

Student Experiences of Active Assessment in Undergraduate Mathematics

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Active-learning-based instructional practices are well-established in undergraduate mathematics. What it means to align assessment with those active learning methods is an emerging area of research and development. Here we present student experiences of “active assessment,” assessment strategies grounded in the values and practices of active learning. As part of a larger study, we gathered undergraduate student responses to survey and semi-structured focus group interview questions about their experiences with various active assessments. Their instructors all were part of a year-long Assessment Community of Practice focused on active assessment. In this paper, we focus on student-identified benefits of active assessments, as well as student perceptions about how the assessments were equitable or potentially inequitable. We conclude with suggestions for instructors and discussion of considerations for moving forward.

Keywords: active assessment, active learning, student experience

What does it mean for assessment to be aligned with the values and practices of active learning? The benefits of active learning for students in college level mathematics courses are well-documented (Freeman, et al., 2014; Theobald, et al., 2020; Uhing, et al, 2021). However, little is known about how to align assessment practices with the methods promoted for active teaching and learning. *Active learning* has been defined broadly as instructional methods involving students in doing things and thinking about what they are doing (Bonwell & Eison, 1991). Our consideration of active learning includes Laursen and Rasmussen’s (2019) four pillars of inquiry-based mathematics education (students engage deeply with meaningful tasks, students collaboratively process ideas, instructors inquire into student thinking, and instructors foster equity in their choices). Consonant with these methods, we have defined *active assessment* based on a consolidation of ideas including active learning, formative assessment, and alternatives to timed, high-stakes individual exams. Our working definition of active assessment was developed across a year of work by an instructor Assessment Community of Practice.

Active assessment captures student progress and facilitates growth in the journey through mathematics. Active assessment is a process that sets high expectations and supports meeting those expectations. The process is rooted in

- engaging student understanding more equitably,
- reinforcing communication, reflection, and collaboration, through mathematically rich tasks,
- valuing diversity in expression while being asset-minded, and
- giving students the opportunity to share, learn, and expand on ideas as a community.

Examples of active assessment include group projects and presentations, exams with a group or collaborative component, variations on standards-based grading, and portfolios. This paper presents student experiences of several of these forms of active assessment. The driving question for the larger project is: What are the benefits that students and instructors identify in the

implementation of specific active assessment strategies? Here we report on analysis of a subset of data aimed at addressing a particular question about student experience. *Research Question:* Among students who participated in at least one group-based active assessment, what did they identify as benefits and what did they point to as equitable (or not) in working with others to complete the assessment?

Conceptual Framing

We draw from Black and Wiliam's (2009) definition of formative assessment and Laursen & Rasmussen's (2019) definition of inquiry based mathematics education in framing this study.

Formative Assessment

Black and Wiliam (2009) give the following definition of formative assessment which highlights how teachers, learners and their peers are involved in formative assessment:

Practice in a classroom is formative to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited.

They elaborate on this definition by introducing five strategies that were developed by crossing the three different agents (teacher, peer, learner) with Ramaprasad's (1983) three key processes for learning (see Table 1).

Table 1. Aspects of formative assessment from Black and Wiliam (2009).

	Where the learner is going	Where the learner is right now	How to get there
Teacher	1. Clarifying learner intentions and criteria for success	2. Engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding	3. Providing feedback that moves learners forward
Peer	Understanding and sharing learning intentions and criteria for success	4. Activating students as instructional resources for one another	
Learner	Understanding learning intentions and criteria for success	5. Activating students at the owners of their own learning	

While elements of active assessment are formative, assessments also may serve as summative for a course or unit. Of particular interest to this study is strategy 4, *activating students as instructional resources for one another*. We explored the ways in which students are "activated" in this way by examining the elements of the active assessment process that students identified as beneficial, equitable, and potentially inequitable.

Four Pillars of Inquiry Based Mathematics Education

The Assessment Community of Practice was conceived in an institutional context that has a strong commitment to active learning. The active learning values of the departmental community were strongly aligned with the four pillars of inquiry based mathematics education (Laursen & Rasmussen, 2019). These four pillars are:

1. Students engage deeply with coherent and meaningful mathematical tasks.

2. Students collaboratively process mathematical ideas.
3. Instructors inquire into student thinking.
4. Instructors foster equity in their design and facilitation choices.

The four pillars did not originate in a context where assessment was considered explicitly. Nonetheless, they deeply influenced the ACoP's definition of active assessment. In this paper, we focus on the second and fourth pillars: students' reported experiences of how they collaboratively process mathematical ideas and their self-reports about perceived equity and inequity in the active assessment process.

Methods

Data for the study was collected through a two-stage process during the Fall 2023 through Fall 2024 semesters. In the 2023-24 academic year, we received a total of 278 survey responses from students in 13 different lower and upper division undergraduate mathematics courses, taught by 8 participating instructors who implemented active assessment strategies. This represented 59% of all students enrolled in those courses. Stage 1 data consisted of written responses to a survey administered during class time towards the end of the semester. Questions asked the students to share their experience with the active assessment strategy implemented in the class that they took, and to identify potential benefits or inequities of the strategy. Stage 2 data were from semi-structured focus group interviews with a subset of 18 of the 278 students who had completed surveys. At least one student from 9 of the 13 courses surveyed was in one of the four focus group interviews. The group interviews were completed across Spring 2024 (5 students and 2 students) and Fall 2024 (6 students and 5 students). Each interview lasted approximately 60 minutes. The interview questions were designed as follow-ups to the stage 1 survey and discussions focused on students' experiences with active assessment.

All data analyzed for this report were qualitative, from open-ended survey and interview prompts. The unit of analysis was a "student response." For the survey, this unit of analysis was the entirety of a student's answer to a survey question. For the focus group, a "student response" was everything a student said in response to a prompt (from the interviewer or from another student). Analysis of student responses was through the inductive constant-comparative method commonly used for qualitative data interpretation (Patton, 2014; Creswell & Creswell, 2018). The inductive hypothesis was that the categories for coding came from the prompts (e.g., the categories of benefits and equitable/inequitable experience). For the surveys, thematic coding was completed by three authors. Each person coded a subset of responses (about 20), then they compared and calibrated their coding. This cycle continued with larger subsets until all responses had been coded for the surveys. A different subset of three authors completed a similar coding and calibrating cycle for the transcripts of the focus group interviews. Next, key themes were identified across coding of student responses from the written surveys from stage 1 and the interview transcripts from stage 2. We report here on this analysis.

Researchers

All of the researchers have experiences of active assessment as students, in undergraduate mathematics courses, graduate courses and/or post-graduate professional development. In the context of undergraduate courses, some of the researchers have experience implementing active assessments as instructors of record and some plan to in the future. Our research team includes one faculty member and three current/former graduate students, each of whom worked on the project for at least one year and contributed to analysis for at least one of the stages.

Results

We present student experiences of active assessment strategies first from the survey and then from the focus group interviews. Students shared benefits and challenges about active assessments that involve collaborative group work, offering insight into how they saw these strategies as impacting their learning, confidence, and sense of equity. The key themes touch on collaboration, access, group dynamics, and equity, highlighting strengths and limitations of active assessment from the student point of view.

Student Survey Results

The two main survey questions we focused on for this report were:

1. Please give an example of something about the [assessment strategy] that you think is beneficial for students? and,
2. Please give an example of something about the [assessment strategy] that you think might be unfair or inequitable? Why?

Of the 268 responses to the first question, the most frequently identified benefit of an active assessment strategy was collaboration, with 85 student responses (31%) mentioning it. For example, one student wrote, “They allow students to share their knowledge and come together to solve problems. Multiple sources of input helps because maybe one section is particularly challenging.” The next most frequently identified benefits were applications and reflection/review, each with 21 student responses (8%) mentioning these aspects as beneficial. Other identified benefits included less stress, building experience, feedback, and the opportunity for demonstrating knowledge. The vast majority of responses identified only one benefit, but several longer responses identified more than one benefit.

On the other hand, among those who responded to the second question, the most commonly identified potential inequity of the active assessment strategies was unequal work, with 76 responses (27%) identifying unequal work distribution as a potential source of unfairness. These comments were similar to the student who wrote, “With any group, there tends to be at least one person who doesn't do much work while there is someone who does too much.” The second most frequently identified inequity was format/accessibility, with 23 student responses (8%), and the third most frequent response was group dynamics (not related to unequal work distribution), which appeared in 18 responses (6%). Other identified inequities included time/pacing and workload. Finally, 44 students (16%) said the strategy they experienced was not inequitable.

Student Interview Results

Students' perspectives were also gathered through focus groups. The interviews offered glimpses into how students defined equity, perceived the benefits of group-based assessments, and how they identified the assessments as equitable or potentially inequitable. Students also suggested improvements for future implementation. The following sections present key themes that emerged from the focus group interviews.

Student definitions of equity. During the focus group interviews we asked students to define equity in their own words. This gave additional context and meaning to their replies to later questions regarding the ways the assessment strategies they experienced were equitable or not. The common themes that arose in their responses were access and accommodations. As one student stated, “[Equity means] a level playing field for everyone.” This was echoed by a student in a different focus group stating “The definition of equity is being able to allocate more toward those who are in need.” In another group, a student said,

I think equity has a lot to do with I guess access for me. Like, if you have access to these certain things or certain... Not learning strategies, like... Access to these different modes or these different styles and different learning. Different kinds of learning, right?

which was then backed by another student who said,

For my definition of equity it would probably be, to be able to accommodate as large of an audience as possible. So pretty much not leave anyone out, be beneficial to everyone. Students' definitions of equity provide a meaningful lens through which to interpret their experiences. Some students saw benefits as being an indicator of equity, and there was significant overlap in responses to questions about benefits of active assessments and what students indicated was equitable.

The beneficial impact of active assessment. A main theme that emerged from the interviews was the academic benefit of learning from peers. Students often described how working collaboratively exposed them to different ways of thinking.

And also you could learn more from the group, because sometimes like you think you're doing it right, for example a lot of graphing for that one and you know sometimes it's just like those small things where someone could actually walk through it and be like, oh, actually I think this, you know, two brains are better than one, you know?

Another benefit students identified was the shift in students' mindset and confidence in problem solving. Rather than viewing assessments with anxiety or dread, some students reported that group assessments had changed their perspective to be more agentic:

Students are not thinking of [math course] as like... it's a terrible exam. 'How am I going to do? What am I going to do?', that perspective changed to 'Okay, I'm going to figure it out. I got this exam.' So that change of perspective is what I observed within me, my friends in that class and all other people as well.

Group dynamics also played a positive role for many students. Several students emphasized how collaboration allowed for a safe environment to make mistakes and learn from them.

When you do it in a group environment, you're allowing for that mistakes that happen. And with those mistakes, they get more confident in their answers, they're like, oh I know exactly what I'm doing now, I learned from my mistakes.

Furthermore, shared responsibility was reported as beneficial:

I really found that effective uh because like for me as well as for others, because people... felt confident they feel comfortable in that setting and then that eventually helped them. also serving to motivate students to engage more deeply with the material:

I also observed that a few people from my group, they actually started putting more efforts in the group when they became a part of this... since everyone is answering questions, I need to put more efforts on myself. Maybe I need to study more so that even I can share answers or even I can help others to get solved and then maybe a few doubts which I have, others can help me with that.

These themes, exposure to other ways of thinking mathematically, an agentic perspective, increased support for risk taking, and the motivational benefit of shared responsibility captured what 14 of the 18 students (78%) said related to benefits. The students whose responses were not represented by these themes focused on reduced stress around grades, opportunities to "think outside the box" when demonstrating knowledge, and instructor support.

The inequities of active assessments. In addition to benefits, students also identified aspects of the assessment strategies that were potentially inequitable. Students identified challenges that raised questions about fairness, accessibility, and the burdens placed on certain individuals

within groups. One theme that arose was the shared responsibility of group work and having to rely on one's peers, particularly in groups where interaction was strained.

For the project I did, a big barrier was not working well with team members, if they don't show up or you don't get along, it's hard to do the work. Unlike an exam where you rely on yourself, the main challenge here is working with others.

Another inequity that many students identified was the discomfort that group interactions might have for students with social anxiety.

I've noticed that some people maybe they want to like, say their point of view out loud, but they just don't feel comfortable. Or, or yeah I guess they don't feel comfortable enough to talk about it as a group, maybe they might be afraid of how they might be judged. Maybe if it's wrong, they might overthink it and assume the entire group is gonna think they don't know what they're talking about.

Additionally, some students also acknowledged the potential to “ride the coattails” of their peers in a group setting.

For mine, I like for sure rode the coattails of one of the dudes in our group, like I mean because math in like upper division takes a lot of time to study and some of these I feel like should be year long courses. So when I was able to study and prepare, I was contributing well.

These themes, interpersonal dynamics, discomfort and social anxiety, and unequal contributions to group work captured what 14 of the students (78%) responded in relation to inequities. While other concerns brought up included fairness of grading and time commitments, not all of the 18 students identified any inequities for their assessment strategy.

Student Suggestions for Next Time

As part of the survey, we asked students “If you could give advice to an instructor who was going to use this strategy in a future class, what would you want them to know?” Students identified areas of opportunity for instructors to combat the challenges that may arise with active assessment strategies. Student suggestions included:

1. Develop and communicate clear rubrics outlining specific expectations for active assessment tasks, as students noted that the unfamiliar nature of these strategies often introduced ambiguity in grading criteria compared to traditional assessments.
2. Integrate structured icebreaker activities to support the development of positive group dynamics and mitigate the social complexities associated with collaborative work.
3. Allocate additional in-class time for group collaboration, which students identified as a means to foster stronger peer connections and reduce the logistical challenges of coordinating meetings outside of class.
4. Incorporate a system of accountability within group assessments, such as peer evaluations and periodic check-ins with the instructor, to ensure equitable participation and sustained engagement.

In the focus group conversations and survey responses, student suggestions conflicted or students identified tensions in their preferences for how the active assessments were structured or implemented. For example, some students preferred randomly assigned groups while others said it “felt more comfortable” working with people they chose to work with. Similarly, some students preferred keeping the same group throughout a term, while others noted benefits from working with different peers. One-third of the focus group participants and about 9% of survey respondents indicated that they would like to be able to choose between assessment strategies (e.g. project or traditional exam for a particular unit).

The survey results indicate that despite the potential inequities they identified, students overwhelmingly preferred active assessments to timed, individual exams, with 79% of students stating that, given a choice, they would choose the active assessment compared to 16% who would choose a timed exam. Other students would choose both forms of assessment, or neither.

Discussion and Recommendations

While the majority of students reported meaningful academic and motivational benefits from active group assessment, their reflections also revealed important concerns. Despite the potential for deeper learning and confidence, experiences in collaborative settings were not universally positive. Student reflections highlight the complexity of group-based active assessments. Though some students reported finding them academically enriching and confidence-building, others encountered challenges that raised concern about equity. These tensions point to a need for thoughtful implementation, reflection, and ongoing improvement.

Some concrete suggestions from students to instructors look to alleviate the social complexity of working in groups and develop stronger relationships among peers. At the same time, students came to active assessments more familiar with individual assessments. Thus, their suggestions emphasized the importance of being graded for their specific contributions and being able to hold groupmates responsible for doing a fair share of work.

Not all challenges in implementing active assessment have straightforward solutions or recommendations. We note that different grouping strategies might work better for particular courses and contexts. Instructors may choose to poll their class to give the class more agency in determining group structures, or give some choice (e.g. choose one person you want to work with) within a more randomized system. Also, student preference for the option to choose among active assessment formats may raise additional concerns about equity in grading and opportunity.

A major ongoing topic of discussion for higher education is how to accommodate and support students who have extensive outside of class obligations or other personal reasons for being unavailable to engage in collaborative assessment activities that call for outside-of-class work. This is particularly relevant at our institution where many students work full time outside of the university, are nontraditional students, and commute to campus. The challenge of collaborating with peers who are not always present came up repeatedly for students, even as many of them found collaboration to be a primary benefit of active assessments.

Topics not raised by students in the interviews, but important for continued research and development of active assessments include: strengths and contexts of multilingual students, considerations for accessibility and accommodations, and adaptability to changing technology.

Each group of students is different. There is no one right way to make an active assessment perfectly equitable. Our conceptualization of active assessment is aspirational, and implicit in its definition is ongoing revision and response focused on making assessment equitable in a specific context. In the words of one student focus group participant: “Maybe it's impossible to have like, equitable classroom[s]. Lovely in theory, but it's just almost impossible to do. Okay. But I appreciate the efforts.” Student participants overwhelmingly preferred active assessments, though imperfect, and identified a number of benefits. This research suggests that active assessment has potential to imperfectly move toward equity.

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