

IMPLEMENTING AN INTEGRATED MATHEMATICS OER PLATFORM IN BLENDED LEARNING

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Abstract

Even with the increasing use of educational technology at universities, students in math courses still have limited engagement and lack student-centered learning opportunities with technology inside and outside class. Math instructors who try to reduce student cost of learning materials have difficulties adopting affordable open educational resources (OER) because of the plethora of OER. The purposes of this project are to enhance student engagement and student-centered learning opportunities inside and outside class in a blended learning environment and to provide an integrated math OER platform to accelerate the use of high-quality OER for no-cost-to-students learning materials.

Introduction

Although math instructors have made the effort to improve the student learning environment and student achievement in mathematics, there is a gap in student learning between inside and outside class. Students in math courses attend class as passive learners without preparing for new materials. Instead of reviewing the learned materials after each class, the majority of students only review the learned materials before exams. Through this project, math instructors can have an integrated math OER platform for students to access the materials anytime and anywhere in order to motivate students to prepare or review course materials. In addition, the educational use of a social networking system through an integrated math OER platform increases the opportunities for students to engage in problems or group projects for collaborative learning.

Math instructors use teacher-centered instruction in class because of time constraints even if class activities, such as group work or presentations, enhance student engagement. According to the accelerated growth of the use of technology, innovative pedagogical methods with technology can be considered to improve a student learning environment.

In general, math instructors adopt commercial education resources because of the convenience. For instance, math instructors simply select problems on a problem bank on a commercial homework system. However, adopting commercial resources increases students' cost for learning materials. For example, math instructors can adopt WebAssign, a commercial online homework systems, for Calculus I. At least 30 students purchase the access codes for \$87.49 each totaling \$2,624.70 in spending.

This project has two aims. The first aim is to enhance student engagement and student-centered learning opportunities inside and outside class using technology in blended learning. The second aim is to provide an integrated math OER platform to improve accessibility and convenience of high-quality OER for no-cost-to-students learning materials.

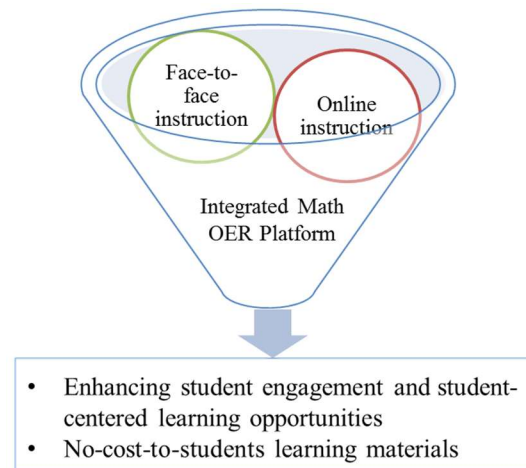


Figure 1. Three factors of a new approach

The new terms are as follows: 1) **OpenStax College** offers peer-reviewed open textbooks written by professional developers. 2) **Khan Academy** is a non-profit educational organization providing open micro lectures in the form of YouTube videos, and the website features practice exercises and tools for educators. The benefits of Khan Academy are that several students experienced Khan Academy in high school and instructors have easy access to student performance reports. 3) **WeBWork** is a free open-source online homework-generating system for mathematics courses and has been supported by the Mathematical Association of America (MAA) and the National Science Foundation (NSF) since 2009. 4) **Mini and review video lectures** are created using Camtasia Studio or are selected from Khan Academy or YouTube. 5) **Interactive digital notes on an integrated math OER platform** guide students to learn new topics and to access open course materials at their own pace. The interactive digital notes are linked to reviewed open educational materials such as an open textbook, short video lectures, adaptive web-based exercises, or WeBWork.

There are five issues for which this project was developed:

1. In teacher-centered instruction, students' roles are passive, for example, listening to instructors' lectures and copying the instructors' solutions in math classes. In addition, students have difficulties understanding lessons in class because of their poor readiness for the next class and poor attitudes that keep the students passive, rather than actively engaged.
2. After leaving class, the majority of students do not review the learned materials. Some students struggle with new materials because of a gap between learned and new materials.

3. For enhancing active student learning in class, instructors try to use interactive activities, such as group projects or presentations in class. However, instructors, who often utilize the activities in class, are concerned that they are not able to cover course content in the limited schedule.
4. Although math instructors try to use effective open educational resources in order to reduce students' cost of learning materials, it is difficult to find reviewed and ready-to-use OER because of the plethora of open educational resources.
5. Even if a number of students are used to technology, students have limited experiences with its educational use for learning mathematics at universities.

This project provides a blended learning environment with an integrated math OER platform in order to solve the above issues. Math instructors and students easily use affordable OER because an integrated math OER platform improves accessibility to reviewed open educational resources. For example, the interactive digital notes on the integrated math OER platform direct students to complete new materials and review learned materials.

Implementing this project enhances student engagement inside and outside class. Math instructors can use more activities in class through adopting technology such as a screen sharing app and classroom response app because of students' learning activities online. In addition, students can keep up with class outside of the classroom using OER such as a social networking system, an adaptive web-based exercise system that generates problems for students based on skill and performance in Khan Academy or WeBWork. Finally, the integrated math OER platform is a potential tool for students to be active learners and for math instructors to develop their pedagogical methods with technology in mathematics education.

Literature

Because of increasing technological advances, researchers and instructors have been interested in blended learning as an innovative pedagogy with technology. In general, blended learning refers to the combination of face-to-face and online instruction. For example, students in blended learning environments learn in a face-to-face classroom and through online delivery at the students' own pace.

Several articles reported the benefits of blended learning. Blended learning models are a more effective pedagogy than purely face-to-face instruction or purely online instruction for students, who are accustomed to technology (Gecer & Dag, 2012). In addition, students in blended instruction enhance their understanding of material and engagement (Garrison & Kanuka, 2004; Alexander, 2001). Thus, a number of instructors from K-12 to higher education have adopted blended learning strategies into their classes to engage students towards meaningful learning outcomes.

Open educational resources (OER) refers to any electronic educational resources such as digital textbooks, course readings, learning applications, or virtual materials with little or no-cost-to-students. After MIT began the OpenCourseWare project in 2002, many

universities posted full courses or supplemental materials online and improved the materials for anyone to use.

Pedagogical Design

In this blended learning project, the primary instruction is face-to-face, and supplemental instructions are delivered through an integrated math OER platform with no-cost-to-students. This project are described by three sections: before class, in class, and after class.

Before class - To improve students' interests and conceptual understanding for new materials, students are assigned to watch mini video lectures and complete interactive web-based exercises before class through an integrated math OER platform. For example, students in Calculus I can watch a mini video lecture of "the Chain rule definition" and solve interactive web-based problems for conceptual understanding of Chain rule before class. Therefore, the mini lectures and interactive web-based problems allow instructors to have more opportunities to conduct class activities beyond the classroom itself.

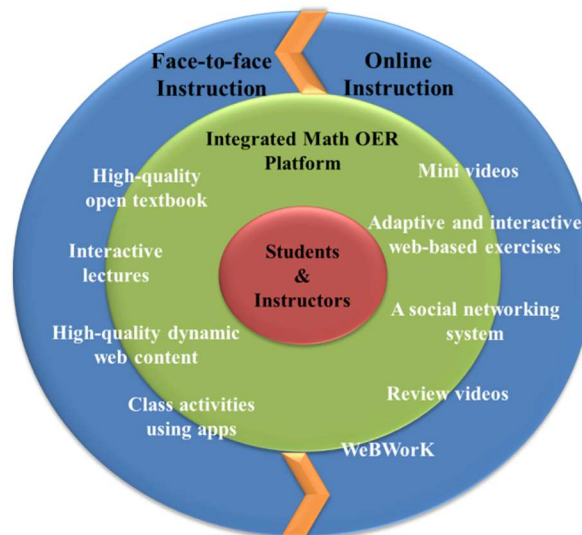
In class - Math instructors can provide interactive lectures using OER to keep students engaged. For instance, math instructors in Calculus I explain how to find the derivative of $\sin x^2$ with diagrams using WolframAlpha or Derivative Calculator.net, which are easily accessible and ready to use for students and instructors through interactive digital notes. In addition, students can immediately share their ideas, engage in class activities, and have instant feedback through technology. For example, each group works on problems using a tablet and instantly shares each solution on a Smart Board using a screen sharing app. Math instructors can instantly correct the students' solutions on a Smart Board to improve student math writing skills. Therefore, employing more class activities using apps enhances student engagement and evoke peer tutoring as collaborative learning.

After class - Instead of a commercial online homework system, students in this project can complete homework or practice problems on WeBWork. Students can receive instant feedback and access WeBWork for practice at their convenience and watch review videos through an integrated math OER platform. In addition, instructors can recognize their students' progress in learning through an open learning management system. For example, WeBWork provides statistics for individual student progress and Khan Academy emails the weekly summary of students' progress to instructors. In addition, a social networking and identity service in this study are used as an effective educational connection in order to help students keep constantly refreshing knowledge of learned material and to encourage collaborative learning. Mobile technologies and social networking services, for example, accessing the Internet everywhere and staying connected to classmates and even instructors, help students stay current with class material. Furthermore, students easily post their digital solutions to problems, notes, or student-generated review videos as group projects on an educational blog.

Implications with this innovative new approach

Here are six benefits with this project:

- 1) Using this combination of face-to-face and online instruction promotes student engagement, conceptual understanding of new materials, and achievement in an innovative learning environment.
- 2) Students can take a math course with no-cost-to-students learning materials because of adopting reviewed OER and can improve their experiences with the use of educational technology at UNG.
- 3) An integrated math OER platform improves accessibility and convenience to affordable OER because interactive digital notes on the integrated math OER platform directly connect math instructors and students to OER with a simple click.
- 4) Math instructors are able to use a variety of activities inside and outside class, for example, online group projects, group work in class, or presentations in class using OER.
- 5) The interactive digital notes on the integrated math OER platform enhance students' interests and their conceptual understanding of materials because of the advanced



educational technology features, for example, short video lectures, adaptive web-based practice exercises, dynamic graphs, or drawing tools from OER.

- 6) Math instructors can develop their pedagogical methods and open interactive digital notes at their own convenience because of the flexibility of OER.

For promoting academic excellence and innovation, this project improves student learning opportunities both inside and outside of classroom with innovative educational technology in a blended learning environment. Because students in this project can develop their readiness before class through online instruction, math instructors can use a variety of activities, for example, group work, presentation, and interactive lectures in class, to enhance student engagement. An integrated math OER platform as an innovative educational tool encourages math instructors to adopt the use of approved OER for no-cost-to-students learning materials because of easy accessibility and ready-to-use OER.

Because of the flexibility of OER, math instructors have chances to develop their pedagogical methods with innovative technology.

Connection to reviewed OER with a simple click through the integrated math OER platform helps students improve their conceptual understanding of materials, develop their self-learning abilities, and experience the use of educational technology. For example, students in this project can have the benefits of the advanced open web-based features such as instant feedback, adaptive and interactive web-based exercises, a variety of short videos, dynamic graphs, or online communication tools.

Thus, this project will contribute to student success in math courses with a variety of learning activities inside and outside class using technology and will be potential for math instructors to develop their pedagogical methods and to increase the use of reviewed OER for no-cost-to-students learning materials.

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