Student questions: SESE postdocs colloquium:

Christine O'Donnell: "A New Model for Culturally Responsive Citizen Science-Based Curriculum"

9/15/21

Is this Curriculum aimed at a specific demographic or age group? Thank you!

> The particular curriculum I described is targeted towards general education college science courses, which is generally a very diverse population demographically. When recruiting instructors to pilot the materials, we did hear from several interested high school teachers, and I think these activities could work well in those settings as well. However, our IRB (i.e., ASU's institutional approval for studies involving human subjects) only extends to adults (people 18 years or older), so we are not currently conducitng pilot testing in high school courses.

How does a culturally responsive teacher discipline a student?

> Being culturally responsive doesn't mean you need to change course norms like having high (but well explained and scaffolded) expectations, assigning grades, etc. However, I would encourage all instructors, regardless of whether they adopt culturally responsive strategies, to have empathy for students and consider strategies like reaching out to students to work with them to identify any factors affecting their course performance before taking any severe actions.

Do students or staff seem disturbed by inclusivity in STEM? If so, how do you explain that it is beneficial?

> I'm not sure what is meant by "disturbed" here, but one of the areas of resistance that I've encountered is around the idea that STEM (especially topics like physics or astronomy) are objective – they're the "TRUTH" of the Universe, and so there shouldn't be a need to discuss any of these "subjective" things like feelings or beliefs. However, the myth of objectivity in science and education has been critiqued for decades (e.g., Mitroff 1972 and O'Brien 2004). In short, who we include in our science course (Newton, Einstein, Galileo) and how we talk about them (as lone individual scientists, which both ignores the collaborative nature of much science research but also ignores these scientists' lived experiences, such as the discrimination Einstein faced for being Jewish) is a highly biased and incorrect practice. Moreover, the history of science and what topics are prioritized is significantly influenced by other sociocultural factors (e.g., the history of the study of energy was in part driven by the Industrial Revolution, which led to many harms against Indigenous populations). Recent critiques include Chanda Prescod-Weinstein's "white empiricism" framework which explicitly calls out the dichotomy between how physicists dismiss the lived experiences of Black women in the field but simultaneously accept the premises of string theory without any empirical evidence.
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> In terms of explaining how inclusivity is beneficial, depending on the context, I will often point out examples like the ones listed above, but I'll also return to student stories and

narratvies, especially in educational contexts. The things we do and say (and what we don't do and don't say) impacts the students in our classrooms, and there's a growing body of literature that creates spaces for students to share their experiences and demonstrate why an inclusive course environment makes such a big difference for them.

In what ways do you plan to measure the effectiveness of the new curriculum?

Our pilot testing includes 3 anonymous surveys we're requesting students complete:

1. **Pre-survey** at the start of their course to determine a baseline on topics like whether students are familiar with citizen science, how do they feel about being able to engage with science, whether they trust science, and whether they feel a sense of belonging.
2. **Post-activity reflection** following implementation of our curricular activities to gauge their experiences. Some of the questions are repeated from the pre-survey to see whether there were any changes in those items due to the activity (though it's always tricky to precisely claim causality, but it would at least demonstrate that this approach is promising). We also have some open-ended questions asking about whether and why/how the various prompt types (e.g., ones designed to connect with their existing knowledge, the emphasis on sharing and working with their peers) made them want to engage more with our activities.
3. **Post-course survey** at the end of their course to gauge how inclusive and culturally responsive the rest of the course was. One of the factors I'm interested in is what happens when a more culturally responsive activity is introduced in a non-responsive course. Do students get excited and want to see more of these activities? Do they feel comfortable engaging with these activities? Or are they just confused by the different style?

At present, we don't evaluate specifically on content learning (e.g., are they better able to answer fact-based questions about Mars); those learning gains are well-established in the literature. Our focus with the evaluation here is whether these activities improve the student experience.

What activities, lessons, and other things make up a good citizen science project?

One of the things I didn't get into with my talk is that the term "citizen science" refers to a very broad range of projects. The Zooniverse platform takes one particular model where researchers can upload images/videos for members of the public to classify. On the other end of the spectrum are much projects that are sometimes called "participatory research" where researchers work with members of a local community to devleop research questions, collect data, analyze data, and draw conclusions. Examples of projects in this space include public health projects (e.g., the effects of a local mine, factory, etc. on health outcomes).

Because there's such a wide range of projects, it's difficult to give a precise answer to this question. For Zooniverse projects, it helps for a project to be dynamic with regular uploads of new data, involvement from researchers on the discussion boards, and enough

variety in the images/videos to make classification interesting (some projects will offer different data sets, and others will have different "levels" where higher levels will have more classification options available and more complicated images/videos). For participatory research, it's crucial that researchers work *with* the local community rather than assuming what their needs may be.

In your opinion, what are at least three main takeaways a general astronomy course should have?

In my opinion, an astronomy course aimed towards non-science majors should focus on takeaways related to the practice of science, e.g., that students can critically assess scientific data and conclusions, that they can discuss how science is a process, and that they can draw parallels to compare/contrast the practices of science with things they do in their everyday lives. I would also hope students learn some astronomy content, though I recognize that instructors often have a lot of leeway in deciding precisely what that content will be. Perhaps the most general way to describe this aspect of the course is that I hope students leave the course with an appreciation of astronomy and the vastness of the Universe, so that when they see an astronomy-related news article, they'll keep reading instead of scrolling to the next thing.

When incorporating the principles of Asset Building, Reflection and Connectedness, do you think there is one that is the most critical in creating techno-social change?

I don't think there is a "most critical" principle among the model – the idea is that the combination of those things is what guides students to become techno-social change agents by connecting content to their own beliefs, knowledge, and values; promoting skills of critical reflection and assessment; and fostering community so that students can become leaders to enact social change. That doesn't mean every single piece of a curriculum will include all three principles, but it does mean that over the course of an activity, they'll experience and/or practice each of those skills.

What reason is given by universities for requiring general education science courses if they don't leave student with a sense of belonging or self-efficacy?

To quote from ASU's requirements:

> In addition to depth of knowledge in a particular academic or professional discipline, students should also be broadly educated, including knowledge of transdisciplinary solutions to address interdependent economic, environmental and social challenges, and develop the general intellectual skills they need to continue learning throughout their lives. Thus, the General Studies requirement complements the undergraduate major by helping students gain mastery of critical learning skills, investigate the traditional branches of knowledge and develop the broad perspective that frees one to appreciate diversity and change across time, culture and national boundaries. (https://catalog.asu.edu/ug_gsr)

You can also find similar language at many colleges and univesities. As I pointed out in my talk, general education science courses have an additional challenge of often being

the last formal exposure to science that our future voters, policymakers, teachers, parents, etc. will have. In astronomy, there's also a potential complication in that these courses may simultaneously be the first time a student has been in a standalone astronomy course. I would argue that these courses are an important and worthwhile endeavor, but that the lack of self-efficacy or belonging is holding these courses back from achieving their stated goals.

How can we create culturally responsive curricula if students in the same course have significantly different cultural backgrounds?

This is something that I'm continuing to work on; there's an inherent tension in this work between being tuned to a particular culture and being open to a diverse student population. My current work focuses on creating opportunities for students to bring their own cultures to the course in a way that's valued and included (sort of a "bottom-up" approach, if you will). I also think it's important to provide students with multiple pathways to be "successful" in a course, e.g., by offering multiple topic options, or multiple modalities of engagement, or multiple options for demonstrating their knowledge of a topic. Further, it can be powerful for an instructor to model working with and incorporating knowledge and beliefs from different cultures (e.g., inviting guest speakers from local communities) to create a classroom norm that explicitly values many cultures and experiences.

For instance, in the Planet Four-based curriculum I focused on in the colloquium, the homework activity gave students choices about what topic they wanted to focus on related to Mars (potential for life in the past, or future exploration), as well as flexibility on how they completed it (e.g., for the future exploration, whether they wanted to focus on technical challenges, ethics, economics/policy, etc. for the success of future missions to Mars). As another example, in our instructor guide, I wrote language about ways that an instructor could incorporate Indigenous knowledge systems and beliefs about Mars into the materials. Many cultures have knowledge and beliefs about Mars, but their knowledge/belief systems are all unique. As a curriculum developer, I do not think it is appropriate for me to highlight one single system, especially for a curriculum that is being implemented in many different locations and cultures. As a result, I provided some guiding prompts and starting points for instructors to add to the materials that we shared.

What can we (grad students) do to promote or help with citizen science?

If you're interested, you can always become citizen scientists yourselves! The Zooniverse platform at any one time will have 100+ active projects on a range of topics from astronomy to biology, medical sciences, humanities, and zoology. Being a nerd, I sometimes "relax" by classifying on the wildlife camera projects.

Beyond participating yourself, you may have opportunities to share this as an idea with the instructor of a course you're TA-ing, or talking with friends/family, or even when giving public talks about science/astronomy (e.g., I gave a talk earlier this year to the Tucson Amateur Astronomy Association and focused on citizen science).

How do you think citizen science impacts cultures -the latin culture for example?

> I mentioned in one of the other answers that there's a branch of citizen science that's often called "participatory research", where researchers work with local community members to develop research questions/studies, collect data, analyze data, and/or interpret and share results. However, these projects are very different from the Zooniverse model we're using in this curriculum, and related curricular activities would likely need to be developed in partnership with and for use by specific projects/communities, rather than being something we can broadly advertise and implement.

In what kinds of classes do you join to use your model (eg: geology, chemistry, biology, etc)?

> All of them! The Planet Four curricular activities are geared towards geosciences and astronomy courses, but this framework is meant to work in any field.