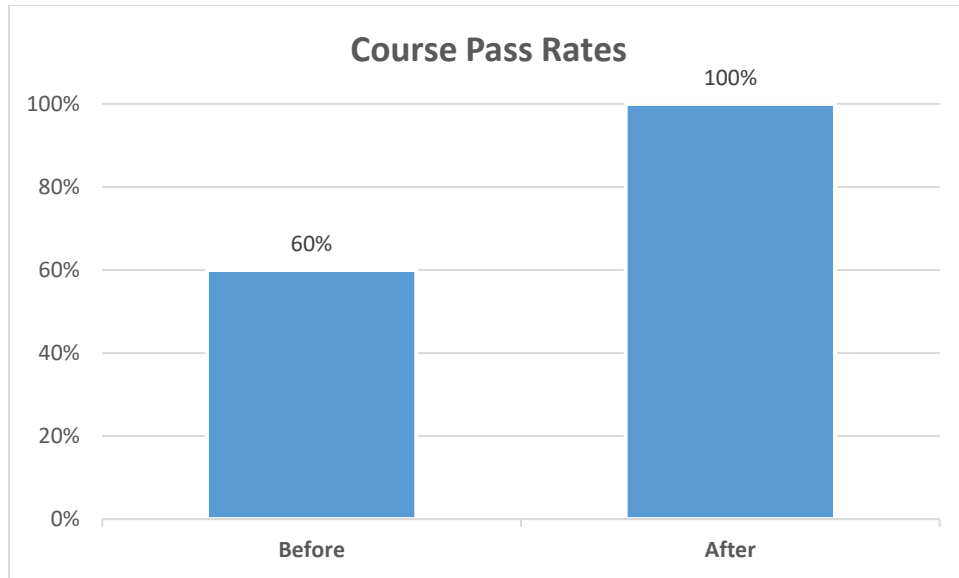


Figure 3: Course pass rates for engineering hydrology

Summary of Findings

The use of OER materials in place of traditional textbooks in engineering courses have shown increases in both student comprehension of materials and the successful completion of courses. Students now have access to course materials from the beginning of class reducing the typical lag in access to course materials by requiring textbook purchases. The OER program at the University has the potential to further reduce educational cost to students by converting more courses to OERs beyond the total of \$3,008,743.00 that has been saved by over 14,000 students thus far. Faculty awareness of OER opportunities and proper training of material selection from the public domain are essential for the success of an OER program at a University.

7. References

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