JDEI CD Report General Chemistry, CH 221-223

The Chemistry Department has previously designed and is currently using a robust series of quiz modules called Quests. These Quests are formative assessments designed based on principles of equity minded and inclusive teaching practices. During the pandemic, the department worked to digitize Quests allowing for their use in online or hybrid teaching as well as in a traditional classroom setting. Currently Quests are designed so that students can repeat the quiz multiple times and each time they will be provided with a new set of randomized questions. The implementation of a "low stakes" method for assessment has been shown to serve underrepresented student populations in STEM (Cotner, 2017) and the use of digitized testing has been demonstrated to increase access.(Brouwer & McDonnell, 2009) One limitation to our current assessment method is the lack of feedback and direction. When students input an incorrect answer, they are able to see that they got the question incorrect but may not understand why. Traditionally students would either attend office hours or tutoring for additional direction. It has been demonstrated that students from historically marginalized populations may be less likely to utilize or have less access to educational resources including tutoring (Le, 2020). Our goal is to support students who may have less opportunity for access to traditional feedback by building a "feedback" section into each of the questions on the digital Quest platform. We believe that increasing access to real time feedback within these resources will help students develop a better foundation in chemistry and allow them to score better on their exams. Ultimately these students will develop better problem solving and critical thinking skills which will provide them with the opportunity for greater success in future stem classes. Ideally this will lead to an increased level of student retention and advancement of underrepresented groups in the STEM fields.

To begin, we reviewed each category of questions in the Moodle test bank and added general feedback to any of the questions asking students to calculate a value, enter a short answer, apply a concept, etc. We did not provide feedback for categories with multiple choice questions, as those tend to be knowledge-based questions and students can review the answer options and use their textbooks to determine the correct answer. We attempted to provide general feedback, referencing resources in the textbook, when possible, as well as steps needed to solve the problem without giving the answer. Additionally, we have had some issues with images not copying from one Moodle course to another because of the copy and paste method of including images when the questions were created. ATC advised us to save images, and use the image icon to add them. This also created the opportunity to write alt-text for each image because the images from the textbook test bank lacked any alt-text descriptions. Moodle limits the image description to 125 characters, let me say, it's very difficult to describe scientific images in 125 characters or less. In some cases, a series of graphs needed to be separated into two different images in order to properly describe them. Interpreting data from graphs and analyzing molecular diagrams are course objectives so eliminating the images was not an option.

To organize our work, we reviewed each question category and listed the categories in a shared Google document with the quest #, the category title, the suggested feedback and who was responsible for each. Initially, we worked together to craft the feedback, then in order to be more efficient as the terms continued, we divided up the categories, drafted the feedback, then met to edit it. This also provided a good opportunity to make sure the questions in each category

matched the category title and we moved questions as necessary. We also rewrote some questions and altered the question type to provide students with more immediate feedback. Our question bank is now much more organized and this will benefit all students in general chemistry and engineering chemistry. The categories are organized by quest (quiz) number with subcategories specific to the topic, such as density calculations or unit conversions, multi-step with work. Having subcategories will allow all instructors to more efficiently use questions in the test bank and adapt for their specific course needs. While the project was specific to general chemistry, CH 221, 222, and 223, the topics from this sequence are part of the newly developed chemistry sequence for engineering majors, CH 201 and CH 202. All of the feedback developed in the project is also being used in the engineering classes.

Students in the general chemistry series were surveyed about the benefits of this project to them using a 5 point Likert scale 1 being “Strongly Disagree” and 5 being “Strongly Agree”. Of the student respondents 83% felt that the quests helped them learn and prepare for the in-class exams. They overwhelmingly (83%) preferred having the feedback boxes integrated into their course work. Many of the students surveyed stated that scheduling and time limitations were obstacles to seeking help and 72% felt that the real time access to feedback was a helpful resource for their success. Students overwhelmingly (100%) responded that they would like to see this type of feedback expanded into more conceptual type questions in the future.

Our goal was to develop a robust integrated digital feedback related to problem solving assignments for our General Chemistry quests. We edited over 150 question categories each of which contained multiple problem sets. Working within the Moodle substructures was challenging, for this project, once we had written the feedback, we had to copy and paste it into each individual version of the question. While this was monotonous and time-consuming work it allowed us to develop a test bank of questions with feedback that can serve as a “Master Class" for each of our general chemistry courses. Other instructors in the chemistry department have been provided access to the JDEI modified Moodle shell and can integrate test bank questions with feedback into their current course Moodle sites.

We believe that this project has been a positive support for our students taking general chemistry. Not only do they have access to a robust series of formative assessments they also have immediate feedback. The development of our project into a Master Class moodle shell has reduced barriers for other instructors implementing this type of formative assessment with immediate feedback into their courses. We currently have one of our adjunct faculty who has integrated the master class into their courses.

Moving forward, we will continue to revise the feedback as needed. As new questions are developed and the test bank expanded, we will continue to include general feedback for new questions.

CH 221: 65 categories
CH 222: 32 categories (fewer total but many more images than CH 221)
CH 223: 65 categories

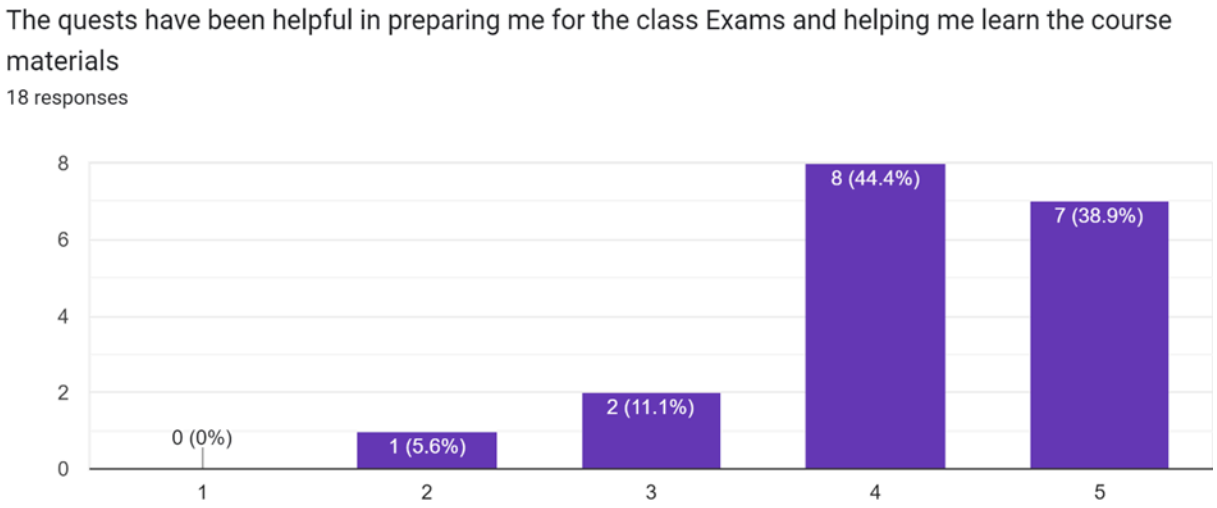
References:

Cotner S., Ballen C. J. (2017) Can mixed assessment methods make biology classes more equitable? PLoS ONE 12(12): e0189610. https://doi.org/10.1371/journal.pone.0189610.

Brouwer, N., & McDonnell, C. (2009). Online support and online assessment for teaching and learning chemistry. In Innovative methods of teaching and learning chemistry in higher education (pp. 123–152). The Royal Society of Chemistry.

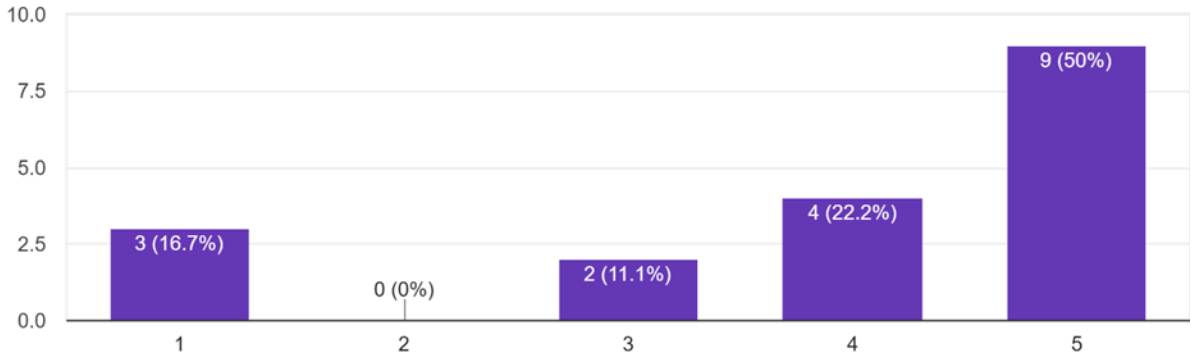
Le, C., Pisacreta, E. D., Ward, J. D., Margolis, J., & Booth, H. (2020, October 1). Policies to Ensure Equitable Access to Well-Resourced Colleges and Universities. https://doi.org/10.18665/sr.313963

Selected survey questions



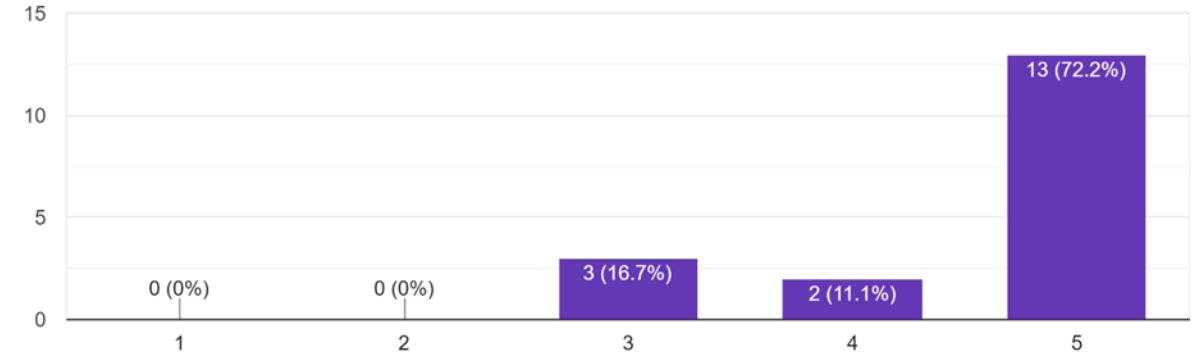
Having real time access to the feedback on specific questions has been a helpful resource

18 responses



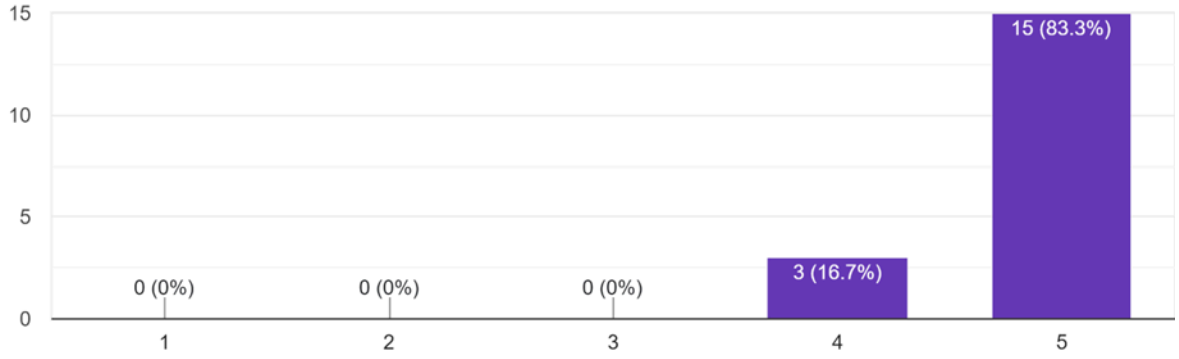
I prefer having the yellows "feedback" boxes when I take my quests.

18 responses



Currently feedback is only available for show your work style problems in the future would you like to see the quest feedback expanded to more question types

18 responses



What are some limitations to you being able to get help for the course (select all that apply)

18 responses