

Introduction to Reproduction: Online Education for the Millennial Learner¹

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ABSTRACT

Despite staggering rates of sexually transmitted infections and unplanned pregnancies, reproductive health education is not yet standardized across secondary or postsecondary curricula. The Women's Health Research Institute and Northwestern University Information Technology created *Introduction to Reproduction*, a massive open online course to encourage global students to learn the biological foundations of reproductive health. This digital education experience appeals to the Millennial learner and offers unique opportunities to explore topics in reproductive biology via lectures, animations, and three-dimensional anatomical illustrations. Data were collected anonymously from de-identified learners who elected to self-report on their experiences while completing the course as well as through Coursera datasets. Northwestern University's Institutional Review Board classified this research project as an exempt status due to the de-identified nature of the collected data. Participants from 47 countries report on reproductive health content knowledge, past reproductive health education, and level of engagement with the topic. These data indicate that the *Introduction to Reproduction* course has a meaningful impact on its participants and presents the information in a concise and accessible format. Distribution of this course to a wider audience is the goal for the program and important to the field of reproductive health.

Introduction to Reproduction, massive open online course, MOOC, reproduction, reproduction courses, reproductive education, reproductive health, reproductive online courses, Women's Health Research Institute

Taboos surrounding sexual and reproductive health education often limit both national and global attention to this area of biology and may contribute to poorer overall health outcomes for many people [1]. Adolescents, who may lack accurate knowledge about reproductive health, are more likely to engage in risky sexual behavior, leaving them susceptible to

debilitating infectious diseases, unintended pregnancies, and unfamiliarity with abnormal reproductive function [2]. The World Health Organization estimates that 340 million new cases of curable sexually transmitted infections occur each year and that many of these cases can be eliminated by providing knowledge and tools to young people who need a firmer understanding of their own reproductive biology [1, 2]. Indeed, in the United States, only 22 states and the District of Columbia mandate sex education, and only 13 of these states mandate that the instruction must be medically accurate [3]. Therefore, despite increased scientific knowledge of reproductive health, educators still face roadblocks in translating and disseminating this knowledge to the millions of adolescents whose health is at risk. Moreover, parents report the desire to educate their children about sexual and reproductive health but may lack fundamental knowledge to do so effectively [4]. The paucity of publically accessible information on reproductive health is a gap that must be addressed in order to improve health and reduce misconceptions about this important topic.

To address this need, the Women's Health Research Institute at Northwestern University created *Introduction to Reproduction* (<https://www.coursera.org/learn/reproductive-health>), a massive open online course (MOOC) to provide a free, accessible, and accurate curriculum on sexual and reproductive biology (www.coursera.org/learn/reproductive-health). In our analysis of course learners evaluated during the first 4 mo since its launch, over 30% have never received prior reproductive health education and self-report that the most common resources they consult to receive information about reproductive health are health professionals and the Internet. This makes the fact that *Introduction to Reproduction* can be accessed globally by anyone with Internet access an essential element in the design. This digital education experience offers unique opportunities to explore topics in reproductive biology using lectures, animations, three-dimensional (3D) anatomical illustrations, case studies, and self-reflection surveys. This course is available on one of the most popular MOOC platforms, Coursera, providing increased access and exposure to the international community. As of February 2016, Coursera had over 17 million learners, participating in nearly 1800 courses, from approximately 140 different universities and educational institutions [5]. To date, *Introduction to Reproduction* has been visited by 6641 individuals, from six continents, and has been well received with a satisfaction rating of 4.3 out of 5. Any viewer can access the Coursera site from an Internet browser to self-search for courses. There have been 2467 active learners and 289 course completers who have finished all the questionnaires.

This course combines pedagogical and instructional design best practices for online education with engaging multimedia experiences designed for today's Millennial learner. Through the inclusion of carefully curated content and meaningful assessment tools (in the form of multiple choice and critical thinking case studies), *Introduction to Reproduction* is designed to strike a balance between approachability and rigor,

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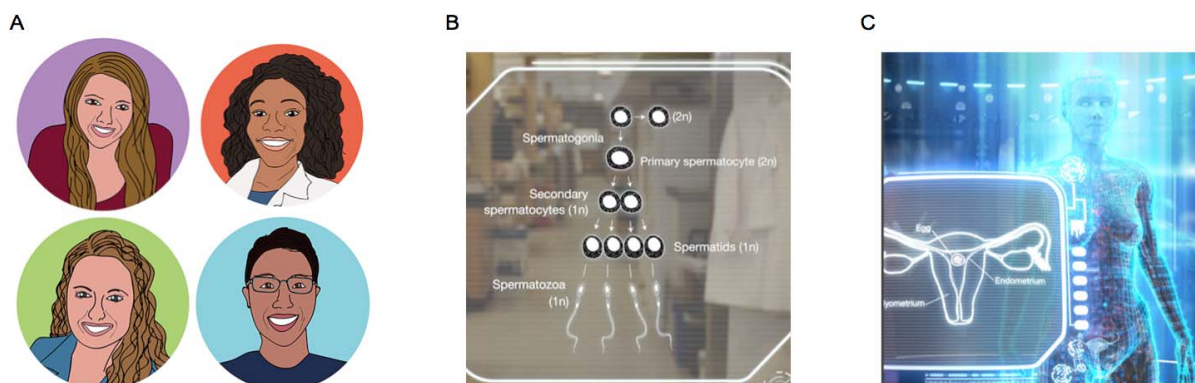


FIG. 1. Mixed media and methods used to communicate course content. **A)** Virtual TAs have a voice and provide commentary in the transcribed lecture material associated with each course. The TAs were involved with the curriculum and pedagogical team in ensuring the language used was accessible to a general rather than specialized audience. **B)** Graphic images are provided with lecture content to illustrate points. **C)** A virtual reality holodeck was created that included a male and female model to provide anatomy lessons in the context of a virtual reality or gaming environment. The mixed kinds of visuals, traditional questions, TA discussion, and short snapshots of each topic were meant to enable superficial learning with the possibility of learning more from resource guides available on the site.

ideally taking less than 2.5 h to complete. Unlike many MOOCs that place a heavy focus on student-to-student interactions, this course takes into consideration the sensitive nature of the topic and instead centers on a student's personal relationship and understanding of sex and reproductive health. Based on research showing that reflection triggers can be useful in promoting learning and prompting internalization [6], self-reflection surveys at the beginning and end of the course were incorporated to encourage students to question preconceived notions and connect to the material on a more individual, reflective level. In an effort to accommodate a variety of learning styles, the lecture material is provided orally and with an annotated script that included comments from virtual teaching assistants (TAs). The TAs have personalities in their voice and are emblemized by cartoon visuals. Online reading materials supplement the short video presentations and links to reproductive health tools—such as an app for menstrual cycle tracking—are placed in context with learning materials. One learner commented on this aspect of the course, stating, “I have learned information about my own body, which should really be basic common knowledge for all.” As research suggests, regular assessment drives student learning, which is especially important in an online context [7]. Reflective questionnaires are combined with knowledge-based quizzes and real-life case studies to allow students the opportunity to test knowledge gained and apply it in a relevant way. Content-based quizzes are administered after each module. Each quiz contains 10 multiple-choice questions that address applied content and critical thinking from each module. Students must score a 70% or higher to adequately complete the course, and students who score below a 70% may rewatch the lecture videos as much as needed and retake the assessment up to three times every 8 h, with no maximum number of attempts. This meets the needs of having summative assessments to certify completion of the course, while also mimicking some of the beneficial qualities of formative assessments, which have been shown to be effective in promoting student learning [8]. Additionally, this course uses college-aged TAs who use real-life examples and everyday jargon to make the content more relatable and bridge the gap between scientific terminology and day-to-day life. One course learner stated, “The quality of the video lectures and the course material is far beyond expectations,” and learners frequently utilize the course's discussion boards to share thoughts and continued insight on the topics taught. Initial analysis based on

learners' comments, completion rates, and postmodule assessments indicates this instructional design model is successful in engaging students and developing their knowledge in reproductive biology. The long-term monitoring of this course will be essential for continued evaluation.

In addition to considerations surrounding the pedagogical development of the course content, equal attention was devoted to the interface through which the viewers engage with the content. More and more people are seeking health information online [9]; long gone are the days when adolescent learners will first consult a library for information when instantaneous, online content is so readily available [10]. Therefore, in crafting this course, special consideration was given to the visuals that would enhance the Millennial learner's experience (Fig. 1).

Students learn about reproductive topics in a series of brief lecture videos, averaging 3.47 min a video. Keeping the videos short and focused encourages a higher audience retention rate [11]. The video content is crafted in four distinct visual styles designed to generate aesthetic variety and to reinforce the narrative arc of the course. The style of each video is tailored to best complement the content presented: 1) introductory videos are conversational and welcoming, with the professor speaking directly to the audience, opening the door to dialog on topics viewers may be initially uncomfortable with or embarrassed to broach; 2) primary lecture videos, hosted by the professor in her laboratory, combine direct scientific pedagogy and 2D animated illustrations; 3) 2D animated deep-dive videos illustrate complex key terms using illustrations and professor narration; and 4) videos focused on anatomy comprehension take place in a virtual world to illustrate not only abstract mechanisms, but also physical outlines of anatomy, and 3D human models accompany the professor as she guides learners through reproductive systems.

The development of these videos combined detailed knowledge of the content, instructional design best practices, and exciting visual technology. To place the professor in a 3D environment required bringing together green screen filming, motion capture, and 3D environment creation, technology that is advanced even in the broader MOOC environment.

Also important to the creation of lecture videos—and the course as a whole—is the international nature of the course's audience. To maximize the reach and approachability of the content, it was critical to be aware and respectful of the different cultures to which audience members belong. People

around the world have different cultural assumptions, different norms, and different concerns and expectations related to reproductive health. The goal was not to promote any single social view of reproduction or health, but to provide reliable, fundamental information and strengthen students' relationship with and investment in their own reproductive health to create informed people invested in their own health [12].

Scientific terminology can be difficult to comprehend, especially when covering topics that are so rarely discussed openly, such as reproductive health. To ensure improved comprehension of the course's modules, this MOOC incorporated the online reproductive health lexicon, Repropedia, to provide authoritative definitions using lay-language [13] (repropedia.org) for users without ever leaving the course page. In the Introduction to Reproduction course, students can hover over words to see Repropedia definitions without leaving the course site. Repropedia was developed in 2012 and continues to be enhanced and augmented with additional words and definitions. The definitions represent a collaboration of global reproductive scientists to serve as an authoritative source of definitions for reproductive health terms, and this integration of Repropedia onto the Coursera platform is the first technology of this kind. By assimilating reproductive terminology into the course via an interactive interface, learners can begin to articulate their own reproductive health experiences, perhaps leading to improved communication links to healthcare providers in the future.

By fusing a range of tactics—pedagogy, technology, and terminology—we feel Introduction to Reproduction has the ability to significantly advance reproductive health education on the individual, national, and global levels. Improved accessibility and understanding of fundamental reproductive biology emboldens viewers to make healthier choices regarding their reproductive health. Developing multimodal reproductive health portals is critical to the fields of reproductive science and medicine and to the public at large. This MOOC is the most recent kind of tool that we hope is broadly disseminated to the public. Moreover, we call on the reproductive science community to continue to build capacity with contributions of definitions to the Repropedia, by answering questions on the MOOC community board, by creating informative blogs and Twitter content that the public

can rely on, and by developing more resources that are accessible to a public that without our intervention are left with unsavory parts of the Internet as their resource pages for reproductive health.

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