

GAUGING STUDENTS' ATTITUDES TOWARDS SCIENCE TO IMPROVE SCIENCE PEDAGOGY. V. Perera¹, C. Mead¹, S. Buxner², L. Horodyskyj¹, S. Semken¹, D. Lopatto³, and A.D. Anbar¹, ¹Center for Education Through eXploration & School of Earth and Space Exploration, Arizona State University (PO Box 876004, Tempe, AZ 85287-6004. Email: viranga@asu.edu), ²Department of Teaching, Learning & Sociocultural Studies, University of Arizona, Tucson, AZ 85721. ³Psychology Department, Grinnell College, Grinnell, IA 50112.

Introduction: Engaging students' affective domain (their emotions, attitudes & motivations) has been argued to be important to education [e.g. 1,2]. That also applies to the emergent field of online education; however, due to its relative novelty, research on online students' affect has been limited. Here we focus on online students' attitudes towards science. The cohort composed of students who took the online, introductory astrobiology course *Habitable Worlds* [3]. Many surveys measure students' attitudes towards science [e.g. 4,5]; however, we were interested in a survey that was not subject-specific and was general enough for an interdisciplinary subject such as astrobiology. Therefore, we selected the Classroom Undergraduate Research Experience (CURE) survey [6]. Though originally intended for small, in-person science courses that had a research component, the subsection that deals with students' attitudes towards, and their perceived benefits of, science are relevant to *Habitable Worlds*. Nevertheless, since the CURE survey is being used outside its original scope and since individual items in the survey have not been validated (i.e., Does each item measure what it was intended to measure?), we will be combining survey responses of scientific experts, student interviews, and student responses from *Habitable Worlds* to establish a validated survey of student attitudes towards science for use in introductory, online science courses. To demonstrate the process, here we focus on one of the items: "creativity does not play a role in science."

View of Experts: Though the word 'creativity' has a certain definition, its connotations can vary from person to person. That applies to other CURE items as well. Therefore, to get baselines for a subset of CURE items, we administered items to scientific experts of our department at ASU. There were 46 participants (25 graduate students, 6 postdocs, 1 professional staff member & 14 faculty). For the creativity item, 10 experts responded that they "disagreed" and 36 responded that they "strongly disagreed." Eleven experts left comments regarding this item. The comments affirmed their belief that creativity was vital to science and the phrase "thinking outside the box" was mentioned by two different experts.

Student Interviews: We interviewed 13 students (8 female & 5 male) during the Fall 2016 offering of the course. All 13 students disagreed with the

creativity item (although one student's response was tepid with "I don't think it's required but it's generally more helpful"). Three students used a variation of the phrase "thinking outside the box," although many students expressed that sentiment without using that phrase. Unlike the experts, 6 students stated that the first things that came to mind when thinking of 'creativity' were the arts. Plausibly the term's meaning might be gender-specific. A male student stated that "[in] the culture at least, I was raised in, creativity always seemed to be the arts. Whereas other things were 'oh that's a smart idea' or 'that's a good idea' not necessarily the word creative."

Online Survey of Students: The survey uses a five point Likert scale, with "strongly agree" coded as 5 and "strongly disagree" coded as 1. Based on survey results from three semesters starting with Fall 2014 (N = 563), we find students disagree with the item, but not strongly. Students also shift their view towards agreement by the end of the course (mean_{pre} = 1.74, mean_{post} = 2.05, p < 0.05). These values are very similar to the national CURE benchmark for this item (mean_{pre} = 1.85, mean_{post} = 2.03, N = 4107).

Discussion: These results suggest students are interpreting and responding to the creativity item in the manner it was intended, supporting the validity of the item. Student attitudes, as observed through the survey and interviews, are aligned with the expert views, though to a lesser degree. Combined with the shift away from the expert view, this suggests that science courses would benefit from pedagogy that is less formulaic, thus doing better to have students "think outside the box". This will not only improve students' understanding of the authentic scientific process but also improve their learning by engaging their affective domain. We aim to change student perceptions of science by improving the pedagogy of *Habitable Worlds*, which should be attainable being a course focused on the interdisciplinary field of astrobiology.

References: [1] van der Hoeven Kraft, K., et al. (2011) *J. Geosci. Educ.*, 59:71–84. [2] Lin-Siegler, X., et al. (2016) *J. Educ. Psychol.*, 108:314–328. [3] Horodyskyj L., et al. (in review) *Astrobiology*. [4] Adams, W. K., et al. (2006) *Phys. Rev. ST Phys. Educ. Res.*, 2:010101. [5] Semsar, K., et al. (2011) *CBE Life Sci. Educ.*, 10:268–278. [6] Lopatto, D. (2009) *Res. Corp. Sci. Adv.*