TITLE
Implementing student-centered assessment: motivations, experiences, supports, and challenges

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ABSTRACT
Over the past three years, a community of faculty and graduate teaching assistants has developed within the University of Kentucky Mathematics department centered around the use and development of student-centered assessment methods. In this article, we discuss the environmental factors that contributed to the growth of this community, our motivations for engaging in this work, and the surprisingly consistent successes we have experienced independent of gender or career stage. We conclude by sharing suggestions for experienced instructors interested in building communities around the theme of student-centered assessment methods.

Introduction

Over the past two decades, there has been a major shift in teaching practices throughout higher education. Among STEM disciplines, the degree of change has been particularly strong in mathematics, with a notable increase in the use of active learning, inquiry-based learning, and other student-centered classroom techniques [1,2,3]. This change has been actively encouraged and supported by mathematics professional societies [4,5,6], and many of these changes have been focused on classroom teaching practices. However, assessment practices that are designed to support student learning are equally important; such methods include mechanisms that provide insightful feedback to students about their learning, assign students credit for ongoing engagement with course material, and foster deep reflection by students on their personal growth and mathematical knowledge. Methods such as specifications-based grading, mastery-based grading, standards-based grading, ungrading, and others all share the common goals of serving as assessment methods that go beyond evaluation of students. The use of these assessment methods has been increasing among mathematics faculty and instructors, as evidenced by the recent *PRIMUS* volume on this topic [7]. We will refer to this collection of assessment methods as *student-centered assessment*.

Over the past three years, a community has developed within the University of Kentucky Mathematics department (UK Math) centered around the use and development of student-centered assessment methods that are effective within the context of our institution. This community includes tenure-track faculty (regular title series, RTS), full-time teaching-focused faculty (lecturer title series, LTS), and graduate student teaching assistants

(TA). While our community has been loosely organized and has developed organically, we have all benefited from being part of a larger movement within the department, and we have learned a lot from each other and our respective experiences.

Our goal for this article is to share our experiences with student-centered assessment as a collective response to five questions:

(1) What environmental factors in our department and university contributed to the creation of this community?
(2) What were our motivations for using student-centered assessment?
(3) What were the assessment methods we implemented and why?
(4) What aspects of implementing student-centered assessment did we collectively think were successful for all of us, regardless of gender or employment status?
(5) Based on our experiences, what advice do we have for experienced instructors who are interested in developing student-centered assessment communities at other institutions?

Our hope is that this article will provide other groups of mathematics instructors with ideas for how to create and support a community implementing student-centered assessment in their own department, and also provide researchers in undergraduate mathematics education with a useful case study of student-centered assessment implementation.

Environmental Factors

Because UK Math has a multifaceted educational mission, including doctoral education, undergraduate major education, undergraduate general education, preservice teacher education, and community outreach, there are a wide range of activities and opportunities related to teaching and learning in our department. One of the most important contexts for this work is that UK Math has a history of excellent teaching and a culture that values teaching, including among department leadership. For example, the department is intentional about nominating both faculty and teaching assistants for college- and university-level teaching awards. When hiring faculty, there are dedicated teaching-related activities and discussion included in interview schedules. When recruiting new graduate students, capacity and potential for high-quality teaching is considered as part of our holistic admissions review process. Further, every pre-promotion faculty member and every TA is observed at least annually by a faculty member as part of our teaching observation and feedback program.

For TAs specifically, our department has a faculty member serve as TA professional development coordinator who interacts with graduate students and faculty, and we have a TA professional development plan. This plan includes training goals assigned to TA orientation leaders, course coordinators, and the instructor of our one-credit-hour course on Teaching College Mathematics (required for all new TAs). These training goals include guidance on classroom practices, grading practices, strategies for tutoring and leading small groups, FERPA and other policy information, and course/syllabus design. For both faculty and graduate students, department leadership is intentional when making teaching assignments, thinking

about the needs of each individual and how best to help them develop as teachers. This general culture that values excellence in teaching and supports the development of high-quality teachers has played an important role in the implementation of student-centered assessment methods.

Another important context for this work is that UK Math courses are taught by professional instructors, with only minimal reliance on part-time instructors. As part of a large, public university, we teach many different undergraduate courses to a wide variety of students. Like many of our peer institutions, we teach large, multi-section, coordinated introductory courses, which are the primary focus of our LTS faculty. In our department, LTS faculty are well-respected for the role they play in our department's mission and for their pedagogical expertise. This is an effect of the department's culture of excellent teaching and contributes to the culture of continual improvement in our courses. For example, two of the courses discussed in this article (College Algebra and Precalculus) are large-enrollment, multi-section, coordinated courses run by LTS faculty. Implementing student-centered grading methods in these courses has been no small task, led by faculty off the tenure-track. Because of the departmental culture, LTS faculty feel empowered to take on these big projects. Additionally, the department leadership explicitly supports these projects through summer stipends for course and curriculum development, thoughtful scheduling of teaching assignments to ease implementation, and mentoring throughout the process from senior faculty across ranks. In turn, this work helps to spread inspiration across the department. The faculty and graduate students who are part of the teaching force in these classes see the assessment scheme in action and experience its benefits, without taking on the work and risks of first having to design it completely individually.

Working together in coordinated courses is just one of many opportunities for idea-sharing across faculty and graduate students. Another is our bi-weekly teaching and learning seminar, attended regularly by faculty of all ranks and by graduate students. The structure of the seminar varies, including external speakers, internal speakers, guided discussions, and more. Regardless of the formal plan for the meeting, however, informal discussions of teaching and ongoing projects nearly always continue well past the scheduled end of the meeting. We also have an interdisciplinary working group on Ethics, Equity, Inclusion, and Justice in the Mathematical Sciences (EEIJMS). This group has served as another beneficial source for conversation, as it meets several times per semester and includes faculty and graduate students from UK Math, Psychology, STEM Education, and other disciplines.

Not only are graduate students encouraged to participate in these professional communities, but they also have a variety of opportunities to try out their ideas in their own classrooms. The role of instructor of record is often given to graduate students in the department who ask for an advanced teaching position, typically after serving as recitation leaders for several semesters. These teaching assistants often want to diversify their teaching portfolio, are interested in a career in teaching, and are willing to experiment with new teaching practices to better serve their students. In some courses, such as College Algebra and Mathematics for Elementary Teachers, the course structure is tightly coordinated across sections, giving the TAs less freedom to explore their own interests in course design. However, in courses such as Matrix

Algebra, Problem Solving and Geometry for Middle School Teachers, Probability, and Contemporary Mathematics, there is significant freedom for graduate students to experiment with course design, modes of assessment, and classroom practices. In all of these courses, TAs are assigned a faculty supervisor who serves as a mentor through the course design and implementation process. In general, faculty in the department are open to discussing teaching ideas, issues, and practices with graduate students.

Faculty Motivations and Choice of Assessment Methods

As a result of the teaching community and resources in UK Math, student-centered classroom practices are broadly used. Clickers and think-pair-shares are common in large lectures, our TA-led recitations are almost all designed on a foundation of small group activities, and many instructors use inquiry-based or inquiry-oriented instruction in advanced courses. However, traditional points-based assessment structures remain the norm. Thus it is worth considering both how student-centered assessment practices have made their way into the department and what motivated our faculty and graduate teaching assistants to use them. Interestingly, there is not a uniform narrative explaining how this has come to happen.

The first use of student-centered assessment in our department was by faculty, specifically the two faculty authors on this paper. Ben is a tenured RTS faculty and Chloe is an LTS faculty who joined UK Math in the Fall of 2020. Ben started using student-centered assessment methods in 2019. He describes his motivation for this as follows:

> "In my first ten years as a faculty member, almost all of my personal innovations regarding assessment involved using writing assignments in math courses; I was still primarily using points-based grading systems without opportunities for revision. As I kept hearing more about specifications-based grading, I thought that this would fit with what I had been doing and help my students focus more on learning and growth than performance, so I decided to try it. I spent two semesters using it in graduate courses prior to implementing it at the undergraduate level."

As an LTS faculty member teaching primarily coordinated, multi-section, large-lecture courses for first-year undergraduates, Chloe had fewer opportunities to "test out" student-centered assessment structures on a small scale. Despite this, she was highly motivated:

> "The pandemic gave me the push to change the grading system in the courses I teach and coordinate. I hoped that two of the biggest challenges the pandemic threw at us (academic integrity and mental health of both students and instructors) would be helped by a more flexible, growth-based grading system. I was largely inspired by the book Cheating Lessons [9], and connected through Twitter to Sharona Krinsky at Cal State LA, who had been implementing standards-based grading in multi-section courses."

As a result of this motivation and of having a supportive co-coordinator in Fall 2021, Chloe's first implementation of student-centered assessment was in a large, coordinated, multi-section

Precalculus course. Chloe and Ben's use of student-centered assessment in both graduate courses and in courses involving TA-led recitations brought graduate students into contact with these methods. It is worth providing some detail regarding what methods were used, as this influenced later adoption. Thus, in the rest of this section we will review and discuss the methods we used. It is also important to note that graduate teaching assistants were motivated to use student-centered assessment by experiences extending beyond the UK Math department, as we will explain in the next section.

The student-centered assessment methods used in UK Math generally fall into two categories, with a few exceptions: **specifications-based grading (specs)** or **standards-based grading (standards)**. Both of these are established assessment methods; for more information see the recent *PRIMUS* volume [7], the book on ungrading edited by Blum [11], the book on specs grading by Nilson [12], the grading for growth substack [13], and the forthcoming grading for growth book by Clark and Talbert. In courses for first-year undergraduates at UK, both methods have been used, while in advanced undergraduate and graduate courses, only specs grading has been used. In their first implementations, Ben used specs grading and Chloe used standards grading, though since 2021 there have been multiple variations and combinations of these systems used by different instructors.

In specs grading systems, assignments are split up by category, e.g., online homework, written homework, exams, essays, portfolios, or participation. To earn a particular letter grade in the course, students are required to satisfactorily complete a certain number of assignments in each category by the end of the semester. If their initial attempt at an assignment is not satisfactory, they can revise and resubmit their work. The policies around revision and levels of correctness vary from class to class. For example, some instructors use a Pass/Revise system for marking while others use a more detailed scale such as Excellent/Meets Expectations/Revise/Not Assessable. For revisions, some instructors limit the time allowed for each revision or the maximum number of times any given assignment can be revised.

An example table is given below from the syllabus of a Matrix Algebra course using specs grading. Students' final course grades are calculated using this chart: the minimum score among all categories determines the final course grade. This requires students to make progress in each category to earn a specific grade. For example, in order for a student to achieve a grade of A in this class, they need to submit satisfactory versions of all 4 essay assignments, 10 of the 12 exams, and 12 of the 14 homeworks, complete 90% of the online homework, and have 9/10 credit for participation in the class. If they do not achieve all five of these benchmarks, they receive the highest letter grade for which they do achieve all five benchmarks. The definition of satisfactory is specified for each assignment or exam, and varies somewhat from instructor to instructor.

Grade	A	B	C	D	E
Essays (out of 4)	4	3	2	1	else

Exams (out of 12)	10	9	8	7	else
Written Homework (out of 14)	12	11	9	8	else
Online Homework (out of 100%)	90%	80%	70%	60%	else
Participation (out of 10)	9	8	7	6	else

Specs grading systems have been used in a variety of UK Math courses ranging from courses for first-year undergraduates to graduate courses. In first-year undergraduate courses, it has been used for a contemporary mathematics course whose audience is largely non-STEM students, often with negative previous experiences with mathematics. At the upper-year undergraduate level, it has been used for courses in problem solving and geometry for future middle school teachers, history of mathematics, and several sections of matrix algebra including both honors and regular sections. Finally, it has been used in graduate combinatorics classes taken by graduate students preparing to take a written qualifying exam in discrete math.

The other prominent type of student-centered assessment we have used is standards grading. In this system, a list of standards to assess are developed for the course based on the topics covered. These standards may be content-based, designed to show that a student has mastered a particular topic from the course, or practice-based, designed to encourage habits that will help the student succeed in the course. An example of each type of standard from our precalculus course is given below.

Linear and Piecewise Linear Functions: I can write the equation of a line in point-slope or slope-intercept form when given sufficient information, connect the equation of a line with its graph, and draw or use the graph of a piecewise linear function.

Habits of Mind: Accumulate 500 out of 600+ points for completing daily activities such as completing pre-class activities, attending class, completing recitation activities, or doing homework.

Various assessments are given throughout the semester that allow the students to demonstrate proficiency in each standard. Although standards systems can incorporate revisions, it was used first at UK Math in our Precalculus course, which is taught at a large enough scale for a revision system to be infeasible. In the first iteration of this system, we gave the students five chances throughout the semester to demonstrate proficiency with the standards in various forms, such as quizzes, exams, and projects, and required them to succeed in doing so twice per standard. To earn a particular letter grade, they had to demonstrate proficiency in a certain number of standards in the course. There were 14 content standards and 3 practice standards. An A required proficiency in 15 of the 17 outcomes, with each letter grade below that requiring roughly one less outcome. In addition to precalculus, we are piloting a similar system in our college algebra course, which is substantially larger. That version has fewer content standards

(7) and only one practice standard, and includes only quizzes, no exams or projects. We began by piloting this for 3 semesters in our co-requisite sections for students who need extra instruction time, with the whole-course implementation planned for the upcoming semester.

The current version of the precalculus class has shifted to a hybrid of specs and standards. Like in a specs system, the grade is broken into categories, and a student's final grade is determined by their work in each category. One of the categories is the content standards, which students complete by performing well on at least 2 of 5 possible quizzes. This hybrid separates the content from the practices while still emphasizing the explicit content requirements of the course. For a class like precalculus, this balance is a good fit.

Grade	A	B	C	D
Content Standards Completed	All 10	At least 9	At least 9	At least 8
Projects	Completed at least 2, with the other at least 80% completed	Completed at least 1, with both of the others at least 80% completed	Completed at least 1, with at least one other 80% completed and the last at least 50% completed	Two at least 80% completed at the last at least 50% completed
Habits of Mind Points (attendance, homework, etc.)	At least 80% of the possible points	At least 75% of the possible points	At least 70% of the possible points	At least 60% of the possible points
End of Semester Reflection	Complete the end of semester reflection	Complete the end of semester reflection	Complete the end of semester reflection	

The principal advantage of standards grading is that grades are tied more directly to target learning outcomes compared to other grading systems. The ways we assign grades signal to our students what we value, and standards grading places the content we want them to learn front and center. However, defining the standards requires having, from the start, a fairly precise vision of what material can be covered in a semester, which can be daunting for instructors teaching a course for the first time. This is one of the main reasons many of us opted instead for specs grading, which allows much more flexibility to plan and adjust the course content as the semester progresses. Specs grading also feels like less of a radical departure from traditional modes of grading, since familiar categories of assignments (homework, quizzes/exams, attendance/participation, etc.) are still the core components of grades, even if they are bundled together differently than in a traditional percentage-based weighted grading system.

Building Momentum Through TA Interest and Faculty Support

The fact that faculty started using specs and standards grading does not entirely explain TA interest and motivation for adopting these methods in their courses. Rather, there were four factors identified by graduate students for adopting these methods: taking a course using specs grading, teaching on a team using standards grading, the experience of teaching during the Covid-19 pandemic, and engagement with professional society workshops or other resources.

Two of the coauthors of this article, Camille and Angela, took graduate courses from Ben during his initial attempts at using this system. Camille describes her experience as follows:

> "I took an intense two course sequence in graduate level combinatorics that used specification based grading. I learned and retained more in this class than I did in my classes with a traditional grading system. Ever since taking courses that used specification based grading I knew I wanted to try it in my classroom as well."

Similarly, Angela writes:

> "I took a graduate course which used specifications-based grading and really enjoyed how the revisions process reduced my anxiety around exams and deadlines. I also found that I learned and retained more each time that I revised a problem. From then on, I was excited to implement it in my own classes."

Thus, for both Angela and Camille, personal experience as a student with student-centered assessment generated motivation for using it in their own courses. For Courtney, the main motivator was her experience teaching during the Covid-19 pandemic. She writes:

> "With the pandemic, flexibility with accepting and grading student work became a necessity. Having lenient policies were praised by students, as they saw understanding and compassion by their instructors as a previously unrealized need. I knew that when I had the freedom to make my own policies, I wanted to try something that took the pressure off my students performing and allowed them to focus on learning."

Hunter's path to using specs grading was also different. A key moment for him was serving as a TA in the Precalculus course that Chloe co-coordinated. Hunter writes:

> "I was familiar with various online resources focused mostly on mastery grading, including the repository that Dr. Rachel Weir maintains [8]. I was a recitation instructor in Precalculus in the first semester it used standards-based grading. That experience was very positive and I resolved to push myself to try something independently in the following semester."

As with Camille and Angela, having an opportunity to experience student-centered assessment prior to fully committing to use it played a critical role in Hunter's decision to adopt these methods himself. Hunter's learning about these methods through non-UK-Math resources was not unique. Justin similarly learned about these methods from sources outside the department:

> "I first learned about nontraditional grading systems through the MAA's webinar 'Build a Syllabus: An Introduction to Mastery Grading' in July 2020 and then the 'Alternative Grading' Slack workspace. My motivations for trying specs grading were that specs makes it very clear to students what they need to do to earn each letter grade, specs frees me up to provide detailed feedback, and the opportunities in specs to submit revised work reward students for their growth."

Once these various motivations were in place, it was important that UK Math had multiple course coordinators and TA supervisors willing to have TAs use these methods in their courses. One of the reasons for this willingness and interest in supporting student-centered assessment was that the faculty in these roles were familiar with the topic, due to ongoing discussions at the teaching seminar, EEIJMS working group, among course coordinators, and beyond. Thus, having a supportive department environment and culture in place expanded the range of opportunities for TAs to implement these methods in their own courses.

Successes

Though we experienced various challenges using specs and standards methods, we consider our experiences implementing student-centered grading to be successful and worthwhile. Further, we found that some successes were experienced by everyone in our community, regardless of gender or career/employment status, and these were among the most important positive aspects of student-centered assessment for us.

One of the standout aspects of specs and standards grading is that these methods establish a more consistent schedule and expectations for both students and instructors. In college mathematics courses, historically there are a small number of high-stakes exams that students "cram" for before they move on to the next high-stakes exam in a different course. It is well-understood [10] that this style of infrequent, high-stakes assessment does not support deep learning. Instead, deep learning is cultivated through frequent, low-stakes assessment. Both specs and standards grading align naturally with this assessment structure. Since each week in one of our courses is similarly structured to every other week, students can get into a rhythm with a predictable workflow that avoids extremely stressful ebbs and flows to the course. In our experience, students explicitly respond with appreciation and acknowledgement for how this supports their mental health and decreases test anxiety.

Another success we collectively experienced was that students have strong buy-in to these assessment methods, and respond with excitement about having expanded opportunities to learn and to demonstrate their learning. For many of our students, and for many of us instructors when we were students, assessment is typically something that occurs after learning, where learning is evaluated. However, assessment can and should be more intricately connected to and aligned with learning. In our courses, our students recognize that this is happening! They sense through not only our words, but our actions in choosing to use specs or

standards grading, that we want them to authentically learn. This has a positive effect on their motivation and effort.

Other successes that we all experienced have to do with workload and classroom culture. Because the specs and standards grading systems give students more agency over the grade they receive (by providing clear and ongoing feedback about what they need to do to earn a particular grade), students can more proactively decide how to invest their time and energy. For example, if a student has a goal of receiving a B in our course, once they have met the requirements for a B grade they can choose not to submit additional work. As a result, when everyone is feeling the most tired and stressed at the end of the semester, our courses function as a pressure release valve. To be clear, in order to reach this point, the students need to have done a lot of work and learned a lot of mathematics by the last few weeks of the semester; the point is that this hard work and authentic learning results in students having more options regarding whether they want to continue investing in our course for a higher grade, or prioritize other courses. From the point of view of the instructor, this also means that we have a somewhat lighter grading load at the end of the semester, and it eliminates all student requests for extra credit and minor disagreements over how many points were given for various problems.

The effective elimination of extra credit requests and the large increase in student requests for learning-focused help are two examples of how conversations around grades shift as students come to understand these grading systems. Because students know they still have opportunities to demonstrate their learning through additional quizzes or revisions, the easiest way for them to get the grade they want is to just learn the material. They don't have to ask for anything extra. Conversely, the feedback about grades that instructors give can be more positive. In a percentage-based system, we often have to inform some students in the middle of the semester that it is no longer possible for them to get an A, or possibly even to pass. In these student-centered grading systems, however, not only can students continue to work to learn the material they need and thus increase their grade, but also instructor feedback can be more tangible. Instead of telling students that they just need to do better on the exams, we can invite students to office hours to discuss, for example, inverse trig functions before the next quiz attempt because we see they are still having trouble with that very difficult topic.

In a less tangible way, yet still something we all experienced, specs and standards grading contribute to a classroom culture where students are open to accepting and providing help and support. It is acknowledged in the structure of the course that errors will occur as part of learning, and that revisions allow students to receive credit for learning from their errors. As a result, compared to our previous teaching experiences, our students are more open about their errors and misunderstandings and, in some classes, more active in helping their peers when someone is struggling.

Suggestions for Building a Student-Centered Assessment Community

While our community developed somewhat organically and from multiple catalysts, we have been led to a variety of important take-aways for faculty or other experienced instructors interested in building a community around student-centered assessment.

Culture matters.

This community developed within a department culture that was already supportive of student-centered teaching practices. Our teaching seminar, EEIJMS working group, coordinated teaching teams for first-year undergraduate courses, support and respect for teaching-focused faculty, and intentional planning for TA development all were important ingredients to our success. If these or similar types of support structures are not in place, establishing them is a good first step toward building a community.

Create teams and get support from your department.

We each benefited substantially from talking with peers and colleagues about our course design and ideas. If it is possible to get a few collaborators on board, even if you are not teaching the same courses, this will make the experience more enjoyable and generate better ideas for how to navigate the challenges that arise. If a TA or pre-promotion faculty member wants to implement student-centered assessment individually, having a supportive mentor or department chair (even if they haven't used these methods) will increase the likelihood of success.

Provide TAs and junior faculty with experiences in student-centered assessment.

One of the major factors that caused our community to grow was having multiple opportunities for TAs to experience student-centered assessment. As previously mentioned, some of our TAs took graduate courses using specs grading, while others served as TAs for a standards-based Precalculus course. Creating opportunities to directly experience these assessment methods allows TAs and junior faculty easy entry points to learn how these methods work.

Keep the system simple, especially at first.

While some experienced instructors have developed detailed systems for how to implement specs and standards grading, for example involving things such as tokens or homework passes, we have found that keeping things as simple as possible has tremendous benefits. Specifically, simple systems are easier for the students to understand, and thus easier for them to buy into. They are easier for instructors to maintain, and easier to manage for TAs and instructors using these systems for the first time. While there are some compromises that might need to be made in order to keep things simple, we are big believers in this.

Develop revision policies that are realistic for your course and department context.

While it is important to keep things simple, it is also important to have some guide rails and policies in place to manage the revision submission and grading process. These are best

decided prior to the start of the semester, as part of the course development stage. One of our main recommendations is to limit the amount of revisions that students can submit.

We've tried various policies, from requiring that revisions are received within seven days after graded assignments are returned, to requiring that each week revisions must all come from a single homework assignment, to having a limited number of revision attempts per week. This also encourages students to make good faith efforts on their first attempt, rather than relying too much on revising incorrect work later. It is also helpful to require students to provide some level of explanation in revisions, to show their understanding of their previous mistake and the new work that resulted. This also helps incentivize students making their best effort to do the problem correctly on the first attempt. If you are supervising TAs in a course using these systems, make sure that everyone has a clear understanding of what the revision policies will be.

Be aware of complications in large-enrollment courses.

Our large-enrollment courses involved unique challenges that were not shared by the small-enrollment courses. First, the large enrollment meant that the grading load was too substantial to allow a significant number of revisions. Second, when teaching on a team that involves multiple faculty and TAs, the course coordinator has to train not only the students in how the system works, but also the members of the teaching team. This adds an extra dimension of training that has to be done in advance of the start of the semester. Finally, some of the members of a teaching team might have had prior negative experiences with specs or standards grading, and thus there are buy-in issues that arise with the teaching team as well as the students. In our department, we have had success in devoting a year to piloting specs and standards systems in one or two sections of a multi-section course prior to full implementation.

As always, consider how you will respond to student cheating.

The usual challenges regarding cheating arose with this system, though in our experience the lower-stress structure helped to alleviate this to some degree. Also, since our systems typically used more frequent in-class assessments, there was some administrative work to determine how to manage absences and make-up quizzes. This also led to some challenges arranging alternate testing environments for students supported by our Disability Resource Center. It is important that everyone involved in using these methods understand that they are not a magic cure for all course challenges.

Share examples of clear and unclear problem prompts.

When using a grading system where everything is done on a pass/revise basis, it is important for both students and instructors to know what the criteria are for a pass. In particular, if there is a specific observation you want students to reach, or technique that you want them to use, make sure that the problem prompt makes this clear. Several of us have written problems with which we wanted to assess a specific item, but the problem was interpreted by students in an

unexpected way, which led to revising the prompt for the problem after it had been distributed (and sometimes after solutions had been turned in). It would have been helpful for everyone involved if we had thought to share and discuss examples of both clear and unclear problem prompts.

Discuss plans for checking in with students and helping them track their progress.

Instructors and TAs should plan an early semester check-in with students to help them understand the grading system and try to get everyone on the right track early. For larger courses, it is possible to send individual updates on progress (e.g. Mailmerge emails). In our experience, we receive many more responses to individual emails than to coursewide announcements.

By far the most universal, and most consequential, challenge that we faced was sharing grades with students. UK Math uses Canvas as our course management system, and none of us have been satisfied with the ways we recorded the grades. For example, with specs grading, if we are grading individual problems but multiple problems are being submitted on each homework (uploaded directly to Canvas), then how are the pass/revise grades recorded? Some of us created a separate Canvas assignment for each problem, while others developed a system where the grade for the assignment consisted of a string of “P”s and “R”s in the same order as the problems, with a separate column containing a running total of the passes. Others tried variations on these methods, but in general they were either flawed or confusing to one degree or another. This is a general problem for users of specs grading, and various ad hoc practices have been developed to make Canvas functional in this context [14].

There are other ways that we can help students track their progress. For example, several of us (inspired by an idea from Justin) who are using specs grading create a chart with checkboxes for each assignment in each category to help students compute their grade and visualize their progress. This allows students to print off their progress page and fill it in as they accumulate passes. One warning when using a checkbox chart is that students tend to think each checkbox corresponds to a particular assignment. Thus, it is important to clearly communicate to students the relationship between the chart and the grading system.

Be intentional in connecting assessment methods with classroom practices.

Student-centered pedagogical practices, such as collaborative learning, flipped classrooms, group work, think-pair-share, and other active learning practices, have had a steady increase in use by mathematicians. These practices are used to engage students at a higher level, and to increase students’ level and use of metacognitive skills. Student-centered assessment such as specs and standards grading complement these classroom practices. When designed in a way to intentionally reinforce each other, these two aspects of teaching can create a rich and supportive classroom environment for students.

Emphasize that student-centered assessment is worth trying.

While these assessment methods are not a magical solution to all the difficulties in teaching and learning, their positive impacts are worth the initial time and energy needed to design and implement them in your courses. We and our students have all had richer, better learning and teaching experiences using student-centered assessment, and we hope that you will as well.

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