

Exploring Innovative Teaching Methods for Developmental Mathematics

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Project Areas

Instructional Effectiveness, LCCC Strategic Plan

This four-phase pilot project within the Mathematics Department at LCCC Albany County Campus is designed to test two innovative teaching methods in developmental mathematics. The first is flipping the classroom, where students view short video lectures outside of class and work on assignments inside of class. The second is incorporating beginner-level robotics projects into the existing curriculum. These innovations aim to improve instructional effectiveness through increased student-teacher and peer interaction in the classroom. This aim addresses LCCC Strategy B.v. of Goal 1 to “Establish learning communities for at-risk students (developmental, first-generation, undeclared programs, etc.) that utilize prescriptive coursework and programming to provide support systems and guidance these students need to succeed in achieving their educational goal.”

Timeline

Fall 2014 - Phases 1 and 2

Phase 1: Develop a plan for using an alternative platform to deliver lessons, conduct assignments, and evaluate developmental math students in a flipped-classroom setting.

Phase 2: Design robotics projects for incorporation into existing developmental math curriculum.

Spring 2015 - Phases 3 and 4

Phase 3: Implement the new platform in a flipped classroom setting.

Phase 4: Evaluate the success of the pilot project and identify areas for improvement.

Estimated Expenses

Item	Cost	Qty	Total
Stipends for project leads	\$4,000/lead + benefits	2	\$9,540
Stipends for task completion	\$450/weight + benefits	9.5	\$5,293
Robots & Parts	\$133 per robot	6	\$800
Software Development	\$1,500		\$1,500
		Total	\$17,133

Project Description

Motivation for this project stems from the need to better engage and retain students in developmental math courses. In reaction to persistent high drop rates and poor performance [1], we would like to take definitive steps toward changing the way we teach these courses. Recently, the Mathematics Department at LCCC developed a new concept-based developmental mathematics curriculum, including instructional materials for a mathematics boot camp and faculty-training program [2]. In addition to these advances, we would like to improve methods for delivering lessons, conducting assignments, and evaluating students in the classroom.

One innovative and effective transformation taking place in classrooms across the nation is that teachers no longer give long lectures. Rather, students watch video lectures outside class, where they can pause and rewind as needed, and spend the valuable time in class working on assignments, where teachers are available to provide direct assistance. By “flipping the classroom” in this way, teachers have more time to closely monitor students, identify specific areas where help is needed, and provide assistance through direct one-on-one interaction. Flipping the classroom has the potential to make teachers especially effective in developmental courses, where students might require direct help in order to succeed. Our intention in this pilot project is to collect data to determine how well flipping the classroom might improve student performance in developmental math courses.

In addition to flipping the classroom, we would like to incorporate robotics projects as a fun new hands-on way of applying math concepts. Through the Laramie Robotics Club, our team has experience doing robotics projects in groups that have little or no background in robotics or computer programming. These projects can be adapted for developmental math courses, and used to teach math concepts in a way that keeps students engaged.

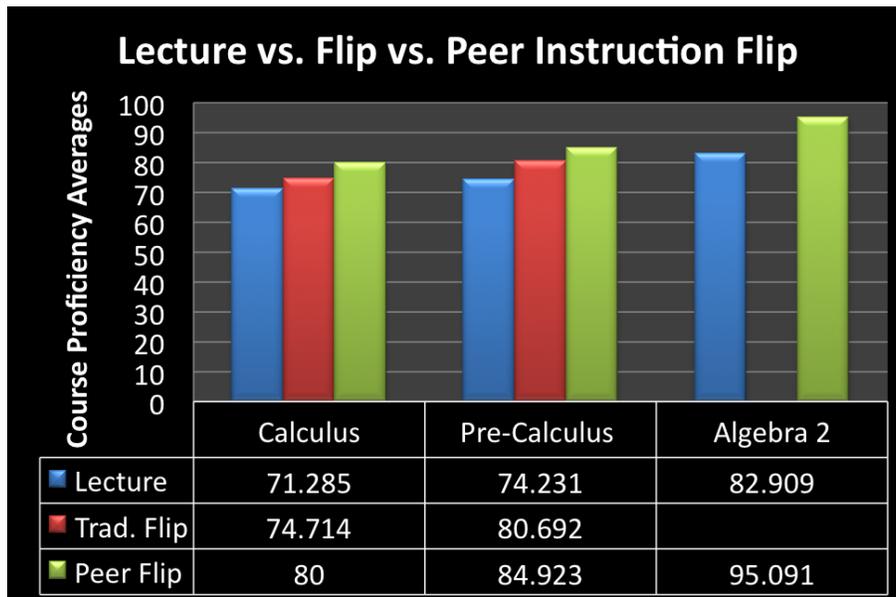


Figure 1: Data showing course proficiency averages for two different methods of flipping the classroom. Traditional flipping swaps lectures and assignments. Peer flipping includes students discussing answers to questions after working through problems individually. Peer flipping shows the benefit of student interaction. Both variations of flipping show improvements in proficiency [3].

Goals, Objectives, Outcomes & Evaluation

- I. Develop an plan for using the free platform Khan Academy (www.khanacademy.org), in place of the existing Pearson MyMathLab platform, to deliver lessons, conduct assignments, and evaluate Algebra II students in a flipped-classroom setting.
 - A. **Task 1:** Identify which Khan Academy video lecture topics correspond to core sections of the existing Algebra II curriculum.
 - i. Prioritize video lecture topics according to their importance with regard core sections of the curriculum.
 - B. **Task 2:** Identify Khan Academy assignments that students should complete in order to satisfy requirements of the existing Algebra II curriculum.
 - C. **Task 3:** Evaluate Khan Academy tools for monitoring student progress. Determine which data should be collected for accurate comparison with the MyMathLab platform.
- II. Design robotics projects for teaching Algebra II concepts by partnering with the Laramie Robotics Club to adapt projects that used the Scribbler Robot (<http://www.parallax.com/product/28136>) for maze navigation challenges.
 - A. **Task 4:** Develop specific maze-navigation challenges that require students to utilize core concepts from the existing Algebra II curriculum.
 - i. Determine the number and duration of projects appropriate to the course. Identify appropriate student evaluation methods for each project.
 - B. **Task 5:** Set up a collaborative effort with the Laramie Robotics Club to facilitate software development and design implementation.
 - i. Partnering with Laramie Robotics Club supports the effort to “establish learning communities for at-risk students” under the LCCC Strategic Plan. We hope to encourage students to attend the Laramie Robotics Club and improve their mathematical, programming and networking skills.
 - ii. Funds to compensate the Laramie Robotics Club for their help are included under “Contract Services” in the budget below.
- III. Implement the plan using Khan Academy and robotics projects to deliver lessons, conduct assignments, and evaluate students in a flipped-classroom setting.
- IV. Evaluate the success of the pilot project and identify areas for improvement.
 - A. **Task 6:** Assess methods for evaluating student progress. Compare the effectiveness of student evaluation methods between Khan Academy and MyMathLab platforms.
 - i. We expect to show that specific evaluation methods and targeted instructor intervention help students achieve proficiency in a greater number of curriculum topics.
 - B. **Task 7:** Assess performance on the common final examination taken by all Algebra II students. Determine average student retention.
 - i. We expect to see improved scores on the final exam, as well as improved student retention relative to averages for current Algebra II courses.

Project Budget

Item	Cost	Qty	Total	Benefit	Qty	Total
Adjunct Faculty	\$4,000/lead + benefits	1	-\$4,587			
ESS part-time	\$4,000/lead + benefits	1	-\$4,953			
	\$450/weight + benefits	9.5	-\$5,293			
Other Supplies	\$133 per robot	6	-\$800			
Contract Services	\$1,500		-\$1,500			
Phase 3 Student Retention*				\$118	25	\$2,950
Total			-\$17,133			\$2,950

* Estimates based on projected student retention in 3 classes, tuition for Wyoming Residence.

Project Timeline

Phase 1 will be conducted during the fall 2014 semester. Tasks 1, 2 and 3 should be completed before December 2014. Planning for collaboration with the Laramie Robotics Club will be ongoing throughout fall 2014 semester. Phase 2 will be conducted late in the fall 2014 semester, and during the holiday break. Tasks 3 and 4 should be completed before January 2015. Phase 3 will be conducted throughout the Spring 2015 semester, with tasks 6 and 7 completed at the end of the semester. Evaluation for improvement should be finalized early in the 2015 summer.

Project Team

Project Leads: Tyler Kjorstad, Spencer Sharpe

Team Members: Tyler Kjorstad, Spencer Sharpe, Eric Quade, Shannon Zavorka

Tyler Kjorstad coordinates the developmental mathematics courses at UW for LCCC Albany County Campus. He holds bachelors degrees in Mathematics, Economics and Finance from The College of St. Scholastica, and a masters in Applied and Computational Mathematics from the University of Minnesota Duluth. Spencer Sharpe is an adjunct instructor for LCCC Albany county campus, a member of the Evolutionary Artificial Intelligence Lab at UW, and a member of the Laramie Robotics Club. He holds a bachelors degree in Mathematics, and a masters in Neuroscience from the University of Wyoming.

References

- [1] Eve Newman and Becky Orr. Many students hit stop sign at college. http://www.wyomingnews.com/articles/2010/09/05/news/1911local_09-05-10.txt#.U_rNn7xdW3p, September 2010.
- [2] Fuji Adachi et al. Reforming developmental mathematics at laramie county community college. <http://lccc.wy.edu/Media/Website-Resources/documents/Presidents-Office/Quarterly-Report-Round-One---1st-Quarter---Reforming-Dev-Mathematics.pdf>, December 2013.
- [3] Troy Faulkner. Leading the way to improve student learning in a flipped classroom. <http://researchnetwork.pearson.com/elearning/leading-the-way-to-improve-student-learning-in-a-flipped-classroom>, June 2013.