Crash Course History of Science: Popular Science for General Education?

Allison Marsh, *University of South Carolina*
Bethany Johnson, *University of South Carolina*

Abstract: In 2017 Allison Marsh joined the team to create the Crash Course History of Science educational video series for YouTube. She then began incorporating these videos into the online version of a popular introductory survey course at the University of South Carolina, "HIST 108: Science and Technology in World History." During the Summer and Fall terms of 2019, she collected data with the hope of comparing content retention between students who watched Crash Course videos and those who read a traditional textbook. Graduate student Bethany Johnson, a teaching assistant for HIST 108, saw how the students engaged much more dramatically with the videos than with the readings. This case study showed students interacting with the videos in surprising ways and caused Marsh and Johnson to rethink course organization and the pedagogical purposes of a General Education history course.

When I (Allison) was asked to be the consultant for the new YouTube series Crash Course History of Science, I only hesitated for a moment. On the one hand, I knew that many of my academic colleagues would not appreciate the fast-talking, slightly snarky videos with goofy animation and a PG-13 sense of humor. I am a college professor trained in the fifty-minute lecture, so Crash Course's quick-cut videos were not my preferred way of learning new information. On the other hand, as a public historian, I saw how effective the videos were in engaging audiences from around the world with clear, if sometimes overly simplistic, content. I also knew that there was unlikely to be a more global platform for my work. Clearly, more people would see these videos than anything I might publish. I said yes.

Allison Marsh is Associate Professor of History and Co-Director of the Ann Johnson Institute for Science, Technology, and Society at the University of South Carolina. Her areas of research include history of technology, public history, and electrical engineering. She writes the monthly "Past Forward" column for IEEE's *Spectrum*. Department of History, University of South Carolina, Gambrell Hall, Columbia, South Carolina 29208, USA; marsha@mailbox.sc.edu.
Bethany Johnson is a doctoral student at the University of South Carolina. Her areas of research include history of science and technology, American history, and history of gender. She is the coauthor of *You're Doing It Wrong! Mothering, Media, and Medical Expertise* (Rutgers, 2019). Department of History, University of South Carolina, Gambrell Hall, Columbia, South Carolina 29208, USA; blj8@email.sc.edu.

Isis, volume 111, number 3. 0021-1753/2020/0111-0010$10.00.

AN INTRODUCTION TO CRASH COURSE

The brainchild of brothers John and Hank Green, Crash Course (CC) is one of the most popular educational channels on YouTube. As of February 2020, Crash Course boasts 10.3 million subscribers and more than 1.15 billion video views across thirty-eight different series on topics ranging from anatomy to world history.[1] CC series generally consist of forty-six episodes of approximately ten-minute videos, although shorter series vary. Most episodes follow the formula of an introductory hook; opening credits; main narrative content that includes key vocabulary, quotations, and factoids; a "thought bubble," which focuses on a specific idea or person for a few minutes; and, finally, a conclusion with a preview of the next episode.

I admit that, at first, I was a CC skeptic. However, my attitude began to change in Spring 2017 when I attended a panel discussion by CC writers, producers, and consultants at the Smithsonian National Museum of American History. There I learned that every CC series has a Ph.D. (or equivalent) consultant to ensure the accuracy of materials. Some series are created in partnership with PBS and have specific requirements, and others align with AP course expectations.[2] Perhaps most interesting to me was that the CC team did not expect students to watch the videos once. They intended a much more interactive participation with their viewers, who they know (from analytics) often watch the episodes three or more times, pausing to capture a factoid that flashed on the screen or rewinding to clarify terminology.

The CC team also actively follows online comments on the videos, as well as related postings on Twitter, Tumblr, and other social media sites. If numerous viewers ask similar questions, they will gather additional references and pin a comment to the text description of the episode. When possible, they will incorporate user feedback into future episodes.

I knew very little about web/video production when I signed on to the team, and one of the first meetings left me a little wary. Hank Green, the series' host and science celebrity, said he did not want to include anything that we now know not to be true. Umm . . . that's just about everything in the history of science. Luckily, Green was very open to learning about the practice of history, acknowledging that people in the past had complex worldviews in which their theories made sense and that one purpose of studying the history of science is to see how and why ideas change.

If a traditional semester-long course tackling three thousand years of world history already seemed like a whirlwind, Crash Course ran at an unrelenting breakneck pace with little room for nuance or complexity. My job as the consultant was to create a syllabus with detailed outlines of the forty-six-episode series, work with the scriptwriter and editors to shape each episode, and review the rough cut of the videos.[3]

I based my outline for the series on "HIST 108: Science and Technology in World History," an introductory survey that I had been teaching for almost a decade. Notes for each episode came from the bullet points of my course's PowerPoint slides, condensing each fifty-minute lecture into a ten-minute highlight reel of simple declarative sentences. I based the series on my notes partly because I was rushed for time. I did not have the luxury of imagining a new course; I had two weeks before the scriptwriter started.

---

[1] Social Blade had it ranked 20th in the education category for YouTube channels in the United States and 208th in education in the world: https://socialblade.com/youtube/user/crashcourse (accessed 19 Feb. 2020). The figures on subscribers and views are from the same source.

[2] For non-American readers, PBS is the Public Broadcasting Service, a nonprofit television production and distribution company that specializes in educational materials. AP is the Advanced Placement curriculum, which is designed as university-equivalent coursework for secondary school classes. CC History of Science had no external constraints from either PBS or AP.

[3] The team included scriptwriter Wythe Marschall (at the time a graduate student in anthropology of science at Harvard University), editors Patrick Davison and Meredith Jenko, and producer Nick Jenkins.

Production moved very quickly. I submitted my outline in January; they started filming in February. Once the scriptwriting began in earnest, we worked on a new episode approximately every week for a year. The first episode of Crash Course History of Science debuted in March 2018 and immediately proved popular with the CC fanbase. As of January 2020, episodes of the History of Science series have been viewed more than ten million times.[4]

Throughout the creation of the CC series, I mostly kept the work separate from my classroom teaching. My comment on almost every paragraph in every script was "It's more complex than that." When the team talked about what got cut (and about half of every script was cut) or responded to users' complaints that some person or idea was not featured in an episode (most of Brazil seemed to object to the exclusion of Alberto Santos-Dumont in Episode 38 on Air and Space), we always acknowledged that CC was not the same as a college course. Entire monographs were written about every person or idea we mentioned. We were simply giving people a taste of the history of science.

INTEGRATING CRASH COURSE INTO AN ONLINE COURSE: A CASE STUDY

At the same time that I was consulting for CC, the College of Arts and Sciences at the University of South Carolina began encouraging departments to offer introductory survey courses online. I saw an opportunity to combine my CC work with online teaching and study the effects of different pedagogical techniques in an online class structure. Specifically, I wanted to assess the difference in content retention between students who read the assigned textbook and those who watched CC videos. This was an opportunity to test how public history and popular science techniques transferred to an online classroom context.

During the Fall 2019 semester, Bethany Johnson was one of three graduate teaching assistants for my HIST 108 course.[5] Johnson, who is pursuing a Ph.D. in the history of science, graded and monitored 108 students. She culled qualitative data from student journal entries, analyzed the survey data, and became a coauthor of this article.

We collected data for this study during the Summer and Fall semesters of 2019, with a total enrollment of 317 students. The summer session was an intensive three-week course; the fall session was a standard fifteen-week semester. All sections had the same assignments, the same required primary source readings, and the same selection of secondary source readings and videos. In our study, each course had one section where the content was delivered primarily through the CC videos and one section where students read the same narrative content in the textbook by James McClellan and Harold Dorn.[6] Additionally, in a third section during the Fall semester students had the choice of either watching the videos or reading the textbook.[7] At the time of enrollment, students did not know what materials (video or textbook or a choice) they would

[4] https://www.youtube.com/user/crashcourse/featured.

[5] For a link to a public version of a sample HIST 108 course see https://blackboard.sc.edu/webapps/login?action=guest_login&new_loc=%2Fwebapps%2Fblackboard%2Fexecute%2FcourseMain?course_id=_1095352_1. Note that Blackboard does not allow all content (such as announcements and discussion posts) to be made public.

[6] James E. McClellan III and Harold Dorn, *Science and Technology in World History: An Introduction*, 3rd ed. (Baltimore: Johns Hopkins Univ. Press, 2015). Note that Joe November, a colleague at the University of South Carolina, consulted with the authors on the third edition, specifically because it was so heavily used in HIST 108.

[7] This is the section that Johnson TAed for; and although students could choose either video or textbook, student feedback indicates that the majority nearly always chose the videos. For example, students started their responses with phrases such as "In the Crash Course video on Darwin, Green suggested that . . . ," illustrating the student preference for the videos over the textbook when both options were available. In one journal entry a student shared that "I have enjoyed the use of the crash course videos in place of reading throughout the course."

be assigned. They could not select a specific section on the basis of their own perceived optimal learning style.

As quantitative assessment tools, we conducted a front-end evaluation during the first week of class and a summative evaluation during the last week of class. Both evaluations included questions with discrete answers as well as some with open-ended responses. The final exam was conceived as an evaluation of content retention by each section of students.

An unexpected cache of qualitative data came from the journal entry assignments. These were private, personal communications between the student and us, the professor or TA, designed as an aid for time management in a semi-asynchronous course. The journals were supposed to be a place where students recorded what they accomplished, their plan for the upcoming week, and what they found most interesting in the course material that they had just covered. As it turned out, many of our students were very comfortable "sharers" or even "oversharers." Entries read like private diaries, wherein students shared their stress and anxiety, details about personal relationships, and remarks on work in other classes. Alongside this personal information, however, students were surprisingly reflective about their work in HIST 108.

RESULTS

The initial front-end evaluation indicates that the overwhelming majority (98 percent) of the enrolled students were not prospective or declared history majors, minors, or cognates. This matched our expectation that most students were enrolled from other majors to satisfy their history General Education requirement. On a Likert scale of 1 (labeling the class "super fascinating") to 6 ("super boring"), the majority of our students (79 percent) showed a positive view of history, although the bulk of them (42 percent) admitted to finding it only "mildly interesting." At the extreme negative end, seven students (3 percent) admitted to finding history to be super boring. Results are shown in Figure 1.

The final exam consisted of a pool of questions created by all the students enrolled in Marsh's online HIST 108. Every student received a random selection of questions, although all students received the same proportion of question types (true/false, fill in the blank, matching, etc.). For both the Summer and Fall terms, our students from the CC video sections performed better on the final exam than the students in the textbook-based sections. They had

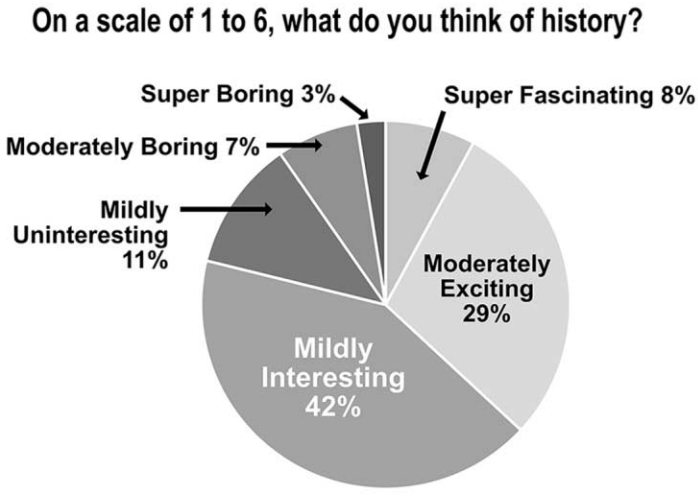

Figure 1. Although the majority of students said they found the subject of history interesting, some may be hesitant to admit a dislike of the subject during the first week of school, even though the survey was anonymous. N=282.

both a higher median grade and a higher mean grade. Clearly, Crash Course History of Science is doing something right, at least in terms of making content memorable for students.

The limited feedback we received from students during office hours and in nearly a dozen journal entries suggests that one reason for increased information retention was that they watched the CC videos multiple times. Although the students often complained that they had to pause and rewind an episode over and over again to take good notes, they never considered how that repetition positively reinforced the material.[8] Students reflected that "I especially liked the crash course videos—they are so easy to understand" and that "if it wasn't a CC video with Hank Green, I didn't want to watch it."[9] One student admitted, "I am not a big science person . . . but I did enjoy it better listening to . . . Green explain it rather than reading it in the book."

At the end of the term we asked the students to complete a summative evaluation that attempted to capture their attitudes toward history classes. The results were somewhat curious and inconclusive, begging additional research. A third of the students (36 percent) would like to take additional courses in the history of science, medicine, and technology, and 27 percent of the students want to take more online history courses, but a measly 12 percent would like to take an upper-division history course. If word of mouth is any indication of usefulness or popularity, more than half of the students (53 percent) would recommend HIST 108 to a friend. These results indicate an opportunity for the Department of History to capitalize on the popularity of online history of science courses (particularly in the summer) at the 100- or 200-level, of which the department currently has none apart from HIST 108.

As for a preference for online classes versus the traditional face-to-face classes, a strong contingent (31 percent) of students reported a preference for the traditional lecture format and an additional 20 percent offered no preference as to class format.[10] Younger professors who still have many years ahead of them might want to note that 49 percent of the students did have a preference for online classes, with more than a quarter (27 percent) sharing their strong preference for online learning, as shown in Figure 2.

When asked if they would consider a history major, minor, or cognate after taking HIST 108, 9 percent of the students overall answered affirmatively. This percentage increased to 16 percent for students who took HIST 108 in the Summer semester. In terms of student numbers, an increase from five to twenty-four students, spread equally across all five sections, suggested that they would consider a more formal relationship with the Department of History after taking HIST 108. Given that at the beginning of HIST 108, 98 percent of the enrolled students were not affiliated with the department, there is significant room for growth.

The final question asked students to reflect on whether this course helped them see the value of the humanities to the STEM fields. Two-thirds of the students (64 percent) agreed that it had, while only 15 percent disagreed, as shown in Figure 3. Students elaborated on the value of humanities in their journals as well, noting, for instance: "[this class] helped me understand the importance of science and technology in world history" and "I have learned so much over this semester that has opened my eyes to a completely different aspect of history [never] introduced to me before." These student comments underscore the importance of STEM history as an avenue to increase interest in and respect for historical work more broadly. As one student summarized, "this course made me think about history, how we learn, and why [we] do experiments

---

[8] I do not have similar data, however anecdotal, for students in the textbook-based sections.

[9] Note that there were a handful of non-CC videos that were assigned, including *Rome: Engineering an Empire*, *Day after Trinity*, and an episode of the television series *The Mill*.

[10] The survey question noted specifically that the face-to-face version of HIST 108 is usually a lecture with 360 students that meets two days a week, with discussion sections led by graduate teaching assistants meeting one day a week. Essay assignments are similar.

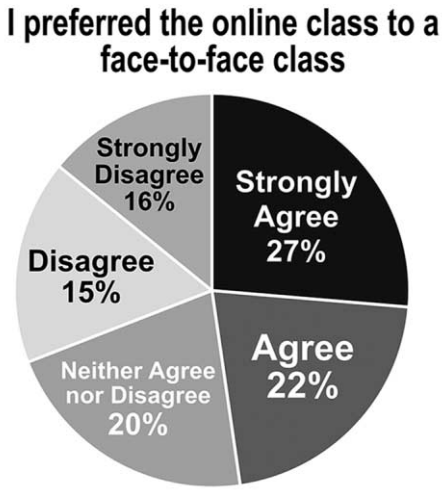

Figure 2. For further comparison, such a question could be posed in the face-to-face class. It might also be interesting to track this data over time to see how attitudes toward online coursework change as it becomes more mainstream. N=269.

significantly more than any of my research classes." At a time when the humanities often feel under attack and STEM degrees are more favored by students, parents, and upper administration, this is useful data for arguments in favor of history coursework.[11]

REFLECTIONS AND NEXT STEPS

Is the purpose of an introductory survey to recruit students into the major? If so, what should faculty be doing to capitalize on the interest in history our students developed? These are not idle questions, and how faculty answer them may depend on their own institutional contexts. At the University of South Carolina, we are about to embark on a new budget model where undergraduate tuition dollars will be allocated to the appropriate division in a ratio of 70 percent to the college of instruction and 30 percent to the college of record/major. From a very practical standpoint, it is in our fiscal interest to capture more students in seats and to increase our number of majors. Having identified students in HIST 108 who may want to pursue additional history coursework, we could attempt to recruit them into the major and offer courses that specifically interest them.

But perhaps the purpose of an introductory course is not about recruitment but, rather, about helping students gain an appreciation for the value of history. Thinking this way, we can position ourselves, not in opposition to STEM fields, but instead as an important and necessary component of STEM education. And so, perhaps, it is time to integrate more tools from public history and popular science into the classroom. Although I felt guilty about cutting out nuance, complexity, and a significant amount of material in the Crash Course videos, maybe the entire textbook is not needed for a university-required introductory class. This is especially true if the students watch and rewatch the videos to the point that they retain the content much better than if they had read it.

---

[11] These discussions about the relative worth of STEM degrees play out over family dinners, conversations in university halls, and proclamations in the popular press, as well as in the academic literature. Some examples include "The Major Divide: Humanities versus STEM Majors," *Huffington Post*, 5 Apr. 2015; and "Behind the Scenes at the STEM–Humanities Culture War," *Chemical and Engineering News*, 16 July 2019.

Figure 3. Further research could be done by coupling this question with a similar question on the front-end evaluation to see how much change occurs during the course. It could be more finely tuned by asking which course modules, assignments, readings, or videos were most important in effecting this change. N=269.

Going forward, recognizing the positive effects the CC videos had in my online class, I am going to double down on their use. I am going to relegate the textbook from required to recommended reading. I am going to encourage more detailed discussion about the creation of online videos—how they engage an audience, what is missing, and how those decisions are made. I may even require my students to complete an assignment (currently optional) to create their own video in the CC History of Science series. There are lots of things we didn't cover, so lots of opportunities. Finally, we are going to dig deeper into the data to see how else we can improve the introductory survey course.

Postscript: Allison Marsh had taught an online version of HIST 108 for three years when the mass disruption of the Covid-19 pandemic caused most courses to move online abruptly during Spring 2020. Online teaching can be as effective as face-to-face teaching, but the techniques to engage students and retain their interest are different. Given the challenges academia faces, the development of pedagogy for online courses is more important than ever.