

Overcoming Geographic Isolation: The Design and Implementation of a Web-based Collaborative Learning Environment

A Master's Thesis Defense by Ryan Lewis

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Outline

- Motivation
- Related Work
- Leveraged Software
- Features
- User Survey
- Conclusions & Future Work

Motivation: STEP

- STEP (Science and Tech. Entry Program)
 - Prepare minorities and economically disadvantaged for entry into post-secondary STEM programs
- Funds institutes offering programs that meet a set of priorities and requirements



Motivation: STEP

- Priorities

- Male recruitment and retention
- Hispanic/Latino recruitment and retention
- 8th grade NYS math and science assessment scores

- Requirements

- Collaboration evidence
- Activities to aid acquiring skills to pursue STEM fields
- Build math and science skills in accordance with Adv. Regents
- Means of involving parents

Motivation: IMPETUS

- Integrated Mathematics and Physics for Entry To Undergraduate STEM
 - Clarkson's STEP funded program
 - Year round events on and off campus
 - Collaboration happens in person...
 - Served region (Northern NY) covers a lot of area
 - Participating schools can 1+ hours to get to campus
 - Results in all participants collaborating only 7 times/year



Motivation: IMPETUS

- Solution: web-based Collaborative Environment
 - Helps satisfy many of the priorities and reqs
 - Students that need help can have personalized tutoring with Clarkson students
 - Teachers can survey and receive feedback from students and parents
 - Parents have access to student data
 - Collect student data and usage data for analysis
 - NSF has stated that analyzing this usage data is a key cyberlearning research topic

Related Work

- Several existing Cyberlearning Systems (CLS)
 - Traditional
 - Blackboard (WebCT)
 - Moodle
 - Specialized
 - Khan Academy

Related Work: Blackboard

- Closed source
- Expensive
- Custom functionality is possible, but one needs to be a customer

Related Work: Moodle

- Open source
- Does not store or track changes to user data
 - Ex: Track total # of 10th grade students taking biology each year and compare
- Offers a lot of unnecessary features
- No personalized tutoring component

Related Work: Khan Academy

- Provides a personalized Knowledge Map of math topics and exercises associated with each
- Open source
- Does not have robust enough user management
- Exercises can not be created by non-technical users (require extensive HTML and JS)

Related Work: Summary

- No perfect drop-in solution
- Required:
 - Khan Academy Knowledge Map
 - Easy quiz (i.e. exercise) creator
 - Continuous user data tracking
- Create IMPETUS Collaborative Environment

Leveraged Software

- Symfony2
 - PHP MVC framework
 - Requires the use of well-understood design principles: service layer, repository layer, ORM, ...
 - Handles security, database abstraction, templating
 - Should make sustainability easier
- Khan Academy
 - Adopting their Knowledge Map code to better suit IMPETUS

Feature: User Management

- All non-anonymous users have an account with a role that defines their general privileges
- Students have additional data stored
 - Year independent
 - Ethnicity, gender, graduated, diploma
 - Year dependent
 - Activities, standardized exam scores, courses, grade, school district
- ✓ Used to show increases in recruitment/retention rates

Feature: User Management

IMPETUS Cooperative Learning
Welcome Admin Example — Logout — Academic Year: 2011

Home
Quiz
Survey
Messaging
Users
Districts
Analytics

No Avatar

Student Example (student)
Student at Central School District
student@example.com

Personal		Education	
Birthday	1993-01-01	Academic Term	Grade 12 at Central School District
Ethnicity	Black or African American	Activities	Roller Coaster Camp
Gender	Male	Courses	Physics
		Standardized Exams	SAT Math: 750 SAT Reading: 700 SAT Writing: 720
		Graduated	2011
		College	Clarkson University
		Major	Mathematics and Statistics

Feature: User Management

IMPETUS Cooperative Learning

Welcome [Admin Example](#) — [Logout](#) — Academic Year: 2010

Home

Quiz

Survey

Messaging

Users

Districts

Analytics

No Avatar

Student Example (student)
Student at Central School District
student@example.com

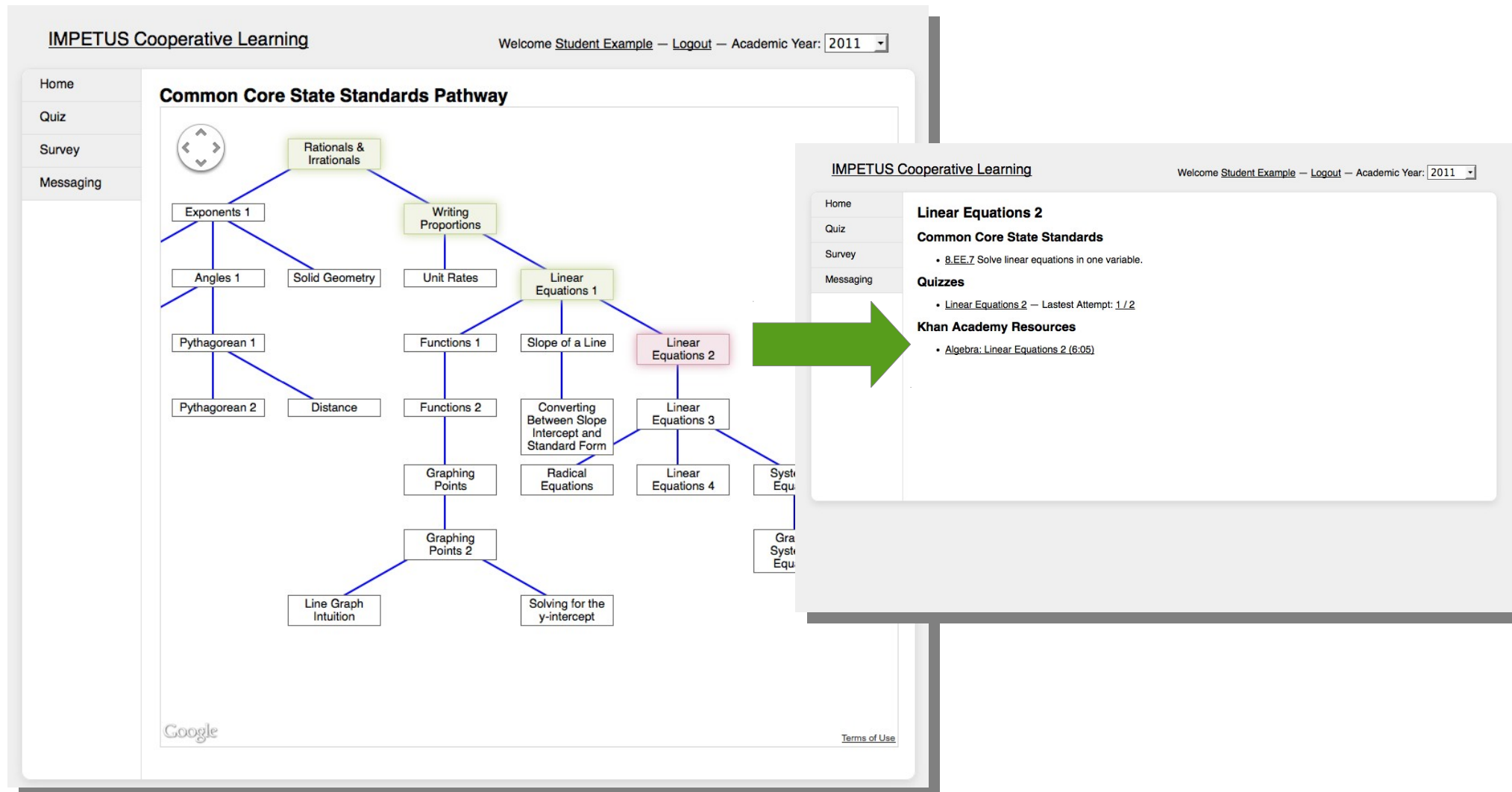
Personal	
Birthday	1993-01-01
Ethnicity	Black or African American
Gender	Male

Education	
Academic Term	Grade 11 at Central School District
Activities	Mathcounts Roller Coaster Camp
Courses	Chemistry
Standardized Exams	<i>Not entered</i>
Graduated	2011
College	Clarkson University
Major	Mathematics and Statistics

Feature: Learning Pathway

- IMPETUS adoption of Khan Academy Knowledge Map
- Students are shown a hierarchical tree of concepts based on State Standards
 - Nodes represent a concept
 - Has videos and quizzes associated with it
 - Completing a quiz changes the color of the node
 - Edges represent requisite knowledge
- ✓ Enhance math and science skills in accordance with the Advanced Regent Diploma and 8th grade assessments

Feature: Learning Pathway



Feature: Quiz System

- Teachers and TAs can create new assessments that can be linked with the Learning Pathway tree
- Students can attempt quizzes numerous times until they master the topic
- ✓ Formal collaborations between the funded institute and the local school districts
- ✓ Activities that assist students in acquiring the skills and aptitudes necessary to pursue collegiate STEM disciplines

Feature: Quiz System

IMPETUS Cooperative Learning

Welcome [Teacher Examp](#)

Home

Quiz

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New Quiz

Name

Linear Equations 2

Instructions

For each problem, solve for x.

Problem

Question

\[
2x+8=16
\]

[Remove Problem](#)

Problem

Question

10+3x=31

IMPETUS Cooperative Learning

Welcome [Student Example](#) — [Logout](#) — Academic Year:

2011

Home

Quiz

Survey

Messaging

Quiz: Linear Equations 2

Instructions

For each problem, solve for x.

Problem 1

2x + 8 = 16

x =

Problem 2

10+3x=31

☐ x = 5

☐ x = 6

☐ x = 7

[Grade Quiz](#)

Text Label

x =

Answer

4

Correct?

☒

[Remove Answer](#)

[Add Answer](#)

Text Label

x = 5

Answer

5

Feature: Survey System

- Teachers and TAs can get feedback from any type of user
- If a student does not participate in surveys, this could be seen as an early indicator of needing more attention
- ✓ Means of involving parents

Feature: Survey System

IMPETUS Cooperative Learning Welcome [Student Example](#) — [Logout](#) — Academic Year: 2011

[Home](#)
[Quiz](#)
[Survey](#)
[Messaging](#)

Survey: College Survey
Instructions
Please answer all of the questions.

Question 1
Did you apply to college?
☒ Yes
☐ No

Question 2
What are you plans after graduating?

Go to college and major in Computer Science.

Question 3
The IMPETUS program helped me with the college decision process.
☐ Disagree Strongly
☐ Disagree
☐ Disagree Somewhat
☐ No Opinion
☐ Agree Somewhat
☐ Agree
☒ Agree Strongly

[Submit Survey](#)

IMPETUS Cooperative Learning Welcome [Teacher Example](#) — [Logout](#) — Academic Year: 2011

[Home](#)
[Quiz](#)
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[Users](#)
[Districts](#)

Survey: College Survey
Question 1: Did you apply to college?

Answer	Count	Percent
Yes	2	50%
No	2	50%

Question 2: What are you plans after graduating?
[Go to college and major in Computer Science.](#) [I'm going to attend Clarkson and study Physics.](#) [Trade school](#) [Work](#)

Question 3: The IMPETUS program helped me with the college decision process.

Answer	Count	Percent
1	0	0%
2	0	0%
3	1	25%
4	0	0%
5	1	25%
6	0	0%
7	2	50%

Participants (4):

Name	Completed
Example, Student	Dec 9, 2011 @ 06:04 AM
Test1, Test1	Dec 9, 2011 @ 06:05 AM
sadf, asdf	Dec 9, 2011 @ 06:06 AM
Example, Teacher	Dec 9, 2011 @ 06:08 AM

Feature: Messaging

- To facilitate communication between all users, a messaging system was created
- Can send messages to single users or groups of users (Teachers, Example District Grade 10)
- Users are notified via email that they have a new private message

Feature: Messaging

IMPETUS Cooperative Learning

Welcome [Student Example](#) — [Logout](#) — Academic Year: 2011

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Messaging

New Message

To

Teacher Example x [Add recipient](#)

Subject

Assignment Help

Content

Hey,
I forgot which problem numbers we were supposed to
homework tonight.

Send Message

IMPETUS Cooperative Learning

Welcome [Teacher Example](#) — [Logout](#) — Academic Year: 2011

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Survey

Messaging

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Districts

Your reply was added! — [Dismiss](#)

Assignment Help

Recipients: [Student Example](#), [Teacher Example](#)

[Student Example](#)

Mon, Dec 5, 2011 at 2:52AM

Hey,
I forgot which problem numbers we were supposed to do for homework
tonight.

[Teacher Example](#)

Tue, Dec 6, 2011 at 9:04AM

Do problems 1a, 1b, 2, 3, 5, 8, and 13.

Reply

Content

Send Reply

Feature: Analytics

- A STEP funded program must submit, each year, a report to NYSED that summarizes data about the participants, activities, program content, and outcomes
- The Collaborative Environment collects this data and outputs it in the format that the report mandates

Feature: Analytics

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Students Served for 2011

Males

Ethnicity	Class Level						Total
	7	8	9	10	11	12	
American Indian or Alaskan Native							
Asian							
Bi-racial							
Black or African American						1	1
Hispanic							
Pacific Islander							
White						1	1
Other							
Total						2	2

Females

Ethnicity	Class Level						Total
	7	8	9	10	11	12	
American Indian or Alaskan Native							
Asian							
Bi-racial							
Black or African American							
Hispanic							
Pacific Islander							
White				1			1
Other							
Total				1			1

[Download CSV](#)

User Survey

- Gather initial qualitative data and get feature feedback
- Surveyed IMPETUS administrators, teachers, and graduate fellows; 18 total
- Participants used the survey as a guide and left feedback throughout the process
- Played the role of a teacher performing routine tasks

User Survey

- Only one survey thus results are just indicators
 - Satisfaction
 - User management, messaging, surveys: $\geq 84\%$
 - Quiz creation: $>55\%$
 - Confusion with creating correct/incorrect answers
- Changes made can now be compared against

Conclusions

- Contributed a free and open source Collaborative Environment
- Satisfies STEP priorities and requirements while aiding in overcoming the issues of operating a geographically isolated STEP program
- In an anecdotal sense, initial survey results have been primarily positive with 89% of the participants indicating satisfaction with the system

Future Work

- Add more analytics tables and graphs
- Run additional user surveys to quantify data
- Once real data starts being collected, this can be used as a powerful tool

¿Questions?