Specifications Grading in STEM Courses: Increasing Rigor and Student Perseverance

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Author Biography

Mai Yin Tsoi is a charter chemistry faculty member in the School of Science and Technology at Georgia Gwinnett College (GGC) with extensive classroom experience at the K-12 and post-secondary levels. As a Professor, she conducts student-led mixed-methods research in Science Education. She created and currently leads the GGC Specifications Grading Group, a 23-member Faculty Learning Community dedicated to the exploration and implementation of specifications grading in student learning. To date, over 2,500 students at GGC have completed a specifications grading-based course. She was named Gwinnett County's Teacher of the Year in 2006 and a finalist in the Georgia Teacher of the Year 2007 competition. She received the GGC Faculty Excellence in Service Award in 2010 and the GGC Faculty Excellence in Teaching Award in 2019.

Introduction

Specifications grading (SG) is an assessment strategy based on mastery learning, clear learning objectives, and frequent evaluations and feedback. Linda Nilson (2015) published *Specifications Grading: Restoring Rigor, Motivating Students, and Saving Faculty Time*, wherein she describes a novel methodology that gives students control of their grades through multiple attempts, with limitations, on course assessments of course objectives. High rigor mastery is defined as a cut-score set at minimum competency with no partial credit assigned. Students either master or must retry objective assessments to earn higher grades. Preliminary observations suggest that, regardless of subject area, SG can be used as an alternative to traditional assessment methodologies in STEM courses.

Description of Specifications Grading

I first read about the concept of specifications grading (SG) in an article by Joshua Ring (2017). SG has three tenets: 1) student grades should accurately reflect student mastery of course content, 2) students should have multiple opportunities to remediate any misconceptions, and 3) course content should be delivered in bite-sized chunks versus chapters of content in a single exam period.

During spring 2017, I jumped into implementing SG for two sections of first-semester organic chemistry, each twenty-four students. I divided my course content into twenty-two discrete course objectives, with a short quiz for each objective. Afterwards, I noticed more A's in my class than ever before. Student comments were overwhelmingly positive and, for the first time, none of my students appealed for extra points in their final grade. Students asked for more courses with SG, even calling the Dean's office before registration opened!

I coached twenty-three faculty in several disciplines over the next three years, spending multiple weeks with each instructor honing their course objectives and assessments to align with the SG methodology, the instructor's own philosophies, and teaching style. This last semester, I onboarded our first non-STEM course: Introduction to Economics. The following table of current SG courses at our school illustrates that the SG methodology is agnostic to both discipline and course-level.

Table 1: Courses using SG methodology at GGC.

Biochemistry	BCHM 3100
Survey of Chemistry I	CHEM 1151
Principles of Chemistry I	CHEM 1211
Principles of Chemistry II	CHEM 1212
Organic Chemistry I	CHEM 2211
Organic Chemistry II	CHEM 2212
Organometallics	CHEM 4000
Integrated Lab II (senior capstone)	CHEM 4702
Quantitative Reasoning	MATH 1001
College Algebra w/ Support	MATH 0098
College Algebra	MATH 1111
Pre-Calculus	MATH 1113
Calculus I	MATH 2200
Calculus II	MATH 2210
Cell Biology	BIOL 3400
Introduction to Physics I	PHYS 1111
Introduction to Physics II	PHYS 1112
Intro to Environmental Science	ESNS 1101
Anatomy & Physiology I	BIOL 2451
Biomechanics	EXSC 3500
Intro to Economics	ECON 2100

In SG, instructors are free to infuse this assessment method in ways that support their individual teaching styles. However, all our instructors set the cut-score, or minimum level of proficiency, at 80% for each assessment. When a student met or exceeded this minimum level for an objective, an assessment PASS was recorded in the gradebook. Otherwise, an assessment TRY AGAIN was recorded and students could retake a new assessment version of that objective until a score of 80+% was earned. There was no partial credit for student answers – each question was full credit or no credit. This streamlined the grading process and freed up instructor energy for feedback and comments. Also, there were no grade penalties for retakes. The number of assessments passed determined the SG portion of the overall course grade.

According to Nilson, course objectives are "a contract" between the student and the teacher because they clearly define the skills and knowledge required for mastery of the course content. Therefore, each instructor spent copious amounts of time distilling their courses into the bare essential objectives and more general objectives. Each objective was assessed using a five- to ten-point scale administered during class time. If not passed, then students could sign up for a retake. Instructors teaching the same course created shared assessment item banks to assist with version creation and control.

Retake Cooperative

When the demand for retakes became untenable for the twenty-three instructors, a "cooperative" was formed where each instructor would proctor a weekly shift and administer retakes for any student in an SG course. An online request system was designed whereby students could choose which retake and a convenient time/day. The system would alert the teaching instructor and deliver the appropriate retake

version to the proctoring instructor. At our school's testing center, the dedicated SG Retake Room has hosted over 10,000 quiz retakes to date.

Artifacts of Specifications Grading

All SG instructors show a video (developed by me and GGC's Educational Technology Office) during the first week of classes. The methodology is thoroughly described and repeatedly explained to all students before Add-Drop period ends.

Link: https://bit.ly/2pq7NxR

Figure 1: Screenshots of the Introduction Video Shown to Students

Preliminary Data from Scholarship of Teaching and Learning (SoTL) Research on specifications grading

Below are some preliminary results from the work of nine senior student SoTL projects I led, examining the impact of specifications grading in STEM courses.

- There is a statistically higher number of A and B course grades in SG courses as compared to traditional courses. ($p = 0.041$, $n = 337$)
- There is no significant difference in final course grade between students of different age groups in SG courses. ($p = 2.47$, $n = 337$)
- There is no significant difference in final course grade between Caucasians, Asians, African-Americans, Hispanics in specifications grading courses. ($p = 1.20$, $n = 337$)
- Students perform statistically better on tasks/content on the Final Exam for which they have taken 3- 4 retakes of the aligned quizzes. ($p = 0.018$, $n = 83$).

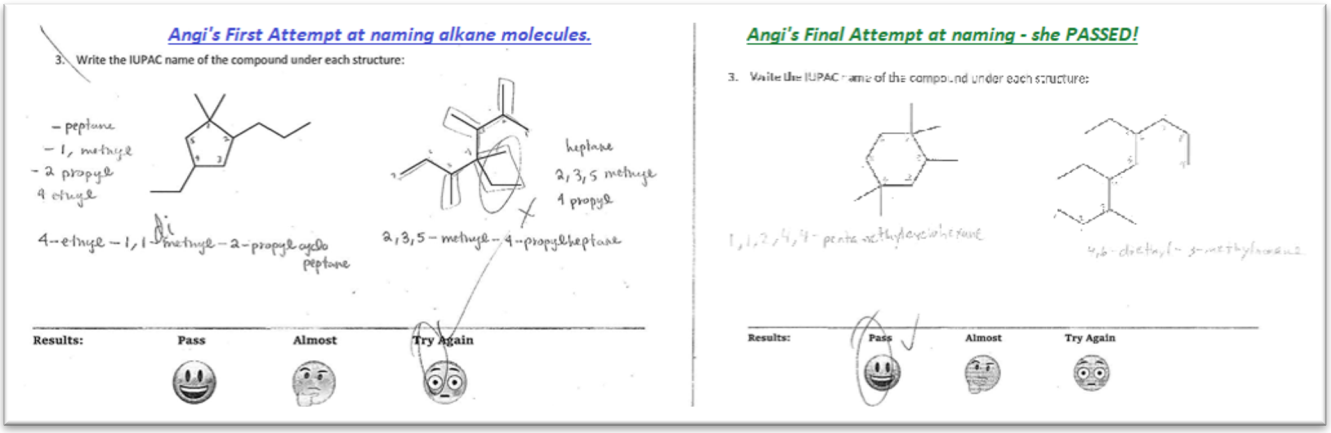

*Figure 2: Example of Quiz Retakes and Student Development Over Time. Note that on the student's final attempt, the student does not write any "hints" for help in the margins of the retake. The student has **mastered** the skill through SG.*

Unsolicited Student Comments on Specifications Grading

> *Specs Grading is one of the greatest gifts a professor can offer a student. I liked the way it allowed us to focus one chapter at a time instead of learning it once…It made me more focused and not as overwhelmed.*

I think Specs is a far superior system because the spec check system allows students to learn the material. I think it is especially important in these gateway courses as majority of the material learned will be needed in later courses.

The specs grading system not only did it give me an opportunity for a better grade, but it actually helped me learn the material and kept it fresh in my mind. Best system ever!

Conclusion

I found the SG methodology to be effective, discipline-agnostic, and simple to understand by students and faculty alike. Because instructors could make personalized choices about their teaching and class policies with SG, I was able to onboard many faculty with varying philosophies and assessment styles. Among the students, SG has become popular because a standards-based system is objective and fair to all invested parties. Moving course assessment towards mastery learning and providing students with multiple opportunities for mastery, with clear communication about expectations, are positive modifications that can impact student learning. At the very least, SG is a worthy exercise in professional development as educators reflect on the roles of course objectives and traditional assessment practices.

References

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