Can you Master This??

Initial Attempts at Specifications-based Grading in Introductory Chemistry

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What is IMSA?

The Illinois Mathematics and Science Academy is a three-year (grades 10-12) residential public magnet school in Aurora, Illinois. IMSA enrolls approximate 650 students from all over the state of Illinois. Students engage in a rigorous STEM-focused curriculum in addition to a full traditional secondary school curriculum.

Course Overview

Scientific Inquiries in Chemistry (SI-Chem) is a semester-long introductory chemistry course required for all sophomores at IMSA. It assumes no previous chemistry knowledge and covers topics ranging from atomic/electronic structure, the periodic table and periodicity, bonding, chemical reactions, stoichiometry, equilibrium, to acids and bases.

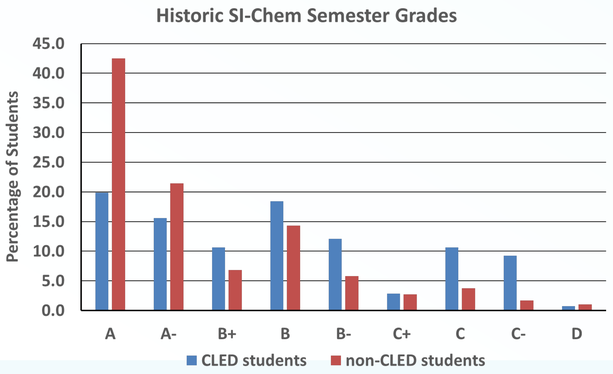
The class meets for 2 105-minute sessions per week, with an optional 1-2 hour help session once a week. Roughly 25% of class time is spent on laboratory activities, with the majority of other instruction time utilizing small group and active learning techniques.

Introduction

Until the Spring of 2021, SI-Chem was taught with a traditional weighted-grade scheme. The course was broken up into 4 units, each with a cumulative exam, and a cumulative final exam at the end of the semester.

Grade Weights (Percent of Total Grade)		
	Traditional	**Spec. Based**
Test/Quiz	54	65
Labs/Activities	36	15
Homework		10*
Final Exam	10	10

Historical grade data showed a discrepancy between final grades of CLED (Culturally, Linguistically, Economically Diverse) students and non-CLED students. Piloting a specifications-based grading system was one strategy to reduce this gap.



Course Specifications

Three different variations of specifications-based grading systems were used in the Spring 2021, Fall 2021, and Spring 2022 semesters. In each semester the material was broken down in to approximately 20 Learning Objectives and students were allowed to retest on LOs.

Spring 2021

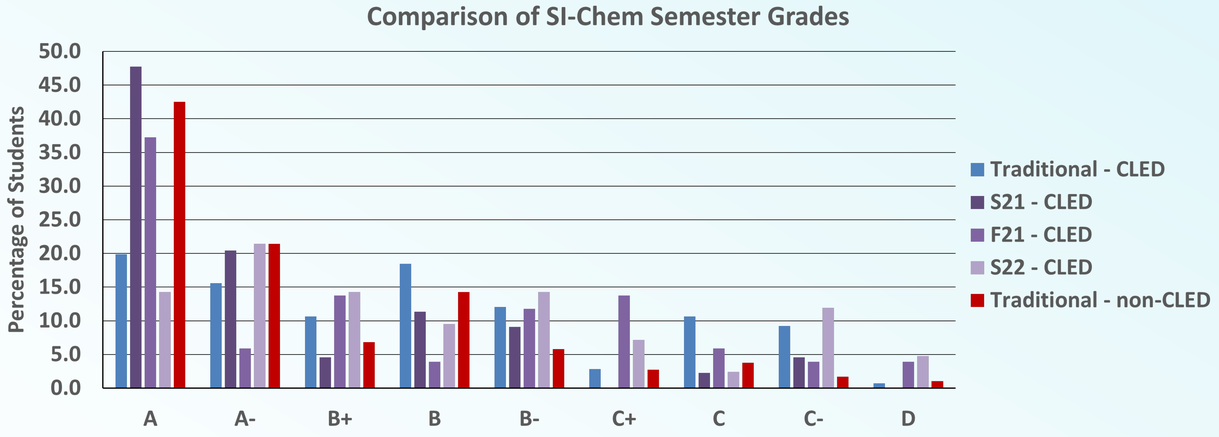
- All instruction/assessment online
- 20 small quizzes ("spec check" SC)
  - 5 questions
  - No partial credit per question
  - SC graded as "mastery", "progressing", or "not yet"
  - Non-cumulative
  - 2 retakes for each SC, highest grade kept
  - No set date to complete retakes
- No final exam
- Minimal graded homework
- Virtual/simulation-based labs

Fall 2021

- In-person instruction and assessment
- 16 Spec Checks
  - 5 questions
  - No partial credit per question
  - SC graded as "mastery", "progressing", or "not yet"
  - Non-cumulative
  - 2 retakes for each SC, highest grade kept
  - No set date to complete retakes
- Cumulative midterm and final exams
- Online homework, minimal graded homework
- Traditional lab activities with lab reports

Spring 2022

- In-person instruction and assessment
- 6 Module Tests
  - Each module covers 3-4 LOs
  - Partial credit
  - Integrative questions, including lab-based questions
  - 1-2 cumulative questions per test
  - 1 retake per test, latest grade kept
  - Set date for test retake
- Cumulative final exam
- Online homework
- Paper homework checked for completion
- Traditional lab activities with lab reports



	Traditional Grading student grades		Specifications Grading CLED student grades		
	Non-CLED	**CLED**	**Spring 21**	**Fall 21**	**Spring 22**
Average grade	B+/A-	B	B+/A-	B/B+	B
% with grade of C (% change)	3.7	10.6	2.3 (-8.3)	5.9 (-4.7)	2.4 (-8.2)
% "at risk" (grade of C-/D) (% change)	2.7	9.9	4.5 (-5.4)	7.8 (-2.1)	16.7 (6.8)

Benefits and Challenges

In general, the change to smaller, more frequent assessments with multiple opportunities for students to demonstrate mastery of material showed an increase in grades for all students, with a marked increase in semester grades for CLED students, compared to historical/traditional grading methods

Benefits

- Students performed better on retakes when given the opportunity to choose the completion date
- Homework completion rates increased when it was graded, even if just graded for completion with minimal total impact on course grades
- Students were better able to articulate where they were struggling

Challenges

- Integrative and critical thinking questions continue to be a challenge for students
- Loss of instruction/activity time with weekly assessments
- Increased work load of teachers – continuously writing SC and proctoring retakes
- Inclusion of lab reports and activities in grading scale
- Students continuously feeling "behind"
- Student completion of homework fell drastically if not graded

Fall 2022 Implementation

From our different implementations of specifications grading, we are proposing the following for the upcoming academic year:

- 15-16 Speck Checks, each covering 1-2 Learning Objectives
  - No partial credit per question
  - Graded on 3-point scale
- 1 retake for each LO, highest grade kept
- No set date for retake completion, but set time frames
- Cumulative midterm and final exam
- Separate grade for lab and in-class activities
- More structured help sessions

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