Sidestepping the Elephant in the Classroom: Using Culturally Localized Technology to Teach Around Taboos

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ABSTRACT
Cultural taboos can restrict student learning on topics of critical importance. In India, such taboos have led multiple states to ban materials intended to educate youth about HIV, putting millions at risk. We present the design of TeachAIDS, a software application that leverages cultural insights, learning science, and affordances of technology to provide comprehensive HIV education while circumventing taboos. Using a mixed-methods evaluation, we demonstrate that this software leaves students with significantly increased knowledge about HIV and reduced stigma toward individuals infected with the virus. Validating the effectiveness of TeachAIDS in circumventing taboos, students report comfort in learning from the software, and it has since been deployed in tens of thousands of schools throughout India. The methodology presented here has broader implications for the design and implementation of interactive technologies for providing education on sensitive topics in health and other areas.

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Taboo Topics; Education; HIV; AIDS; India; HCI4D

ACM Classification Keywords
H.5.m. Information Interfaces and Presentation (e.g., HCI): Miscellaneous

INTRODUCTION
In every culture, there are taboo topics whose open discussion is considered inappropriate [57], especially within the classroom [18]. Depending on the culture, these topics can range from menstruation to racial inequality to homosexuality [13, 39, 18]. Inability or disinclination to foster open discussion leaves education on these topics incomplete or nonexistent.

When the topic in question involves significant threat to life or well-being, withholding education can be dangerous. Such is true with HIV, a virus that has claimed more than 35 million lives worldwide [71] and subjected millions more to social stigma and ostracism [37, 40, 72]. In India, which has the third-largest population of HIV-infected individuals in the world [68], taboos around the virus' modes of transmission have kept millions of youth from learning about it. State-sponsored adolescent education programs targeting HIV education have been banned across many states [9], leaving students uninformed about the virus. Even where HIV education is provided, it is often incomplete because of embarrassment, moral judgment, or lack of knowledge on the part of teachers [69, 14].

Culture and laws are slow and hard to change; we must find ways to circumvent taboos when they restrict education on critical topics. In India, working around taboos to provide HIV education can help curb the virus' spread by encouraging behavior change [32] and reduce stigma against infected individuals [66], impacting millions of lives. Any educational solution that addresses these goals must be *culturally acceptable* to ensure adoption and *complete* to ensure efficacy. Achieving this balance is challenging but possible by appropriately leveraging cultural insights, learning science principles, and the affordances of information and communications technology (ICT). Using cultural customizations to get around identified taboos and using techniques from learning science to fill identified gaps in knowledge can ensure acceptability without sacrificing completeness. Affordances of ICT, such as anonymity and uniformity, can enhance comfort and completeness by mitigating the impact of educators' embarrassment, moral judgment, or lack of knowledge.

We present TeachAIDS, an interactive educational software application that circumvents taboos to teach urban Indian youth about HIV. We describe the iterative design approach we used, which leveraged learning science, cultural insights, and the affordances of ICT. We also present a quantitative and qualitative evaluation of the design to highlight that it succeeded in increasing knowledge and reducing stigma around HIV. Finally, we discuss takeaways for the design of interventions for other cultures and topics and note that the software was deployed throughout India following the completion of this study.

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BACKGROUND AND RELATED WORK

In this section, we first describe our motivation for focusing on HIV education in India. We next discuss how learning science, cultural insights, and affordances of ICT can be leveraged to provide education that is both complete and culturally acceptable. Finally, we discuss research in the area of Human-Computer Interaction (HCI) and global development that has addressed the needs of individuals with HIV and other health topics.

HIV Education in India

Although HIV is a problem throughout the world, we focus on India here. This is because of lack of knowledge and stigma around HIV and limits on HIV education in India. Studies of adolescents and adults in India have found that significant percentages of people believe HIV can be cured [41, 26], are uncertain whether a contraceptive pill can prevent HIV infection [41], cannot identify all modes of HIV transmission [42, 23], do not know that condoms can prevent HIV [42, 23], or have never heard of HIV [44, 23]. In one study, many people reported believing HIV-positive individuals should be quarantined, be kept out of classes, or commit suicide [1]. Children with HIV have been expelled from schools within the last few years just for being infected [60, 35], and individuals involuntarily tested for HIV have had surgeries canceled if seropositive [33]. Lack of knowledge about HIV is associated with increased stigma [38, 7].

HIV education in India has been limited by laws and social norms. Explicit discussion or depiction of topics relevant to HIV transmission is often considered highly inappropriate, especially in the classroom. These topics include sexual acts and organs, intravenous drug use, and breastfeeding [9, 14, 65]. Materials made by India's National AIDS Control Organisation (NACO) to teach about HIV have been banned in numerous states largely due to explicit discussion of such topics [9, 14].

To our knowledge, no standard curriculum has been approved for schools across all Indian states. Thus, where HIV is taught, it is frequently left to educators to create or adapt their own materials. Teachers often provide incomplete information due to embarrassment, moral judgment, or lack of knowledge, and students are uncomfortable learning [14, 69].

Mass media interventions intended to educate people about HIV have been created and deployed through television, posters, and other media. These include the BBC World Service Trust's Haath se Haath Milaa Media Project, The Heroes Project, ZMQ Software Systems, and the Buladi Campaign [22, 59, 63]. However, constraints of time and space make it difficult to transmit complete information using mass media.

This leaves a gap for a school-based intervention that circumvents taboos to deliver complete information about HIV while leaving learners comfortable. Because of dangers posed by lack of knowledge and stigma around HIV, it is important that an effective solution be made widely available.

Insights from the Learning Sciences

Providing complete information should involve helping students form a sufficiently accurate mental model of the target topic. A mental model is a representation of how the world works, a view of how concepts and facts are connected that allows learners to store and access information more readily and reason through new situations when they encounter them [29]. It is unlikely students will form a sufficient mental model when they merely memorize a set of unconnected facts, a common problem in HIV education that leaves students unprepared to face unfamiliar situations [4]. Given that students often come in with inaccurate mental models, it is important to build toward more accurate conceptions in driving conceptual change [70, 61]. Efforts must also be taken to help students connect scientific knowledge (e.g., biological processes) to real-world scenarios (e.g., situations where HIV might be transmitted) [43].

Through consultations with experts in the learning sciences, public health, and medicine, mental mapping components—the relationships among HIV/AIDS content and concepts—can be identified. Through interviews, surveys, and tests of a representative sample of students, we can determine what knowledge and common misconceptions students have about HIV/AIDS and design a curriculum accordingly. Once these parameters are understood, we can incorporate other common learning techniques such as interactivity, analogies, and mnemonic devices [58, 8].

Cultural Sensitivity

Making a curriculum culturally acceptable requires understanding the nature of local taboos and finding ways to teach while respecting them. Surveys of students and teachers can be used to determine how comfortable they are with images and discussions of different levels of explicitness, identifying a *taboo tipping point* that should not be crossed. Subsequently, common cultural euphemisms can be used to address taboo-violating topics like sex in a way that does not cross this line. Such euphemisms can be drawn, for example, from common cultural reference points like Bollywood.

Customizing features like language, accent, and appearance of characters can increase learner comfort and attention by making learning materials more relatable, trustworthy, and familiar. Past work, for example, has shown that people are more likely to trust and be influenced by characters who share their accent and appearance [15, 46, 47, 54, 6].

Unique Affordances of ICT

ICT has a number of unique affordances [28] that have contributed to its success in teaching about sensitive topics. First, ICT can be used anonymously and privately [2, 5]. This can relieve students and teachers of the discomfort and embarrassment inherent in discussing a conversational taboo with another human [17, 31], a problem that can lead to incomplete knowledge transmission [69, 14]. Second, past work suggests that parents, teachers, and administrators view ICT as a reliable and respectable means of engaging material [50], which may help support adoption of educational resources for sensitive topics. Third, ICT interventions can be transmitted with a high degree of fidelity [49] and uniformity. This ensures that sensitive topics will be taught in the same way every time, with no information lost because of embarrassment, moral judgment, or lack of knowledge on the part of teachers.

HCI and Global Development

A body of HCI research focuses on understanding and designing for underserved, under-represented, and under-resourced populations across the world [16]. Much HCI for Development (HCI4D) research examines interventions for global health, including HIV/AIDS, maternal health, and human milk banking, among others [48, 52, 11]. ICT-based HIV/AIDS interventions successfully increase antiretroviral therapy (ART) compliance [24], provide healthcare decision support and confidential delivery of test results [27], and address patients' privacy needs to protect them from high stigma [30]. HIV/AIDS education and awareness-based interventions that focus on information dissemination include Project Masiluleke in South Africa [53], Text to Change in Uganda [67], Freedom HIV in India [19], and Learning about Living in Nigeria [36]. They use text messages and mobile games as vehicles for providing education on HIV/AIDS and related topics such as stigma and privacy. By considering interventions that leverage digital storytelling and incorporating a learning sciences-based approach, we can create a carefully designed conceptual framework that prioritizes cultural acceptability [55, 20, 56, 10].

DESIGNING TEACHAIDS

TeachAIDS consists of a twenty-minute animated curriculum that uses a conceptual explanation of biological principles and culturally familiar euphemisms to teach students about HIV. The animation consists of a back-and-forth question-answer conversation between a male doctor and a young male student. The doctor teaches about critical concepts relevant to understanding HIV transmission and prevention. We describe the human-centered design process we used to create the animation, outlining the key insights we discovered through this process and how they contributed to the final design.[1] This process, as well as the following quantitative and qualitative evaluation, received IRB approval from Stanford University.

Design Process

The design process consisted of the two phases below.

Phase 1: Initial Interviews and Surveys

To gauge students' knowledge of HIV and comfort learning about it, we conducted interviews with young adults born and raised in India as well as Indian school teachers, administrators, and leaders managing local non-governmental organizations (NGOs). Using semi-structured interviews, we asked participants questions to determine what educational interventions students had been exposed to, how knowledgeable students were about HIV, and what topics around HIV made them uncomfortable. We also showed existing educational interventions to students and collected their reactions. Following these interviews, we conducted an in-depth anonymous survey of 200 Indian urban college students to understand gaps in their knowledge around major HIV concepts. We also tested images and language around transmission modes used in actual HIV materials to ascertain student comfort levels.

In parallel, we interviewed dozens of experts in public health and medicine to determine what concepts around HIV were essential for student knowledge. We also interviewed cultural experts[2] and anthropologists with expertise in India to identify the most taboo concepts related to HIV as well as effective alternative methods of communicating them.

Phase 2: Prototyping and Testing

We triangulated our understanding of student knowledge states with knowledge considered important by experts to build a map of essential concepts around HIV transmission and prevention. We made sure to address concepts that students did not fully understand and about which students were found to commonly have questions, as revealed by initial interviews and surveys. We next worked with educators and learning scientists, who helped us further simplify these concepts in order to build a comprehensive curriculum.

Having developed this curriculum, we began creating and testing prototypes with Indian young adults as the user group. We tested approximately 150 iterations of the design. We began with paper prototypes; we then moved to PowerPoint and ultimately animations. In testing, we asked users to go through a think-aloud exercise as they interacted with the tool and to provide overall feedback. After each test, we incorporated insights gained into the next iteration.

Design Insights and Outcomes

Conceptualizing a Complete Curriculum

We designed the curriculum based on the questions and misconceptions students had about HIV and the information public health and medical experts considered essential for them to have. We took the union of these two sets to ensure that the knowledge students received was complete and that no critical information was missing.

Biology-Based Mental Model: Consistent with previous research [41, 23], our initial interviews identified significant gaps in student knowledge around transmission modalities (e.g., can you get HIV from kissing or hugging?) and prevention methods (e.g., can a condom prevent HIV?). Health and education experts helped us determine that a biological framing would allow us to teach these and other necessary concepts relevant to HIV prevention. In addition to helping students develop a clear mental model, a biology-based approach proved beneficial because biology is a standard topic taught in schools with which students and teachers are familiar and comfortable.

Our interviews had revealed that many students thought of HIV as a frightening abstraction associated with moral impurity rather than a biological concept. To address this, we first described biological concepts relevant to HIV (e.g., viruses, the human body) and used this to explain features of its transmission and prevention (e.g., high concentrations of the virus only exist in certain bodily fluids, HIV can only enter the

[1] This software, current versions of which can be found at http://teachaids.org/software, was the basis for Dr. Sorcar's thesis at Stanford University. The thesis [64] and a related book chapter [65] explore in greater detail the theoretical framework and design considerations around developing technology-based interventions for taboo topics.

[2] These included scholars studying India and others deeply familiar with the culture.

Figure 1. Scenes from TeachAIDS software. Doctor character (left); Kissing euphemism from Bollywood (center); "Suhaag Raat" wedding night (right).

body through particular pathways). We then linked these concepts to real-world scenarios like sexual activity with the help of cultural euphemisms, as described below. This linkage allowed students to reason through whether any given scenario carried a risk of HIV infection. Because stigma against HIV-infected individuals is associated with lack of knowledge and moral judgment, we hypothesized that this biology-based approach could drive decreases in stigma by *(a)* helping students recognize that the ways HIV can be contracted from an HIV-positive individual are quite limited and *(b)* shifting focus from moral judgment to biological understanding.

Learning Science Techniques: Having decided to use a biological framing, we used learning science elements like analogies and mnemonic devices to further simplify complex concepts, making them easier to understand and retain. For example, we used an analogy relating the body to a country, immune cells to soldiers protecting the country, and HIV to a foreign invader that can only enter the country in certain ways. This allowed students to understand the mechanism of HIV infection more clearly by relating it to something with which they were familiar. We also developed localized mnemonic devices to help students remember especially important concepts and reason through risk of infection in situations they had not previously encountered. One of these is the *Three-Point Mantra*, which helps learners remember the three high-risk fluids through which HIV can spread. Another is *The Triangle Test*, which helps learners identify whether they are at risk of infection and when to seek support from a medical professional.

Culturally Customizing for Comfort

Interviews, surveys, and testing helped us identify that taboos surrounding the depiction and discussion of sex represented the greatest potential obstacle to providing complete HIV education, but it was important for us to use images and language depicting sex to relate the biology-driven understanding of HIV transmission to real-world situations. We discuss here examples of how we identified the nature of these taboos and then circumvented them. We also describe how we used other cultural customizations to make materials more familiar and relevant to learners.

Graphics: In interviews and surveys with students and administrators, we showed images of intimacy of varying levels of explicitness, discovering that even the least explicit images were deemed unacceptable (e.g., two people kissing, a black and white line drawing of a naked couple embracing). Relying on insights derived from the cultural experts, we instead used common depictions of intimacy from Bollywood that we knew would be both acceptable and commonly understood. To represent kissing, we panned from an image of a couple leaning in for a kiss to an image of two doves pecking, a common Bollywood trope. To represent sex, we showed an image of a newlywed woman sitting on a bed decorated with flowers on her wedding night (*suhaag raat*), another commonly used reference in Bollywood (see fig. 1).

We also used interviews and surveys to determine how much skin was acceptable to show for a variety of scenarios, such as a woman breastfeeding. For each scenario, we iteratively tested out a collection of images with different levels of skin exposure, getting feedback in some cases directly from students and in others from whether the version of the survey containing an image of a certain level of exposure was allowed to be deployed in schools. This helped us determine where the 'taboo tipping point' was for skin exposure for various scenes in the animation (see fig. 2).

In addition, we depicted many characters and objects using cultural elements specific to India. These include clothes (e.g., *salwar*, *dhoti*, *sari*, *bangles*, *bindi*), mannerisms (e.g., *namaskar*), food (e.g., *roti*, *sabji*), and animals (e.g., *brahman cow*, or a white cow with horns). We took steps to give the materials relevance to people across different demographic groups; these included using characters from across different geographies and religions of India.

Language: Our interviews revealed that certain sex-related language could be written but not spoken, and that some ways of discussing sex were completely unacceptable. We found that words like "semen" or "vaginal secretion" made learners uncomfortable when spoken but were acceptable in written form. Interviews also revealed that discussion of specific orifices (e.g., "vagina") combined with sexual actions (e.g., "penetration") was unacceptable. Instead, we clearly defined words such as "natural openings" and "direct transfer" individually earlier in the animation and then used them later, in combination, to discuss transmission.

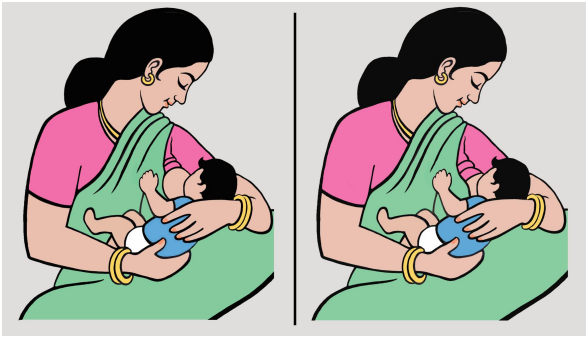

Figure 2. Example of the image testing process to identify a taboo tipping point. The exposure of skin (in picture on right) was the final version approved by learners and other stakeholders for the TeachAIDS software.

We also customized the sound and appearance of the animations by drawing on research that suggests that people find agents similar to them more trustworthy, motivating, and comfortable [15, 46, 47, 54, 6]. Characters all spoke with an Indian accent, and the voice for each character was chosen from a wider selection using feedback by learners. We ensured certain words and phrases whose usage varies across English dialects were properly represented in Indian English. These include "prevention is better than cure" ("an ounce of prevention is worth a pound of cure" in American English), "appearances can be deceptive" ("looks can be deceiving"), and "cold and cough" ("flu").

Drawing on Affordances of ICT

We designed and implemented TeachAIDS in ways that leveraged specific affordances of ICT for teaching around taboos. Interviews indicated that students were embarrassed to learn about topics related to HIV in group settings and hesitant to talk about them with peers. For anonymity and privacy, students can watch the animation individually on separate computers with their own set of headphones, and the entire curriculum can be presented without the teacher's involvement. We incorporated a student character so that learners can easily relate and a doctor character to lend increased credibility to the information presented; however, to strengthen the feeling of anonymity, we did not give names to the doctor or student avatars, a decision that also avoided the potential issue of students associating the student character with any peers who might share the same name. We also confirmed through our interviews that teachers are often embarrassed to teach about HIV or do not have full knowledge about it, leading important information to be omitted. The software that students interact with is an executable file that plays the entire set of animations. This can ensure that the same complete information about HIV is presented uniformly each time, regardless of teachers' embarrassment or lack of knowledge.

QUANTITATIVE RESEARCH FINDINGS

We now describe the data, analytical approach, and results from the quantitative side of the evaluation, which examined students' changes in knowledge, attitudes, and comfort as they engaged with TeachAIDS to learn about HIV.

Data Collection

The sample for the quantitative evaluation consisted of 295 students randomly selected from three high schools in New Delhi and Haryana in India. The number of students recruited at each institution was based on the number of functioning computers at each site. All students were recruited on a voluntary basis and assured that they could discontinue participation at any time if they experienced discomfort. No students refused to participate.

We asked the sampled students to take a 15-minute baseline survey (hereafter known as the "pretest" at T1), which measured students' pre-intervention knowledge and attitudes about HIV. The knowledge questions measured how educated each student was around HIV transmission and prevention issues. The attitudinal questions measured general acceptance and tolerance around HIV and HIV-positive individuals. Immediately after the pretest, students in the treatment group (n=198) were assigned to receive the TeachAIDS intervention (for more information, see the Assignment, Balance and Attrition subsection below), and students in the control group (n=97) silently read text unrelated to HIV or science for the same amount of time as the intervention group.

Immediately after the administration of the pretest and intervention, we measured students' post-treatment outcomes with a 20-minute survey (hereafter known as the "posttest" at T2). The posttest contained similar questions to the pretest but in an alternate order. The survey also consisted of questions about students' backgrounds and their subjective reactions to the intervention. The background-related questions were added to the end of the posttest instead of the pretest so as not to influence student performance on either. Furthermore, approximately one month after the posttest, all students were asked to take another 20-minute survey (hereafter known as the "retention test" at T3). The retention test again contained similar questions as the pretest and posttest but in random order. It also contained questions about subjective reactions to the intervention and interest in sharing information about HIV with others.

In each survey administration (pretest, posttest, and retention test) students were asked to fill out the survey forms individually. Each administration was closely proctored by our survey enumerators, who were local school administrators trained for this activity.

Variables

We measured student knowledge and attitudes by drawing on and adapting survey questions that are commonly used in the research literature. For example, we drew on questions from the Stereotypes About AIDS scale [62] and the Assessment of Knowledge and Beliefs About HIV/AIDS Among Adolescents scale [34], among other sources. Altogether, we analyzed responses to 40 questions about knowledge and 17 questions about attitudes. Knowledge measures included questions like "Can you get HIV from touching a public toilet seat?" and "Can you get HIV from a blood transfusion?" Attitude measures asked students to give affirmative or negative responses to statements like "I won't talk to or interact with

anyone with HIV/AIDS" and "People with HIV/AIDS should not be allowed to handle food in restaurants."

To estimate the total knowledge and total attitude scores at T1, T2, and T3, we calculated the number of questions that were answered correctly in each category. Similar to other studies using the knowledge questions, each student selected an answer of *yes, no,* or *not sure*. A correct answer was assigned *1,* and *0* was given to any answers that were incorrect, "not sure", or had a missing value. For the attitude questions, the students could reply with *agree*, or *disagree*, or *not sure*. A value of *1* was assigned to the responses reflecting greater acceptance or positive attitudes towards HIV and AIDS related issues, and *0* was assigned for responses reflecting less acceptance or negative attitudes. After calculating the total correct scores (for knowledge and attitudes separately and in each survey administration separately), we transformed them into z-scores. We then constructed a binary indicator to distinguish between the treatment and control conditions. Specifically, the indicator *TeachAIDS* equaled 1 if the student received the TeachAIDS animated software and 0 if they were in the control condition. Finally, we constructed a set of control variables using background information collected during the posttest. In particular, we controlled for gender (female = 0, male = 1), age (calculated in years), mother's education level, and father's education level. The analyses also controlled for the standardized pretest knowledge and attitudinal measures.

Assignment, Balance, and Attrition

Two high schools (one in Delhi and one in Haryana) received the treatment condition, while one high school (in Delhi) received the control condition. The assignment was done at the school level in order to avoid contamination between the treatment conditions, as it was plausible that students would share knowledge or attitudes with their peers between the posttest and retention test. Because of this, we tested for balance across the treatment and control samples, adjusting standard errors to account for the fact that students were nested within schools. We found no statistical differences in student background characteristics across schools or between the control and treatment groups.

Students in the treatment condition received TeachAIDS while students in the control condition were asked to read silently from one of their existing non-science textbooks. In particular, the control condition was not given a comparable HIV program as no standard, nationally approved curriculum existed at the time. However, teachers informed us that the student participants had learned about HIV through exposure to larger HIV awareness campaigns in the mass media.

Statistical Approach

To determine the impact of TeachAIDS on student knowledge and attitudes, we ran the following adjusted regression model:

$$Y_{ij} = \beta_0 + \beta_1 TeachAIDS_j + Z_{ij}\beta + \epsilon_{ij}$$

Where Y_{ij} represents the outcome (knowledge or attitudes, posttest or retention test) of student i in institution j, $TeachAIDS_j$ represents the binary treatment indicator for whether the student received TeachAIDS or not, and Z_{ij} represents a vector of baseline student characteristics (controls including pretest measures, gender, age, mother's education level, and father's education level). In the above equation, β_1 represents the impact of TeachAIDS on student outcomes. In all of the analyses, we use the vce(cluster) option in Stata 13.0 to adjust the standard errors. We make this adjustment because unlike the standard case in which unobservable values are independently and identically distributed, the unobservable values of students are likely more similar within schools than across schools [3]. Using the cluster adjustment results in larger standard error estimates and thus leads to a more conservative interpretation of the statistical results.

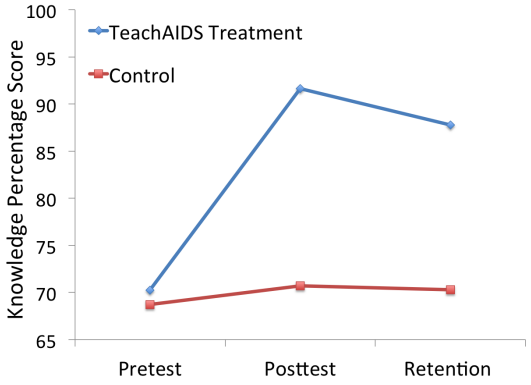

Figure 3. Knowledge percentage scores for TeachAIDS treatment and control groups at pretest, posttest, and retention test.

Results

Gains in Knowledge

In the model that fully adjusts for all covariates (including pretest measures and demographic features), students who had undergone the TeachAIDS intervention scored 1.44 standard deviations higher on knowledge measures at posttest than students who did not undergo the intervention, significant at the level of $p<0.01$ (t-value = 55.54). Importantly, at the retention test one month later, students who had undergone the TeachAIDS intervention still scored 1.14 standard deviations higher on knowledge measures than students who did not undergo the intervention, significant at the level of $p<0.01$ (t-value = 40.64). There was no significant difference between groups at pretest.

These results suggest that the TeachAIDS intervention drove significant increases in knowledge about HIV and that these increases largely persisted over time. Total scores on the knowledge measures at pretest, posttest, and retention test for the treatment and control groups are shown in Figure 1. Consistent with these improvements in knowledge, 96.5% of students said they learned more about prevention through the TeachAIDS tutorial than through any other prior communications channel, including television and school.

Changes in Attitudes

In the adjusted model, students who had undergone the TeachAIDS intervention scored 0.40 standard deviations

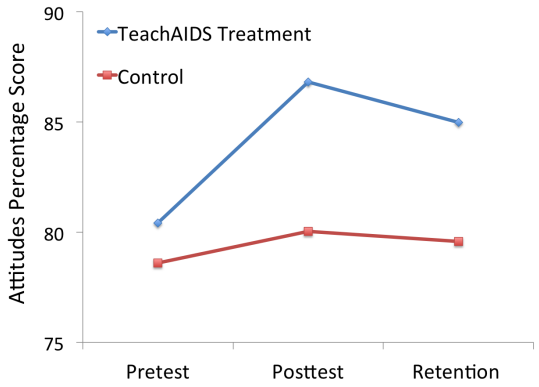

Figure 4. Attitude percentage scores for TeachAIDS treatment and control groups at pretest, posttest, and retention test.

higher on attitude measures at posttest than students who did not undergo the intervention, significant at the level of $p<0.01$ (t-value = 20.20). Importantly, in the retention test one month later, students who had undergone the TeachAIDS intervention still scored 0.24 standard deviations higher on attitude measures than students who did not undergo the intervention, significant at the level of $p<0.01$ (t-value = 58.75). There was no significant difference between groups at pretest. These results suggest that the TeachAIDS intervention drove decreases in negative attitudes about HIV and HIV-positive individuals, and that these decreases largely persisted over time. Total scores on the attitude measures at pretest, posttest, and retention test for the treatment and control groups are shown in Figure 2.

Results revealed that after watching the animated tutorial, a greater proportion of intervention students indicated they felt less afraid of interacting with HIV-infected people rather than feeling more afraid ($p<0.01$) and were less afraid of being infected with HIV rather than more afraid ($p<0.01$). One month later, 89% of students exposed to the intervention reported having shared information about HIV with others, and 75% reported having sought additional HIV-related information on their own.

Comfort levels

Though HIV and its modes of transmission are generally considered taboo to discuss in India, 99% of intervention students indicated they were comfortable learning from TeachAIDS. Additionally, 77% of students said they preferred learning about HIV from the TeachAIDS tutorial, while only 1% preferred learning about HIV from their teacher, with the remainder showing equal preference for either option. Also, 96% of students said they would be willing to forward the tutorial to others they cared about, and 78% said they would be willing to join our team to stop the spread of HIV. This further suggests that TeachAIDS successfully circumvents taboos, with students comfortable learning from it, sharing it with others, and being public messengers of HIV prevention.

QUALITATIVE RESEARCH FINDINGS

The original plan was to directly interview select students to understand their experience of engaging with TeachAIDS. This was met with strong disapproval from school administrators and teachers, yet they did allow us to design a survey that sought detailed, open-ended feedback anonymously. This survey included broader questions around students' comfort in watching and interacting with the animated curriculum and what they liked or did not like.

The responses were insightful and validating. We present results from an open-coding process and the identification of themes. We describe how the students perceived the learning content, including the elements of the design they found acceptable.

The Learning Experience

Students across the board responded with positive feedback on the learning experience. This included feedback on the curriculum and the information presented, the use of animation, and the intervention's potential to reach a wider audience across the country.

Complete, Clear, Concise Curriculum

Many students shared that the curriculum addressed all their questions and concerns and that the content was comprehensive and complete, leaving *"no doubts"* in their mind.[3] One student *(F, 17)* said and many agreed, *"all the necessary information was present."* Another *(M, 17)* shared that he had known much of the information previously, but that TeachAIDS explained concepts to him in more detail. To this point, another student added:

> *"the animated tutorial was beautifuuly designed, covering various areas related to HIV/AIDS . It answered all the quetions and cleared most of the doubts" [sic] (F, 16 yrs).*

In addition to completeness, students praised the curriculum for its clarity and ease of understanding. They mentioned the material had been presented *"nicely"* and *"systematically."* One student *(F, 16)* voiced that *"everything was to the point and easy to understand."* In general, students found the curriculum to be well organized and appreciated the *"step by step" (M, 16)* approach.

Although we went through multiple iterations with students and experts to ensure the materials included all relevant and necessary information, some students posed additional questions not explored directly in the materials. For example, one student *(F, 16)* asked, *"should a child blame his parents for hiv?" [sic].* She was skeptical about the ease of getting tested for HIV because it would involve asking parents' permission, which would be awkward. Students were also interested in learning more about treatment options for HIV, that is, whether it could be cured if detected early. One of them *(M, 16)* asked if yoga could prevent HIV.[4] Subsequent iterations of the software have addressed these questions.

[3] In India, the word "doubt" is common terminology for "question".

[4] Though the animation did not mention yoga, this question may have been raised because of the media attention to political leaders who have suggested replacing "sex education" with yoga [21].

Engaging and "Fun" Animation

Students found the process of interacting with the curriculum *"user friendly"* and *"fun."* One student shared: *"i want to tell that the animation was a very entertaining means of informing people..." [sic] (F, 18 yrs).* Students liked the animation (particularly the doctor's animated mustache) and found that it made the material easier to learn and entertaining. One student *(M, 16)* mentioned, *"because the animated part is the best way to understand each and every thing about the hiv virus" [sic].* Though students consistently appeared to identify several benefits to using an animated curriculum, there was one outlier student *(F, 16)* who thought it was *"very boring",* but still *"learnt a few new facts about HIV" [sic].*

Targeting a Broader Audience

The students' favorable response to the curriculum was further validated by their overwhelmingly strong sentiment that the curriculum need not be limited to eleventh graders alone—a far broader audience could engage with it. They suggested that this audience could include younger students (starting with seventh graders), as well as those in other schools, *"every school,"* across the country, and in *"every part of the world" (M, 16).* Students also suggested that we create similar tutorials on other sensitive topics related to public health, requesting *"please do spread information and preventive measures about other diseases as well" (M, 16).* Finally, they advised that the materials could cater just as well to those who lived in villages or were unable to read.

The Sociocultural Experience

The findings indicated that, in addition to having an effective learning experience, students found the curriculum to be culturally acceptable and relatable. One of the major design objectives was to ensure that the students felt comfortable learning from the curriculum. This also meant ensuring that the students did not feel threatened or embarrassed due to the presence of their teacher or peers. We now present findings that demonstrate the high comfort levels of the students as they engaged with the material.

Comfortable

Many students mentioned that they felt shy or embarrassed at the thought of discussing sensitive topics with their teachers and that the curriculum saved them from this discomfort:

> *"in this way u dont have to bother about what others are thinking" [sic] (F, 17 yrs).*

Learning through the curriculum made them feel at ease, as one student *(F, 16)* shared, *"It was more comfortable to have an interactive learning through an animation series rather than a live person even doctor" [sic].* There were a few students who remarked that they were fine with a live person disseminating the same content as long as this content was accurate. Some pointed out that the animated curriculum was better for those from more conservative backgrounds. Indeed, the most common response from students was that this kind of material was not *"easy to discuss with anyone" (M, 16).*

Although the respondents were all students, they also mentioned the teacher's perspective. For example, one student said that the animation was more friendly than a teacher would have been. Feeling uncomfortable with the teacher appeared to be the norm, but some students also had concern for how their teachers would feel, sharing, *"well....i am comfortable with teachers.....i am just doubtfull of the teacher though...." [sic] (F, 16).* Engaging with the curriculum thus also freed the students of this concern for their teachers.

Figure 5. School children in New Delhi, India, engaging with the TeachAIDS animated software.

The qualitative data provided further evidence for the quantitative findings that TeachAIDS left students feeling comfortable. Below we highlight two specific reasons shared—that their engagement with the curriculum was one-on-one and that there was complete anonymity in this exchange.

Learning One-on-One

Students had a strong positive response to the one-on-one nature of the learning experience. They mentioned this experience was preferable to having a teacher go through the curriculum with them as it saved them from *"embarrassment".* A few students shared they were able to discuss this sensitive topic with friends, though this did not seem to be the norm:

> *"yes this is true because i dont have the guts to talk to my parents about aids , i just talk about it with my friends but i didnt know this much about it" [sic] (F, 16 yrs).*

The need for privacy was strong among students given the intense social stigma associated with HIV. They appreciated the opportunity to engage with the curriculum without anyone else being part of the learning experience. We also found that students were sensitive to the issue of gender. For example, one student shared her hesitation that stemmed from her teacher being male, making it harder for her to talk about HIV openly in the classroom:

> *"class teachers arent always the best peopletp talk to about sensitive issues ike these because one they are males which doesn not make us feel any comfprtable and a anonymous tutprial conveys the important message without making us feel uncomfortable which we would have felt sitting and learning in a group with all the classmates around" [sic] (F, 18 yrs).*

Although the students were learning in a group surrounded by their classmates, their engagement with the material took

place one-on-one—that is, each student used one desktop (see fig. 5). Using headphones made them feel that they were watching *"alone.... and no one was standing on my shoulder or seeing what i was doing" [sic] (M, 16).*

Anonymity

In addition to learning one-on-one, even if in a full room of peers, students drew comfort from the fact that their participation was anonymous. That is, no one would know that (or how) they were engaging with the curriculum. Talking to teachers about topics such as these seemed quite challenging for the students. Thus, the ability to learn from an *"anonymous tutor [who didn't know] whom he was teaching to" (M, 17)* was received well. Our design decision to not use names in the animation but to instead refer to the characters as *"doctor"* and *"student"* further reinforced a sense of anonymity.

LIMITATIONS

The generalizability of these results may be limited because the students who participated in this study are not fully representative of the country's student population. Due to the taboo nature of the topic of HIV, we were only able to test the intervention in private schools. Additionally, the sample schools were in North India, used English as a medium of instruction, and were attended by students from middle-income backgrounds. For example, the participants may have started with higher knowledge and attitude levels and hence been differentially affected by the intervention compared to less-educated individuals. Students from different socioeconomic and geographic backgrounds may also show different levels of comfort with the topics covered in the animations. Future studies should involve participants from more diverse backgrounds to explore these issues.

DISCUSSION

We would first like to share parts of the design process that we learned from and found particularly challenging and insightful. We then share how the software could be improved and how our approach might translate to other cultures or sensitive topics.

Challenges in Designing for Sensitive Topics

The process of identifying the taboo tipping point in the context of schools was challenging, as it required great sensitivity in designing a survey that would itself not be rejected for being inappropriate. The survey went through seven iterations before it was finally approved. The first iteration included questions asking students to draw pictures about their understanding of HIV, which was outright rejected. In the sixth iteration, we were instructed to change the name of the survey from "HIV/AIDS Survey" to something more "scientific" or "general." This led us ultimately to use "General Health Survey", itself a euphemism. Because approval by gatekeepers was a key goal in designing TeachAIDS, we were able to glean insights from the survey rejections (if, for example, the survey was rejected for having an image with too much skin) to help identify the taboo tipping point.

Understanding and adjusting for the constraints imposed by gatekeepers was key in other parts of the design process as well, especially because of the sensitivity of this topic and perceptions of student knowledge. Multiple gatekeepers initially claimed that an intervention was unnecessary as students would have learned all relevant information from mass media, implying there would be a ceiling effect in pretest knowledge levels. This was in fact not the case, making the increase in knowledge driven by the software a surprise to them. We worked with private schools as we were not allowed to run the TeachAIDS intervention in public schools without formal approval of the curricula by NACO. However, private schools were also worried about the reactions of parents when they found out their children were learning about HIV in class. Since private schools are run by fees paid by the parents, their approvals and blessings matter. Showing the software to gatekeepers including the schools' administrators and owners allowed us to convince them that it was appropriate for students in the upper grades. It had the side benefit of providing education on this topic to these gatekeepers, a group whose knowledge and attitudes of HIV could have a real impact on students' lives. Once the software was developed, dozens of NGOs were interested in it but scared to use it. We learned that all HIV materials, including ours, needed to be approved by NACO in order to be used by any organizations across the country.

Improving the Approach

A number of considerations could lead to pedagogically beneficial improvements for future versions of the software.

Gender: For this study, the TeachAIDS materials were shown in mixed-gender classrooms. However, while teaching sensitive subjects, educators often divide the classroom by gender suggesting it may maximize comfort for all learners. In the interviews and surveys, a number of female students specifically noted discomfort learning about sensitive subjects from a male (human) instructor. Given these responses, female students may perhaps show greater comfort or changes in knowledge and attitudes while learning from a female (animated) instructor. It is possible for these differences to be greater in urban vs. rural settings, as gender dynamics vary. To address this, female and male student comfort and learning could be measured using gender-specific versions of the TeachAIDS software across various contexts.

Privacy: Students noted they were comfortable because they were watching materials "alone", but they were not alone. More investigation is needed to understand how technology can create a virtual private learning environment for the learners. This is especially important because a one-computer-per-child administration of the software with headphones is not feasible in many scholastic environments.

Rural vs. Urban: The ways in which knowledge gaps and social stigma differ between urban groups (who have received greater exposure to mass media) and rural populations should be explored further. Evidence suggests that rural populations may know less about HIV than urban ones [23], meaning TeachAIDS could be particularly useful in rural areas. However, rural schools are much less likely to have access to technological resources that would allow them to play the software. Additionally, compared to urban students, students in

rural areas might not have the same background knowledge to help them understand the biological concepts explained in the animation. They also might have a different taboo tipping point around each image (e.g. less or more skin exposure) and sensitive term (e.g. less or more explicit language) used. Given this, would the learning effects of the software change in a rural setting? Aside from official central and state government approvals, are there other gatekeepers whose buy-in would be needed to share education on taboo topics in more rural communities?

Using this Approach with Other Cultures

The approach presented here may be used to create culturally acceptable materials for cultures beyond North India. Knowledge states and myths around HIV may vary significantly across cultures. Both the taboo tipping point and cultural euphemisms to address it will also vary significantly, as will particular accents, language, and cultural artifacts. Interviews and testing with users and conversations with cultural experts can help us identify these.

Differences across cultures in knowledge about HIV and myths surrounding HIV may necessitate differences in what information is presented. For example, in Zimbabwe, there is a myth that having a sexual encounter with a virgin may cure an HIV-positive person [45, 25]. In places like South Africa, the myth that AIDS is not caused by HIV has been promoted by influential leaders for many years [12, 51]. Changing such beliefs can only be accomplished by first fully understanding them and what has led people to hold them.

Elements of how information is presented must also differ across cultures. Language is key; even within India, linguistic and cultural diversity justify the creation of different versions for different languages and regions. Further, analogies like comparing the immune system to an army work well in India but may not work well where the military is not trusted, and the depiction of the body as a country may be sensitive for groups who have been displaced from their homeland or whose countries are not recognized formally by the United Nations. The doctor character as an authority is a natural choice in urban India, where interviews with students and cultural experts identified doctors as the most trusted source on this topic. However, in places where doctors are scarce and people are more accustomed to rural health care workers, such workers may be a better representative. In other places, the most authoritative and trusted sources may be village chiefs or religious leaders.

Using this Approach with Other Topics

Our design process could be used to create educational tools for other important topics like sexual assault and racism around which conversational taboos exist. To help designers of such tools, it may be valuable to generate a repository of images, words, and metaphors that are culturally appropriate within a given culture or across cultures. These could include, for example, images of the body that show a culturally appropriate amount of skin. It would also be important to identify necessary changes; for example, a doctor as the teacher and the comparison of the body to a country would be useful for some health topics but potentially not others.

POST-STUDY DEVELOPMENT

Since this study, the TeachAIDS software has been officially approved and distributed by the National AIDS Control Organisation in India. It has been approved for in-school use by the governments of states like Karnataka that had previously banned other forms of HIV education. States such as Andhra Pradesh, where HIV-positive children were expelled from schools, have also formally adopted and distributed locally customized versions of TeachAIDS. These examples provide further evidence that TeachAIDS successfully circumvents the local taboos that had prevented previous interventions from being adopted and scaled. The success of this model and approach has led to the development of further customized versions of TeachAIDS, which are being used as standard materials for HIV prevention education in every state across India, as well as other countries.[5] To date, NACO has distributed 100,000 physical copies of the software, which have been shown in more than 30,000 schools in India. TeachAIDS has also been adopted enthusiastically by other groups within India, such as hospital personnel, midwives, military doctors, and corporations.

CONCLUSION

To create TeachAIDS, we used a human-centered design approach relying on insights from learners and experts, incorporation of learning science techniques, attention to cultural acceptance, and utilization of the affordances of technology. Our process has led to the development of an intervention that effectively addresses the tension between complete knowledge and cultural sensitivity that often hinders education on taboo topics. This intervention drives increased knowledge and decreased attitudes of stigma, leaves learners comfortable, and has found widespread adoption across India, even in places where other HIV education materials had been banned. As described, we believe the process we detail in this paper can be used to develop teaching materials for sensitive topics in a wide variety of other fields and cultures. As with any intervention, good design is a necessary but not sufficient prerequisite of large-scale adoption. Other critical facets of the process of adoption, such as the challenges around managing politics and stakeholders, will be addressed in future papers.

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[5]The cultural transferability of the design of TeachAIDS – within and across countries – will be the focus of future publications.

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