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

A Master's Thesis Defense by Ryan Lewis

Clarkson University: Department of Computer Science

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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

Clarkson University
IMPETUS
For Career Success

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

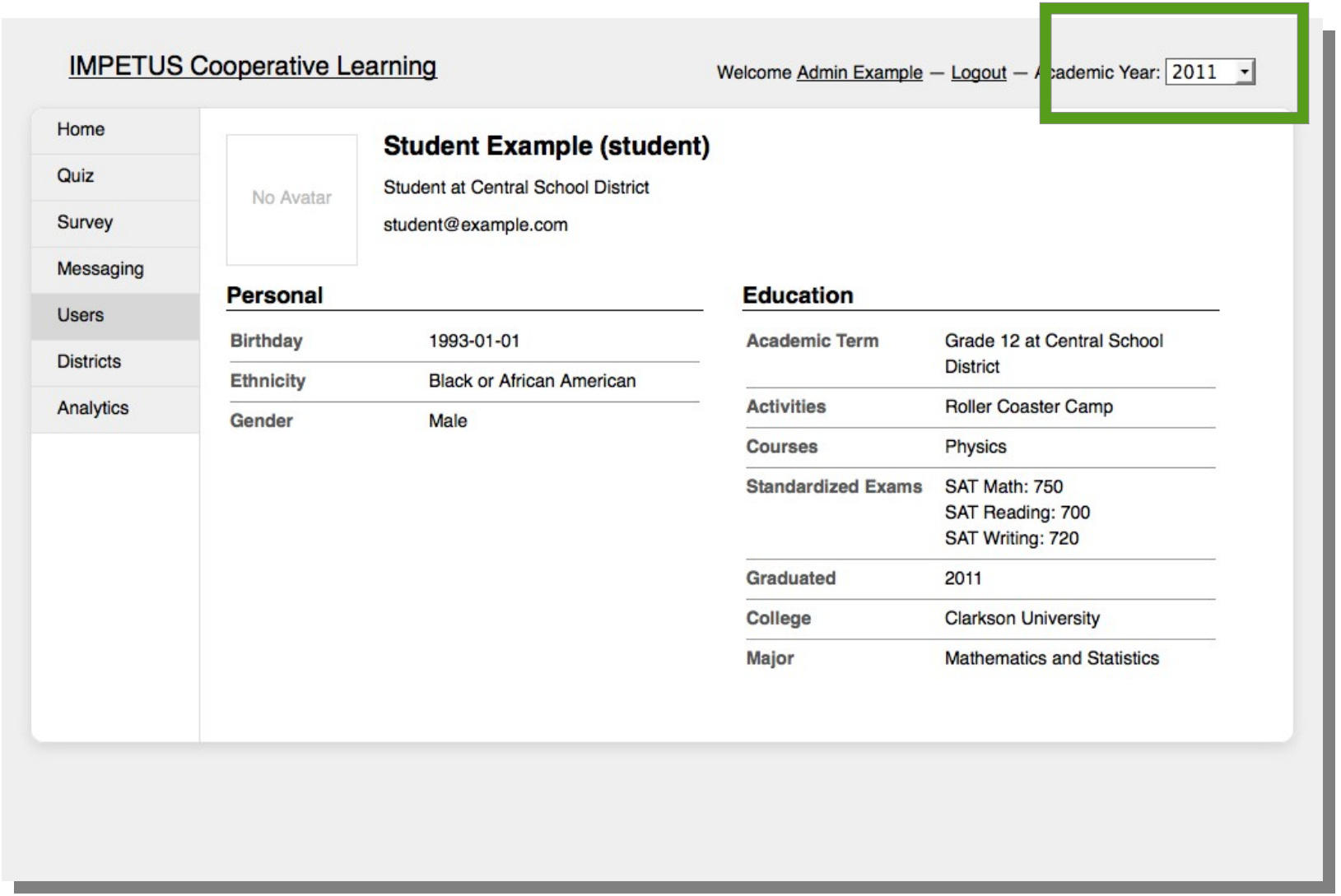
Leveraged Software

- 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

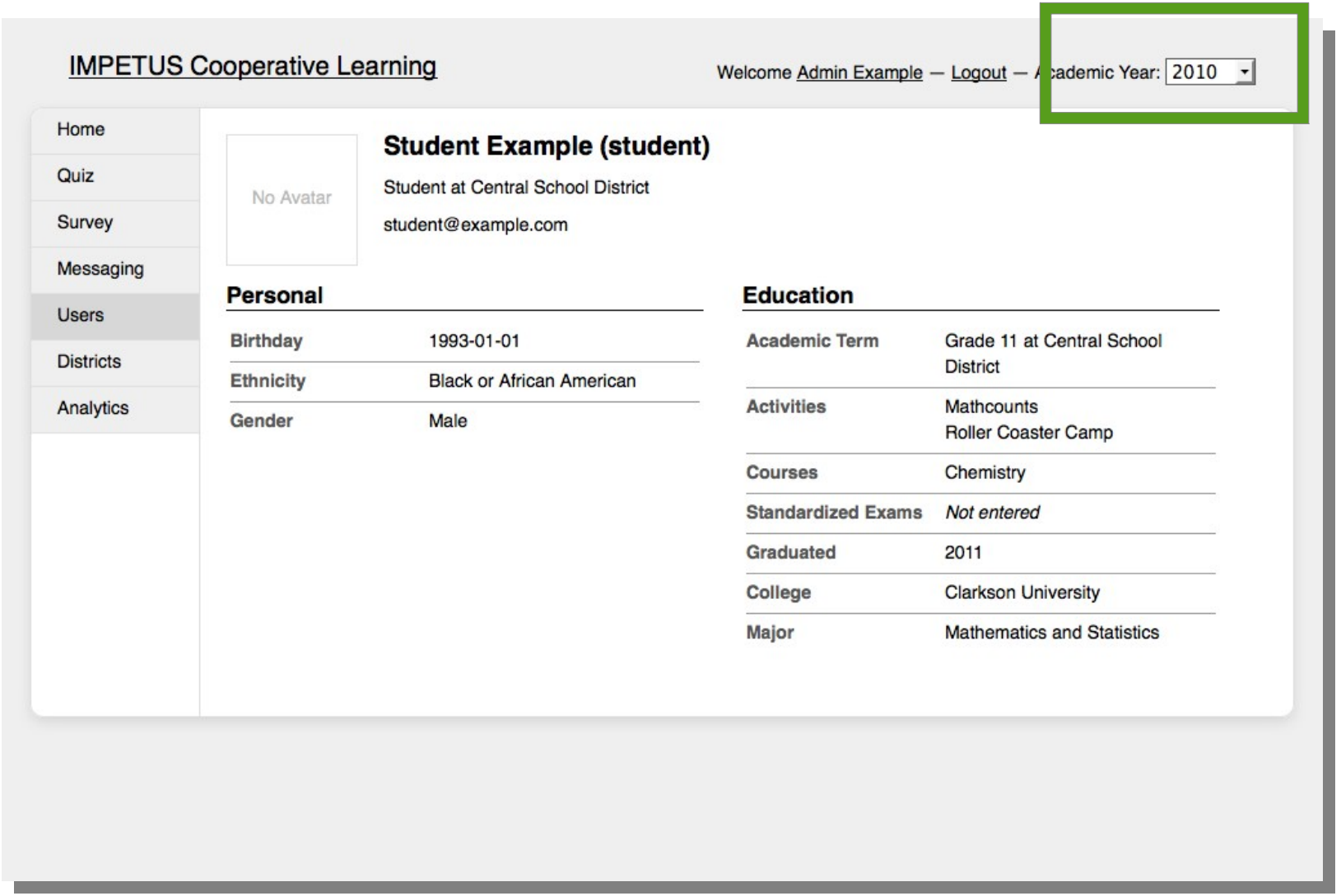
Feature: User Management

- 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



Feature: User Management

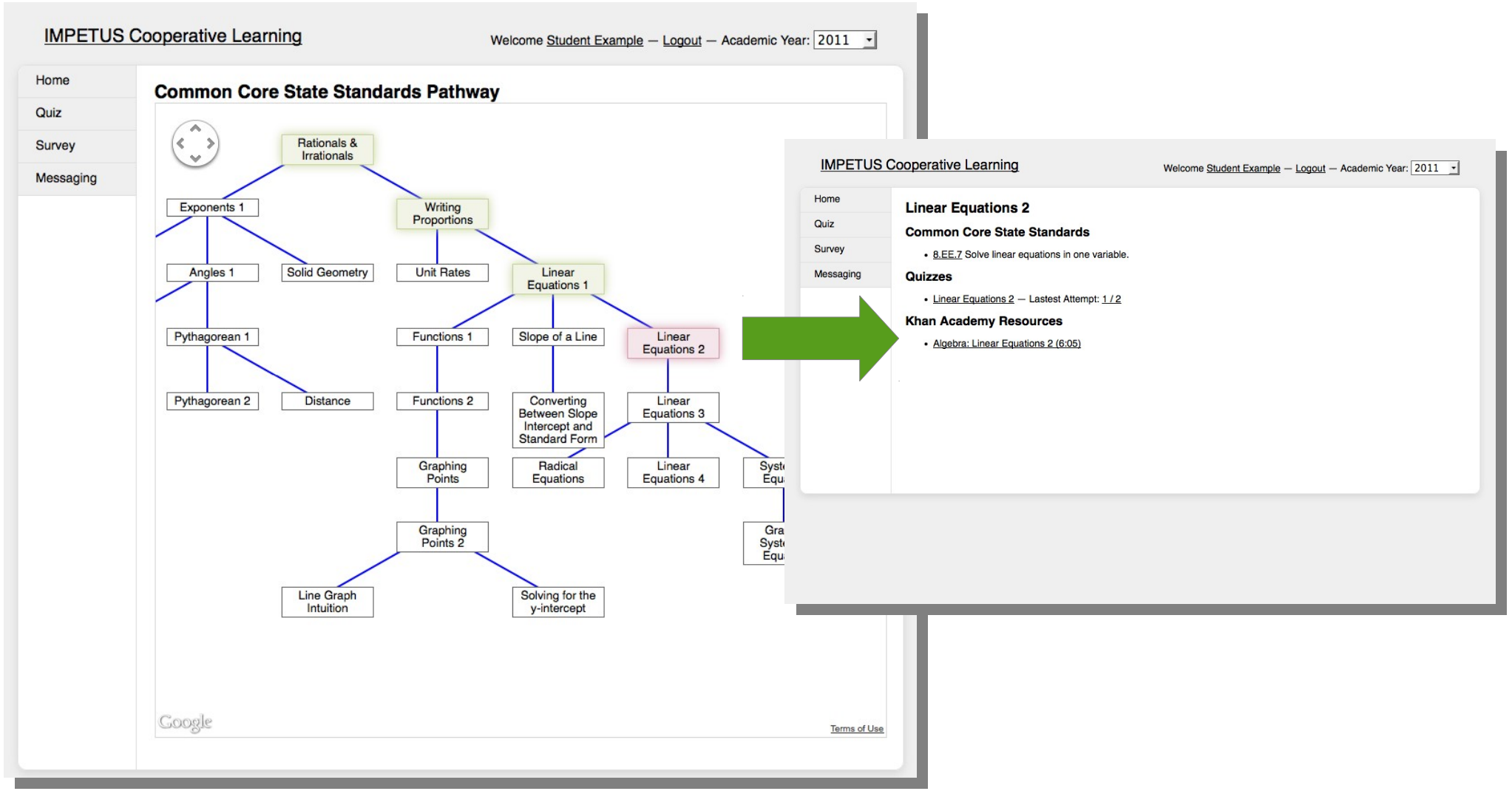


Feature: Learning Pathway

- 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



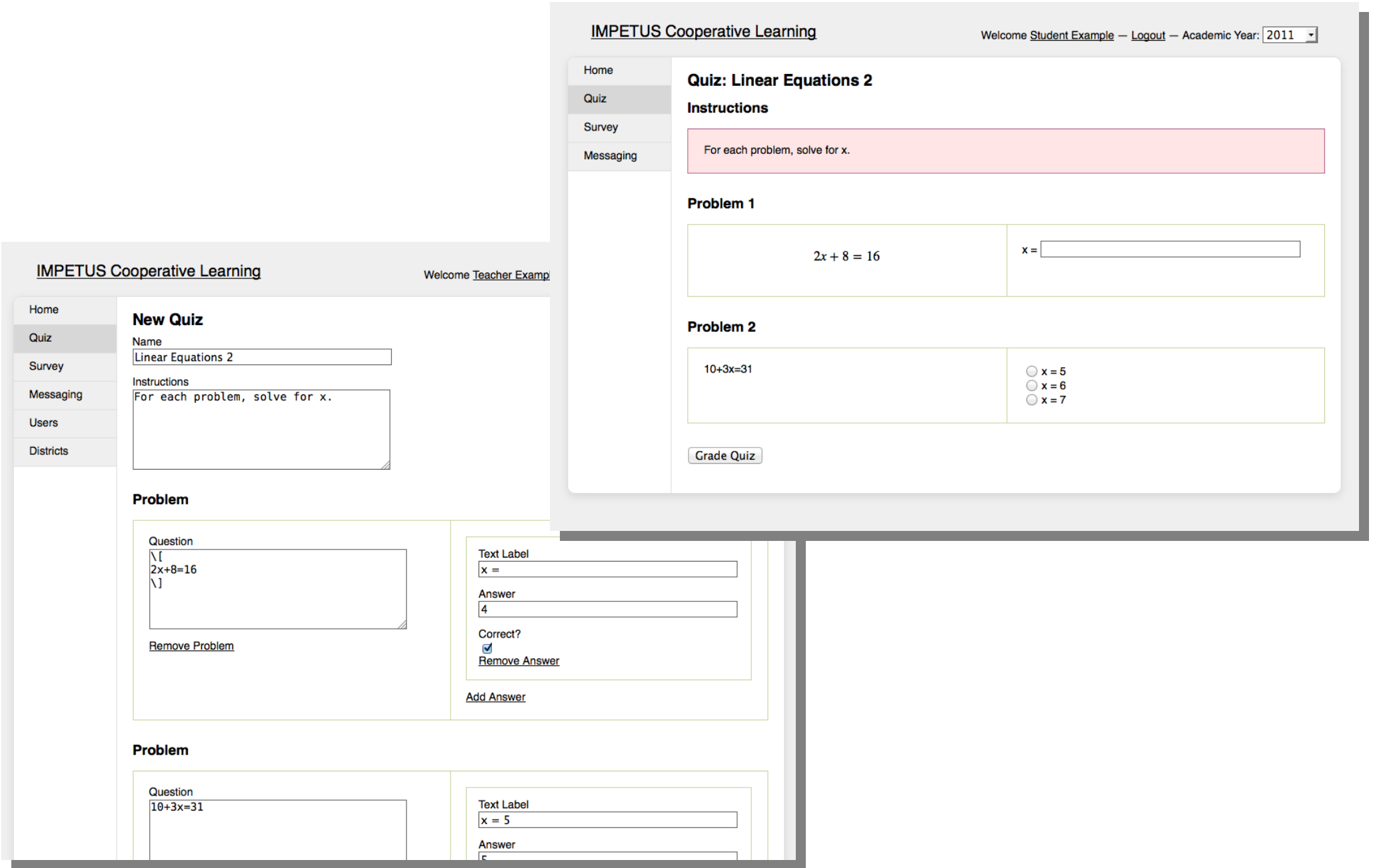
Feature: Quiz System

- 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

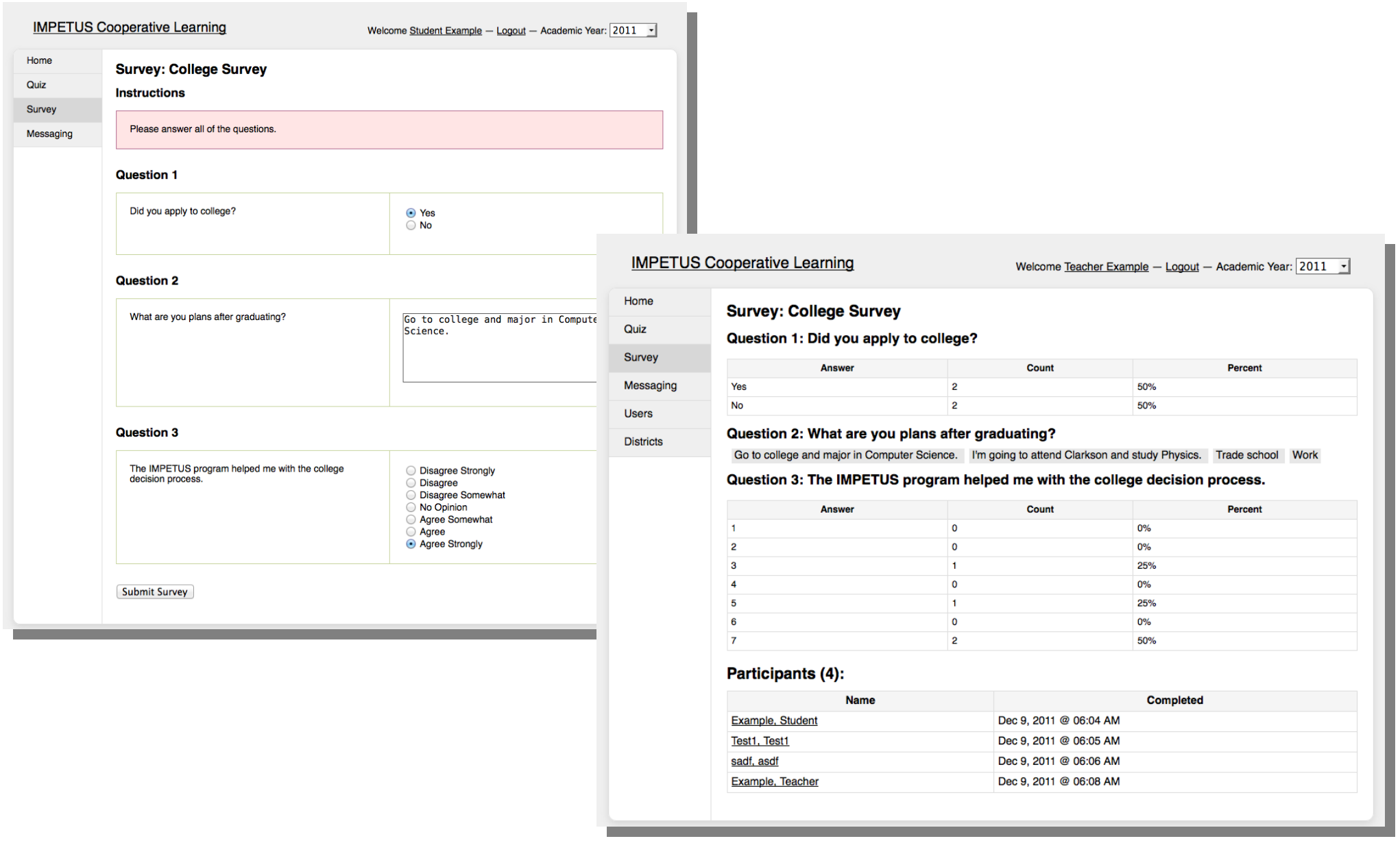
Feature: Quiz System



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

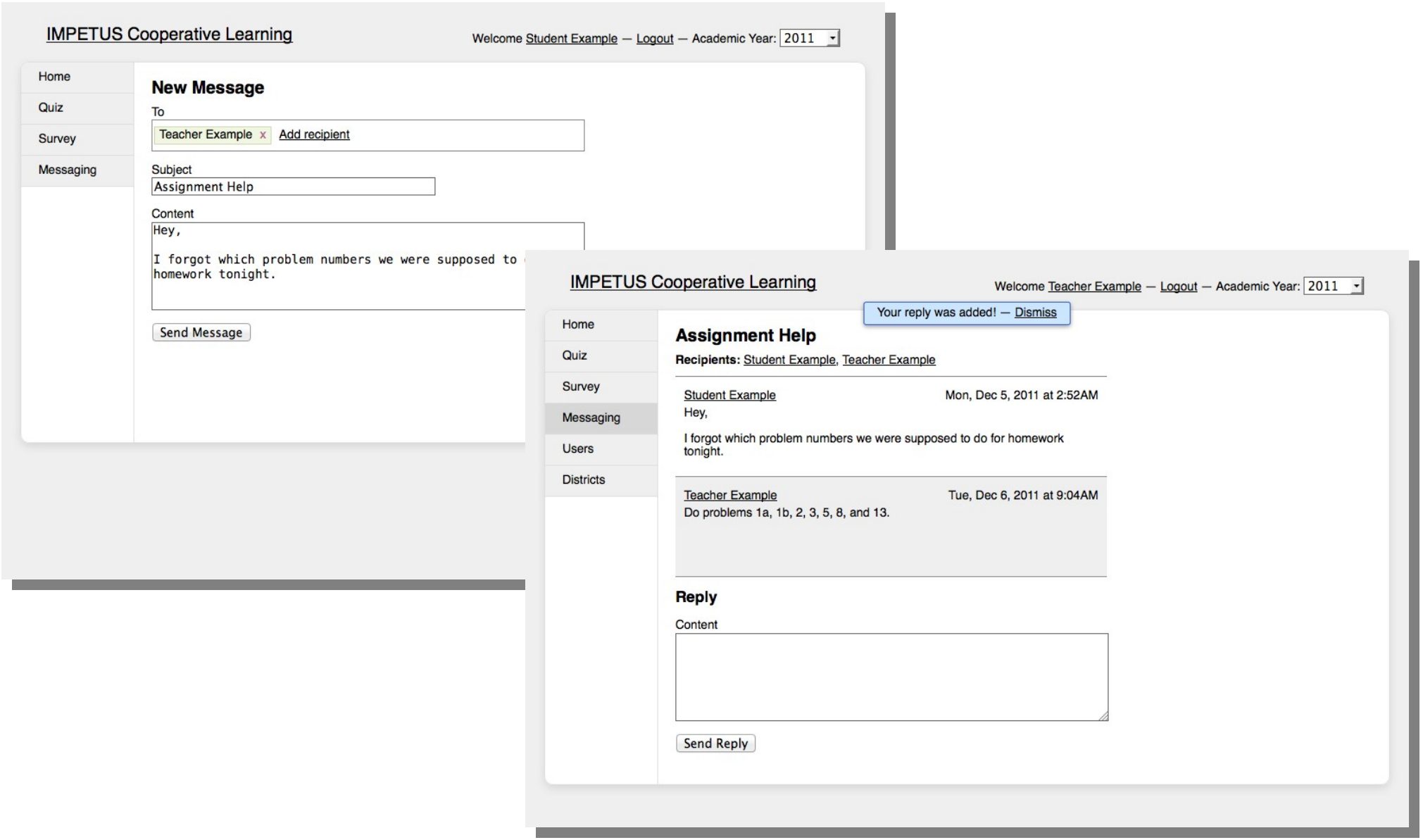
Feature: Survey System



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

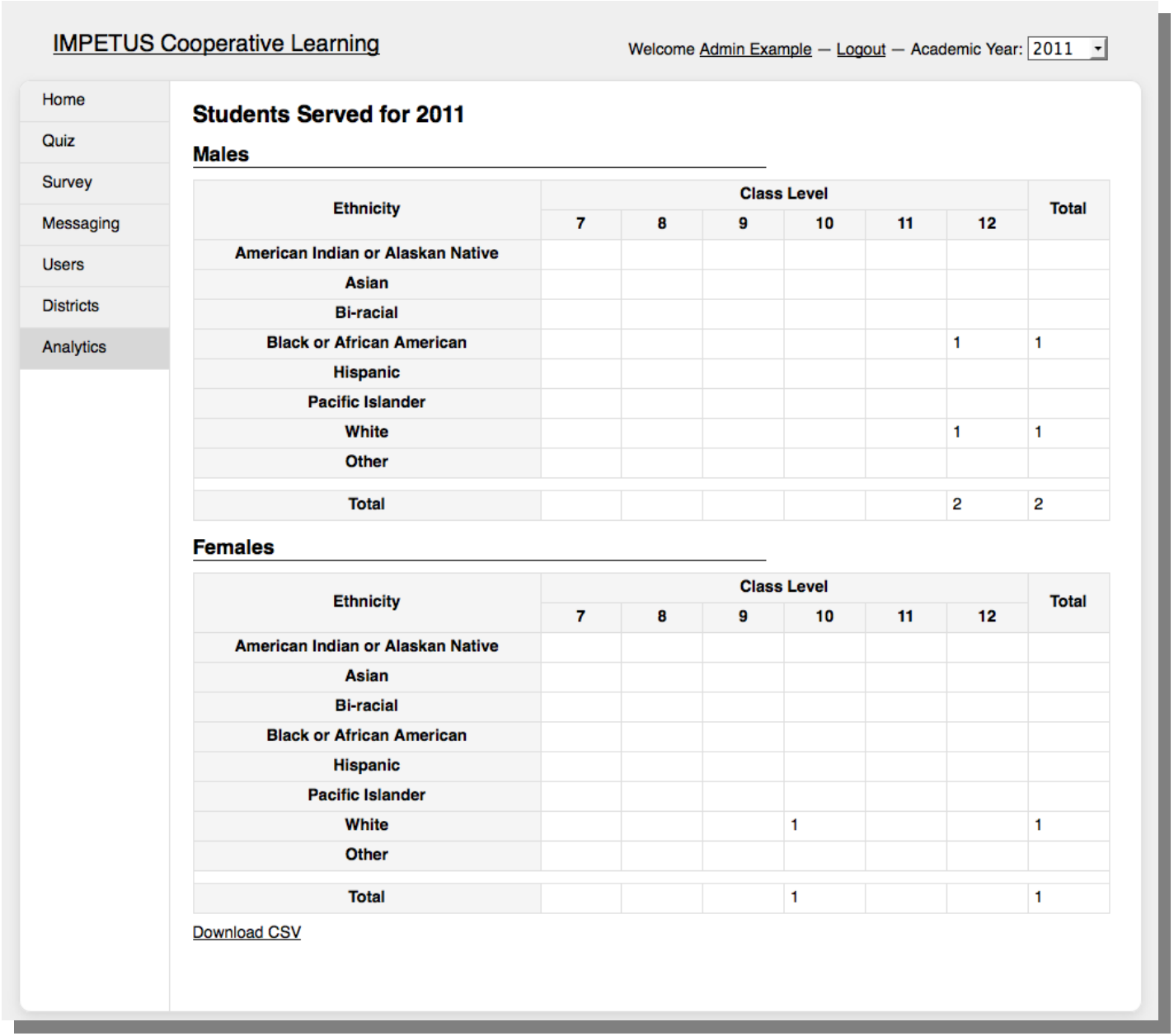
Feature: Messaging



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



IMPETUS Cooperative Learning

Welcome Admin Example — Logout — Academic Year: 2011

- Home
- Quiz
- Survey
- Messaging
- Users
- Districts
- Analytics

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: >=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?