CHALLENGES AND LEARNING OPPORTUNITIES IN A CONTROVERSIAL MOOC FORUM ON CLIMATE SCIENCE DENIAL

J. Cook[1], B. Winkler[2], C. Finn[3], T. Dodgen[3]

[1] George Mason University (UNITED STATES)
[2] Skeptical Science (GERMANY)
[3] The University of Queensland (AUSTRALIA)

Abstract

Scientific understanding is often settled within a discipline before it reaches a broader social understanding and acceptance. Contemporary examples include vaccination, evolution and human-caused global warming. Universities and researchers can play an essential role in raising public levels of scientific literacy about these topics by creating and sharing evidence-based educational materials. Massive open online courses (MOOCs) are a relatively new tool enabling universities to bring scientific literacy to large numbers of people across geographical borders and cultural divides. A growing body of research offers insight into how MOOCs can constructively engage learners in controversial topics. This paper outlines a case study of the MOOC "Making sense of climate science denial" (Denial101x on edX) and the data collected from discussion forum user habits. Here, we document the processes and approaches adopted in Denial101x to explain the denial of climate science and maximise the benefits of student-to-student interaction within course discussion boards. Further, we describe how the course team anticipated potential course disruptions, formulated responses in real-time and documented the interactions that eventuated in course discussions. The techniques used in Denial101x can provide educators with a framework for publishing materials on contentious topics, responding constructively to disruptive online behaviour, turning potentially problematic forum posts into active learning opportunities for students and effectively advancing societal scientific literacy.

Keywords: Scientific literacy, MOOC, climate science, controversy, discussion forum, case study, online behaviour.

1 INTRODUCTION

Open educational resources (OER) were released by MIT as early as 2001, and Massive Open Online Courses (MOOCs) were being developed by George Siemens and Stephen Downes at the University of Manitoba in 2008 [1]. However, it wasn't until 2011 when Sebastian Thrun welcomed students via video lecture to his free, online artificial intelligence course that the groundwork was laid for what *The New York Times* later referred to as "The Year of the MOOC" [2]. This simple idea - to offer university courses for free and online to the world - was deemed "a budding revolution in global higher education" [3]. The popularity of these courses is seen in the growth of course offerings. Between March 2013 and April 2014, the number of MOOCs grew from 409 to 2230 [4].

Massive Open Online Courses (MOOCs) present an opportunity to increase literacy on issues of global significance. This is of particular importance with issues that are beset with misinformation and misconceptions, such as climate change.

Numerous studies indicate an overwhelming and strengthening scientific consensus that human activity, primarily through the burning of fossil fuels, is causing global warming [5]. One of the key perceptions about climate change is whether or not an individual is aware of the nearly unanimous (greater than 90%) scientific consensus that humans are causing recent global warming. Perceived consensus has been identified as a "gateway belief" linked to a range of climate beliefs and attitudes such as acceptance of climate change, concern about climate impacts and support for mitigation policy [6], [7], [8].

However, public perception of consensus is low. Less than 10% of Americans are aware that the scientific consensus on climate change is over 90% [9].

An effective approach to neutralise the influence of misinformation is misconception-based learning [10], also known as agnotology-based learning [11]. Misconception-based learning involves explaining scientific concepts while also explicitly introducing and refuting related misconceptions. The refutation

will often include the fallacy or technique of the misconception, thus explaining how the myth distorts the scientific facts.

Misconception-based learning has been found to result in greater and long-lasting learning gains relative to standard lessons that simply teach the science without reference to misconceptions [12], [10], [13], [14]. It increases student's argumentative skills and awareness of the importance of evidence [15]. In addition, this teaching approach fosters students' critical thinking skills [16] and provokes greater student interest relative to standard textbook text [17].

"Denial101x: Making sense of climate science denial" is the first MOOC to adopt the approach of misconception-based learning [18]. This MOOC was developed for edX by the University of Queensland (UQ) in collaboration with academics who were team members of Skeptical Science (SkS), an online community focused on refuting climate misinformation. The Denial101x course had an interdisciplinary scope, simultaneously addressing the psychology of misinformation as well as the physical science of climate change.

2 METHODOLOGY

Despite the lack of scientific controversy around climate science, significant social controversy exists [5]. Therefore, the course team anticipated that Denial101x would be perceived as contentious by some students. A primary consideration was to develop course material that was objective and academically rigorous. We adopted a number of procedures in order to lay a SOLID foundation to respond to anticipated criticisms. These included:

- **Sources:** All lecture videos cited peer-reviewed research, with reference lists supplied for each lecture and direct links to open-access papers provided where possible.

- **Outside Review:** Individual lectures and the course as a whole were sent for review to academics who were not involved in the making of Denial101x and/or were not currently employed by the University of Queensland.

- **Lent authority:** Lectures were supplemented with expert interviews. This lent authority to the course by demonstrating that the course was not misinterpreting or misrepresenting the work of those currently conducting the research on which the course was based.

- **Internal Review:** Each lecture had a primary author and was reviewed/edited by at least 3 people (course staff or volunteers) before being finalised.

- **Diversity:** The course team came from a broad range of backgrounds - both in terms of geographic location (Australia, USA, Canada, Germany, UK, New Zealand) and discipline (psychology, computer science, journalism, climate science, meteorology). This allowed the course team to better anticipate how course material would be perceived in different contexts.

Given the controversial nature of Denial101x and the potential for disruptive activity in the discussion forums, proactively developing and implementing a strategy to manage disruption was crucial to the success of Denial101x. Here, we describe the procedures put into place and implemented throughout our course to manage disruptions. Due to the unique nature of our course, which was designed to promote critical thinking and equip students to respond to misinformation, trolling activity in forums was viewed as a potential opportunity for students to apply their learning. However, we needed to ensure that trolling posts did not overload or excessively confuse students. Our goal was to create an environment balanced between active discussion and respectful, science-based commentary. Many of our adopted procedures are transferrable to other research-grounded topics which, for political or rhetorical reasons, have become socially controversial.

Registrations for Denial101x opened on 21 September 2014 with the course launching on 28 April 2015. Early social media attention indicated the necessity of vigilant moderation with a number of comments displaying an intent to disrupt the discussion forums or amplify negative course feedback.

These comments motivated the team to follow the advice of Herring, Job-Sluder, Scheckler and Barab [19] who argued that online forums need to pre-emptively articulate policies and guidelines for appropriate participation and penalties for violating those guidelines. Developing clearly defined guidelines was an important aspect of the Denial101x moderation policy, both for forum participants and for moderators. The forum guidelines were developed based on the existing commenting guidelines from the Skeptical Science website [20].

Additional refinements were prompted by guidance from the online educators at UQx and one of our team-members with prior experience as a community teaching assistant (CTA) in climate-related MOOCs on Coursera.org. It was decided to adopt a smaller set of guidelines and more minimalist approach relative to the SkS guidelines. Further, the decision was made to adopt a light touch when dealing with comments containing misinformation about climate change. The intent was that such comments would provide practical learning opportunities for the students, who could apply their newly acquired critical thinking skills by responding to myths in forum comments. The final Denial101x discussion forum guidelines are available in Figure 1.

Guidelines for any Denial101x participants:

Throughout the course, you will find discussion forums devoted to specific questions that connect to course content as well as more general forums to share ideas and ask questions.

Please keep the following guidelines in mind as you read, post and reply on our forums:

- Discussion forums are a place to learn in a friendly - if virtual - setting. Any postings aimed at disrupting the discussions or the course will be deleted and can lead to a ban from participation. Additionally, any posts that are off-topic or gish gallops [posts that include multiple half-truths and lies with the aim of preventing response] could be closed by the moderators.

- Be respectful of others in our global classroom. If you encounter a derogatory comment on the forum, please flag it so it can be addressed by a moderator.

- If you refer to something in a post, please provide everyone with a link or a reference. And if it is a link to someone else's opinion, be sure to explain why you agree or disagree with it and how it connects to the course content. Your opinions are an integral part of the forum, and we are interested in what you think.

- Others will be able to understand you and provide useful responses to your postings if you proofread your writing for spelling and grammar. Additionally, we encourage you to avoid using all caps, abbreviations of words that could be confusing to others and excessive punctuation that could distract. Since students in this course are from many nations, please try to avoid the use of jargon or national idiom or slang as not everyone may understand.

- If you notice an error in any course materials or a bug in course content, please notify course staff by posting in the Troubleshooting forum. If, however, you are experiencing a technical problem with the edX platform, please use the Support tab on the left of each page to report your problem to edX directly.

- If you read something you like, be sure to upvote good posts and/or responses by clicking the green "+" button on a post. This will help others find those good posts easily.

- When posting, there are two types of posts you can choose from: questions and discussions. Questions draw attention to issues that need answers, while discussions begin conversations and share ideas. Be sure to select the appropriate identifier when posting.

- Please refrain from posting content of the forums publicly unless individuals consent to having their contributions mentioned elsewhere.

Consult edX's Terms of Service for additional information about student conduct online.

3   **Guidelines distributed to volunteer Denial101x discussion board moderators**

Before stepping in - esp. in contentious threads - touch base with the other CTAs/Moderators via the **Skype-chat group**. Also avoid the appearance of piling on by too many of you responding in a thread all at once. If need be, designate one of you to be the main responder, but get input about the best wording from the others.

A good idea is usually to **start following a thread** which starts out as or might get contentious - either due to the content or the student who started to or replied in it. It's then easy to keep an eye on followed threads for new activity

Some general guidelines of how to react to various guideline-violations:

- **Off-topic** - close thread and say "this is off-topic", and if there is a more appropriate forum, say "move to more appropriate thread".

- **Disrupting discussion** - if repetitive, then close the first repeat, then delete subsequents, then if

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persistent, discuss whether to de-enrol student

- **Link only** - post response saying "please accompany links with explanation how this link relates to the course content".

- **Derogatory comments** - either trim it or completely delete it depending on the severity and whether it's trimmable.

- **Political rants** - if it's off-topic, then use judgement on whether to trim, delete or post response then close thread. The edX guidelines say "no partisan political activities" so if a post gets too politically partisan, then you're able to moderate it.

- **All caps/excessive punctuation** - post a response asking that they avoid using all caps or excessive punctuation. You may trim depending on how bad it is.

- **Profanity** - trim or if it's really bad, delete thread

Add your name - or initials - to inline comments where you snipped some text. This is standard practice at the SkS-homepage so will make sense in the MOOC-forums as well.

Suggestion from lead moderator:

Try wording your forum responses as "I" instead of "You" messages. That way you are sharing your perspective, how you see/interpret comments made by others without actually "attacking" them. One thing I learned in that seminar was that almost any message starting out with or containing "You should...", "You are...." puts the receiver of that message on the defensive.

With comments worded with "I"-messages, the student you reply to can no longer reply back to you as if you were attacking her/him

Figure 1. Forum posting guidelines for participants and moderators

The course team planned to provide as close to 24/7 moderation-coverage of the discussion forums as possible, which was achievable due to the international distribution of the SkS team. Around-the-clock attention was possible due to the geographically dispersed nature of the moderation team (see Figure 2). The purpose of moderation was two-fold: first, to minimise disruptions of discussion threads and, second, to be available whenever students ran into technical or other issues.

Figure 2. Locations of team members helping with forum moderation. Blue pin: Location of course staff at the University of Queensland. Orange pins: volunteer moderators (New Zealand; Australia; Germany; United Kingdom; Missouri and Colorado, United States). Green pins: Course lecturers who engaged in the discussion forums (Queensland, Australia; United Kingdom; Michigan, Colorado and California, United States; British Columbia, Canada).

To facilitate immediate and responsive moderation, real-time chat communications were set up via a Skype chat group. In addition, a document repository was established using a dedicated Google Drive folder, shared with all people actively involved with the MOOC. This system allowed moderators to access and edit moderation documents for the course and provided a historical record of moderation actions.

Shortly after the MOOC commenced on April 28, comments reflecting a contrarian perspective began to appear in the forums. These posts required monitoring from the moderation team as the contained misinformation could be confusing or difficult to identify by students.. who were new to the course's subject matter. Such posts used the aforementioned techniques characteristic of trolling: appearing sincere while intending to disrupt and/or misinform. Before intervening, moderators utilised the Skype-chat group as a sounding board to deliberate whether a staff-reply was necessary and, if so, to decide who would respond (to prevent multiple responses by different staff-members). As contrarian activity increased, moderators were forced to intervene more often, reminding some students of the posting guidelines. If comments violated forum guidelines they were partially or completely removed from the forum, with a note for students explaining the action the moderation team had taken.

To give the students opportunity to post their own responses to misinformation, the moderation team avoided intervening in discussion threads immediately. A number of students demonstrated familiarity with many of the trolling tactics exhibited in discussions, and applied strategies from Denial101x in their responses. In these cases, contrarian and/or misinformed posts presented an opportunity for students to apply learning from Denial101x course content.

Specifically, a lecture in week one aimed to promote critical thinking about misinformation and introduced students to the five characteristics of science denial (summarised with the acronym FLICC, shown in Figure 3). One exercise presented examples of myths, with students required to identify which characteristic of denial was employed by each myth.

Figure 3. The five characteristics of science denial (Diethelm & McKee, 2009).

Students began to identify the characteristics of science denial being posted in the forum. Consequently, those cases of misinformation became opportunities for active learning where students applied their newly acquired knowledge to identify and respond to science denial characteristics. The FLICC framework grew in popularity among the students with the end-of-course survey indicating it was one of the most popular aspects of the course.

4   RESULTS

The results presented in this paper come from the initial run of Denial101x, which took place from April 28 to June 16, 2015. A total of 16,861 people enrolled in the course and 962 students completed the course with a passing grade of at least 70%. Students enrolled from 165 countries, with a median, self-reported age of 42.

Of the 16,861 students, 3,004 participants were active in the forums. The forum participants were divided into four distinct groups based on their roles and stances:

Table 1. *Four categories of forum participants.*

Participant type	Meaning	Description	Number of people	Number of contributions
S	Staff	UQx-MOOC-staff, initial group of moderators recruited from SkS, lecturers and community teaching assistants (CTA) added during the MOOC	12	1,439
P	Participant	All students participating in the forums without needing / attracting specific attention from staff	2,038	15,858
E	Engaged	Participants actively engaging in the forums with frequent and thoughtful comments. Several out of this group were later asked if they'd be interested to help as a CTA in later iterations of the MOOC.	30	3,912
D	Dismissive	Participants either dismissive of human-caused climate change and/or SkS and the MOOC	24	1,277

Figure 4 shows activity levels based on all 22,486 contributions in 8,528 distinct discussion threads in the forum throughout the MOOC broken down into the four groups. Activity from the dismissive group was highest during the first two weeks of the MOOC with a small spike after the MOOC had officially ended. Even when dismissives were most active, their contribution was far outweighed by posts from other participants.
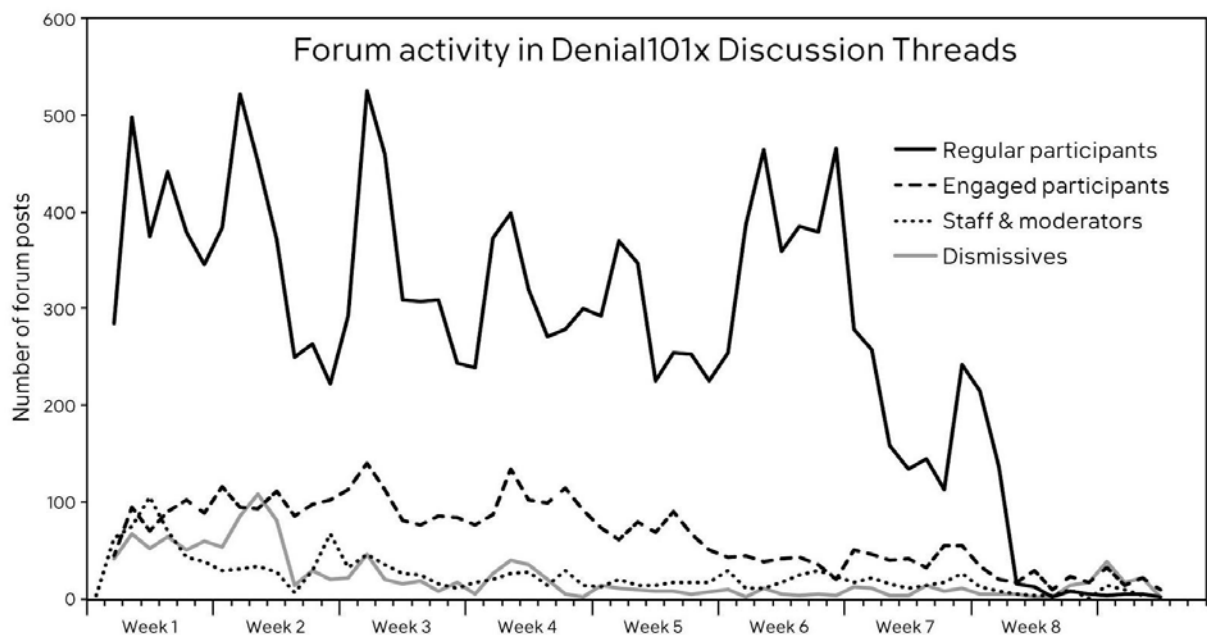

Figure 4. Forum activity of 4 distinct groups: Dotted black = staff & mods, Solid black = regular participants, Dashed black = engaged participants, Solid grey = dismissive.

While the overall contribution of dismissive participants was proportionally small, their activity tended to cluster within a small proportion of unusually active threads. Figure 5 shows group activity in the most active threads, revealing that dismissive contribution was significantly higher in those. This was due to vigorous back-and-forth exchanges between the dismissives and other participants.

Arguably, part of the reason for the concentration of dismissive activity in a small number of threads was due to the structure of edX forums. This structure allowed moderators to constrict specific discussions to a relatively small number of threads, preventing potentially misinforming discourse from polluting the entire forum. While perceived deficiencies in the edX forum platform has been a source of frustration for students and course runners, in cases of controversial topics, it does serve to restrict potential disruption from dissenting participants.
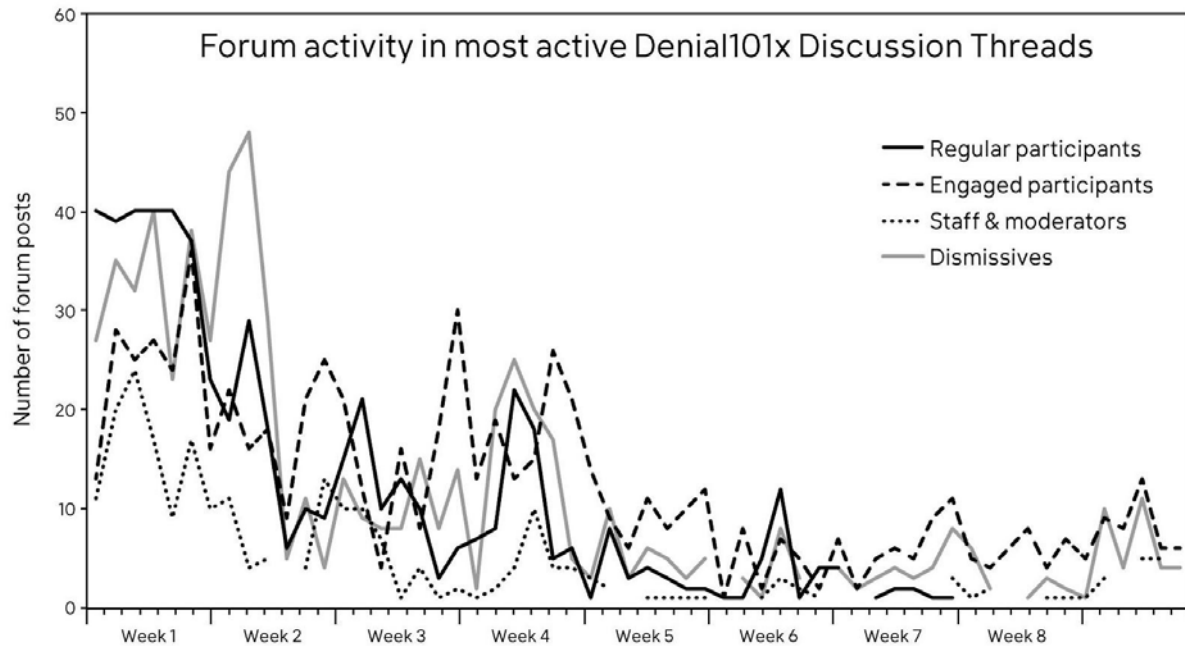
Figure 5. Forum activity in threads with at least 30 posts, divided into 4 distinct groups: Dotted black = staff & mods, Solid black = regular participants, Dashed black = engaged participants, Solid grey = dismissive.

5   CONCLUSIONS

In summary, we found that adopting the following five guidelines for Denial101x - represented with the acronym TROLL - helped to maintain a healthy forum:

- **Teamwork:** Ideal moderator teams include members across multiple time-zones so that responses can be responsive to online communities spanning multiple countries. A culturally diverse team is desirable to promote moderator responses that are polite, unbiased and transculturally appropriate. Regular, inclusive communication among team members is important. The Denial101x moderators used Skype and Google Docs to keep all team members in touch and up-to-date.

- **Rules:** Clearly define forum guidelines up-front. This includes specific guidelines for forum participants and for moderators.

- **Oversight:** Enforce rules consistently and observe forum activity closely to contain potentially problematic posts. This can involve redirecting/closing threads that feature repeats of earlier posts (e.g., linking to relevant thread) and closing inactive threads to ensure they do not stray off topic at a later date.

- **Light touch:** Moderators need to be careful not to be too heavy-handed. It is important to allow dissenting voices to be heard. Moderators should avoid prematurely closing threads or responding to threads before other students get a chance to respond. Moderators who do engage in discussion threads should avoid moderating those threads. Comments should only be deleted or hidden in extreme cases.

- **Log:** Document all moderator activity, including instances of moderation and interaction with participants.

A number of scientific topics are socially controversial, even in cases such as human-caused global warming or evolution theory where there is no scientific controversy. It is precisely these topics where universities are poised to make a valuable contribution in raising public levels of scientific literacy through the use of rigorous, evidence-based educational material. MOOCs are a powerful tool enabling universities to provide educational material to large numbers of people across geographical borders and cultural divides.

A growing body of research offers many insights into how MOOCs can engage in controversial topics in a productive, effective manner. This paper outlines a case study of a MOOC, Denial101x, on the topic of climate science denial. We document the processes and approaches we adopted in

Denial101x in order to provide a rigorous, evidence-based MOOC that was implemented in a way that had students engage with the content and each other in a productive, active learning environment.

It is important that institutions are not dissuaded from participating in educational outreach on contentious topics, for fear of potential controversy that may eventuate. Rather, universities should consider adopting leadership roles in advocating for greater scientific literacy based on rigorous, scholarly research.

REFERENCES

[1] T. R. Liyanagunawardena, A. A. Adams, and S. A. Williams. "MOOCs: A systematic study of the published literature 2008-2012," *International Review of Research in Open and Distance Learning*, vol. 14, no.3, pp. 202-227, 2013.

[2] L. Pappano, "The year of the MOOC," *The New York Times*, pp. ED26, Nov. 4, 2012.

[3] T. Friedman, "Revolution hits the universities,"*The New York Times*, pp. SR1, Jan. 27, 2013.

[4] S. Porter, *To MOOC or not to MOOC: How can online learning help to build the future of higher education?.* Kidlington, UK: Elsevier, 2015.

[5] J. Cook, N. Oreskes, P. T. Doran, W. R. L. Anderegg, B. Verheggen, E. W. Maibach, J. S. Carlton, S. Lewandowsky, S. A. Green, A. G. Skuce, D. Nuccitelli, P. Jacobs, M. Richardson, B. Winkler, R. Painting, and K. Rice, "Consensus on consensus: A synthesis of consensus estimates on human-caused global warming," *Environmental Research Letters*, vol. 11, no. 4, 048002, 2016.

[6] D. Ding, E. W. Maibach, X. Zhao, C. Roser-Renouf, and A. Leiserowitz, "Support for climate policy and societal action are linked to perceptions about scientific agreement," *Nature Climate Change*, vol. 1, no. 9, pp. 462-466, 2011.

[7] A. M. McCright, R. E. Dunlap, and C. Xiao, "Perceived scientific agreement and support for government action on climate change in the USA," *Climatic Change*, vol. 119, no. 2, pp. 511-518, 2013.

[8] S. van der Linden, A. A. Leiserowitz, G. D. Feinberg, and E. W. Maibach, "The scientific consensus on climate change as a gateway belief: Experimental evidence," *PloS one*, vol. 10, no. 2, e0118489.

[9] A. Leiserowitz, E. W. Maibach, C. Roser-Renouf, G. Feinberg, and S. Rosenthal, *Climate change in the American Mind: March 2015*. New Haven, CT: Yale Project on Climate Change Communication. Retrieved from http://environment.yale.edu/climate-communication/files/ Global-Warming-CCAM-March-2015.pdf.

[10] J. L. McCuin, K. Hayhoe, and D. Hayhoe, "Comparing the effects of traditional vs. misconceptions-based Instruction on student understanding of the greenhouse effect," *Journal of Geoscience Education*, vol. 62, no. 3, pp. 445-459, 2014.

[11] D. Bedford, "Agnotology as a teaching tool: Learning climate science by studying misinformation," *Journal of Geography*, vol. 109, no. 4, pp. 159-165, 2010.

[12] P. Kowalski, and A. K. Taylor, "The effect of refuting misconceptions in the introductory psychology class," *Teaching of Psychology*, vol. 36, pp. 153–159, 2009.

[13] D. A. Muller, M. D. Sharma, and P. Reimann, "Raising cognitive load with linear multimedia to promote conceptual change," *Science Education*, vol. 92, no. 2, pp. 278-296, 2008.

[14] C. D. Tippett, "Refutation text in science education: A review of two decades of research," *International Journal of Science and Mathematics Education*, vol. 8, no. 6, pp. 951-970, 2010.

[15] D. Kuhn, and A. Crowell, "Dialogic argumentation as a vehicle for developing young adolescents' thinking," *Psychological Science*, vol. 22, no. 4, pp. 545-552, 2011.

[16] L. K. Berland, and B. J. Reiser, "Making sense of argumentation and explanation," *Science Education*, vol. 93, no. 1, pp. 26-55, 2008.

[17] L. Manson, M. Gava, and A. Boldrin, "On warm conceptual change: The interplay of text, epistemological beliefs and topic interest," *Journal of Educational Psychology*, vol. 100, pp. 291-309, 2008.

[18] J. Cook, K. Schuennemann, D. Nuccitelli, P. Jacobs, K. Cowtan, S. Green, R. Way, M. Richardson, G. Cawley, S. Mandia, A. G. Skuce, and D. Bedford, *Denial101x: Making Sense of Climate Science Denial*, edX. Retrieved from http://edx.org/understanding-climate-denial.

[19] S. Herring, K. Job-Sluder, R. Scheckler, and S. Barab, "Searching for safety online: Managing 'trolling' in a feminist forum," *The Information Society*, vol. 18, no. 5, pp. 371-384, 2002.

[20] Skeptical Science, "Comments Policy," Retrieved January 1, 2015, from http://skepticalscience.com/comments_policy.shtml.