

# Use of New Media to Engage the Public in the Ethics of Nanotechnology

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July 2010



Project sponsored by the National Science Foundation and the Regents of the University of California.

This publication was supported by a subcontract with the University of California under Award #0452371 from the National Science Foundation. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the University of California nor those of the National Science Foundation.

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## Evaluation Overview

**THIS REPORT PRESENTS FINDINGS** from external evaluation of [powerofsmall.org](http://powerofsmall.org), an interactive website developed by the Center for Technology Innovation at the University of California Berkeley's Lawrence Hall of Science (LHS). The purpose of the website was to engage the public in decision making on ethics and nanotechnology. The National Science Foundation (NSF) provided funding for the project through the Informal Science Education program (Award Number 0452371) under the Directorate for Education & Human Resources. This is the final external evaluation report for [powerofsmall.org](http://powerofsmall.org); it synthesizes data on project activities from April 2006 through May 2010.

### Methodology – The Evaluation Study

Edu, Inc. served—under contract to the University of California—as external evaluator for [powerofsmall.org](http://powerofsmall.org). Edu, Inc. assisted with web content planning, usability testing, and authored a summative brief reporting the project's activities.

The overarching purpose of evaluation was to provide expertise and experience in user testing and evaluation of public outreach using new media. Project sponsors asked Edu, Inc. to act as coach, critical friend, and advisor on usability testing.

Edu, Inc. guided use of storyboards to test ethical scenarios, and led six rounds of web usability testing to evaluate information architecture, user interface, and navigation at [powerofsmall.org](http://powerofsmall.org). This summative brief documents project activities, presents the evaluator's observations and lessons learned.

The purpose and budget of this engagement did not allow the evaluator to conduct systematic testing nor gather multiple data to formally measure the effectiveness of new media to engage the public in ethical discourse.

### Evaluation Findings

- LHS successfully produced and tested five models of interactive media and several feedback mechanisms allowing people to share opinions on ethics and nanotechnology.
- LHS successfully used video to present ethical scenarios to the public.
- LHS developed and tested an interactive kiosk that effectively gathered video responses to ethical scenarios at five public venues.
- The current website is a proof of concept for engaging the public. It offers three tools to provide online feedback: voting, text commenting, and video upload.
- Not all users wanted or knew how to upload a video response to the web.
- The project offers several lessons learned in the areas of: scalable technology, scenario design, user testing, creating social media, designing for mobile devices, and evaluation of the efficacy of new media to engage the public.

## Executive Summary

Nanotechnology creates new materials by manipulating molecules at the ultra-small scale of 0.1 to 100 nanometers. Nanoscale products offer powerful and unprecedented applications for society but may raise ethical issues. This report documents a project to develop and test use of new media to engage the public in discourse regarding the ethics of nanotechnology.

To encourage informed decision-making among the general public regarding ethical issues in nanotechnology, a team at the Center for Technology Innovation at UC Berkeley's Lawrence Hall of Science developed [powerofsmall.org](http://powerofsmall.org), a companion website to *Power of Small*, a three-part national series presenting ethical scenarios in nanotechnology. The series aired on the Public Broadcasting Service (PBS).

Visitors to [powerofsmall.org](http://powerofsmall.org) can view short videos from the PBS series that present a variety of ethical scenarios dealing with the potential impact of nanotechnology on privacy, health, and the environment. Visitors can respond to an ethical issue presented in the video through three interactive media: posting a text comment, voting, or uploading a video response to YouTube. Visitors may respond to text or video feedback left by other users or share content through social media providers.

This report documents the evolution of the project from 2006 to 2010. It begins with early efforts using storyboards to create and test compelling ethical scenarios about nanotechnology. It next documents the progression from presenting scenarios using web-only devices such as comics and online forums to developing a portable kiosk that allows people to watch video scenarios and record a video response.

Finally the report describes the current suite of web-based tools at [powerofsmall.org](http://powerofsmall.org) to allow public feedback on ethical issues.

The authors find evidence that the project produced a successful proof of concept satisfying the goal of developing and testing new models of interactive new media to allow the public to engage in discussion of ethical issues in nanotechnology.

The report ends with eight lessons learned to guide the design and implementation of innovative multimedia learning resources essential to growing the portfolio of Informal Science Education tools.

The National Science Foundation, a United States government agency, provided funding for the project.

## Introduction

The report details the efforts of the Center for Technology Innovation at UC Berkeley's Lawrence Hall of Science (LHS) to develop and test new media as a vehicle to educate and engage the public in discourse regarding ethics and ethical dilemmas pertaining to new technology, particularly nanotechnology.

The report documents the work of LHS to develop interactive features at [powerofsmall.org](http://powerofsmall.org), the companion website to the National Public Broadcast System (PBS) series *Power of Small*.

Visitors to [powerofsmall.org](http://powerofsmall.org) can view and consider short videos from the PBS series that present a variety of ethical scenarios dealing with the potential impact of nanotechnology on privacy, health, and the environment. Visitors can respond to a video through three interactive media: posting a text comment, voting, or uploading a video response to YouTube.

The Center for Technology Innovation also experimented with web comics, an online forum and a video response kiosk to promote ethical discourse.

This report considers two questions:

- 1) To what degree did LHS successfully produce and test new models of interactive media to allow the public to register personal opinions on ethical scenarios regarding nanotechnology?
- 2) What lessons learned can guide and inform NSF ISE as it considers new opportunities to reach large numbers of people through interactive new media?

## Emerging Technologies Require Ethical Decisions

Emerging new technologies raise new possibilities, challenges, and potential ethical dilemmas that will need to be addressed. It is consequently essential to engage and accustom the public to ethical decision-making in the context of emerging technology, particularly nanotechnology.

## Define Nanotechnology

Nanotechnology constitutes a body of rapidly developing technologies with potential applications to medicine, energy, manufacturing, and communication. It is a multidisciplinary field that focuses on the creation and manipulation of objects at the nanoscale. A nanometer is one billionth of a meter. Such technology has the potential to pervade every facet of life, and consequently it raises numerous critical policy and ethical questions.

## Traditional Media Informs; New Media Can Engage

Media can be leveraged as a vehicle to inform and engage the public. Traditional media such as print and television is a one-way process of informing the audience,

but new media can allow and encourage participants to actively engage with the material, making it a two-way experience.

New media is an emerging and changing catchall term for interactive digital media using internet-based technologies to allow communication and collaboration among users and between users and content. Examples include forums, blogs, videos, chat, multi-player video games and social media services.

Owing to its interactive format new media has potential for eliciting interest, and promoting discourse and ethical decision-making, but valid models need to be developed and tested.

## What was Produced

This section documents the evolution of testing performed by the Center for Technology Innovation at Lawrence Hall of Science (LHS) to develop an input device using new media to allow public discussion of ethics and nanotechnology. It chronicles the transition from web only devices like comics and an online forum to a physical kiosk and finally to an online kiosk at the [powerofsmall.org](http://powerofsmall.org) website.

In this section Edu, Inc., the external evaluator, reports evaluation activities to test usability and feasibility of various new media technologies deployed by LHS between September 2006 and May 2010.

Date	Evaluation	What was Evaluated
November and December 2006	Topic Testing of Ethical Scenarios	Topics and scenarios storyboards
January to June 2007	First Usability Testing – Several rounds	Information Architecture, User Interface, Forums, Early Comics, Earth and Sky Radio
July to December 2007	Second Usability Testing – Several rounds	User Interface, Usability Issues, Comics, Videos, Feedback Mechanisms - Commenting Polling
June to December 2008	YouTube and Blogs – Front-end evaluation	Feasibility of YouTube and blogs to promote discourse between the public and experts
August 2009 to April 2010	Kiosk – Formative evaluation	Efficacy of and public interest in recording video responses to ethical scenarios
April and May 2010	Online Kiosk – Usability testing	Usability of interface to allow public upload of video responses to ethical scenarios

Table 1 What was evaluated when.

### *Intended Outcome*

The intended outcome for the project was to engage the public and to promote discourse on ethical topics relating to nanotechnology. LHS used new media to create an online venue to promote interaction and discussion.

This section illustrates the progression from web only devices like the comics and an online forum to a physical kiosk that asked the public to record video responses to ethical scenarios. The story ends with an online kiosk at the [powerofsmall.org](http://powerofsmall.org) website that allows the public to vote, leave text comments, or upload video in response to ethical scenarios.

Edu, Inc. and LHS agreed at the beginning of the project that unrelenting contact with users throughout the formative evaluation was a critical component to creating a user-centered experience. That story follows.

### **Scenarios**

The project began with a list of written scenarios designed to elicit interest and promote inquiry into the ethics of nanotechnology. Edu, Inc. convened a panel of testers to determine which scenarios were the most interesting and engaging.

### *Topic Testing*

To evaluate individual scenarios Edu, Inc. conducted two rounds of topic testing through purposeful sampling of five test audiences: Teens age 16 to 19, twenty somethings, PBS watchers and NPR listeners ages 30-39, 40-49, 50 and older. Results were aggregated and reported through six personas.

The evaluation focused on determining three things: which scenarios were believable, which scenarios evoked strong assenting or dissenting opinions, and which scenarios encouraged users to seek more information about nanotechnology.

### **Storyboards**

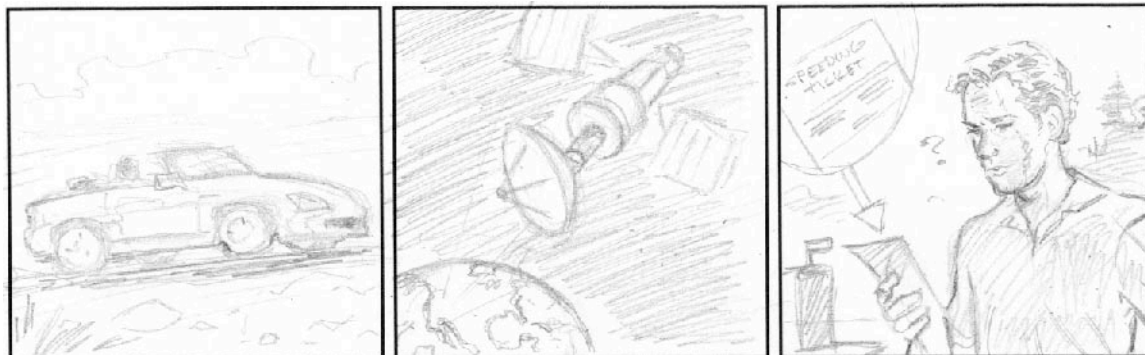
To prune the list of scenarios LHS constructed visual storyboards to test the content, in order to ascertain which scenarios were interesting and to learn how to present the scenarios in a way that forced users to make a decision or to take a stand.

LHS produced storyboards of 11 scenarios, each in the form of a three-panel comic. Storyboards simplified the process gathering feedback and metrics from user testing.

User testing helped LHS adjust the scenarios to be more clear and compelling and improved the process of communicating concepts through comics.

Finally – user testing with storyboards led to the selection of three final ethical topics that were featured on [powerofsmall.org](http://powerofsmall.org): privacy, health, and environment.

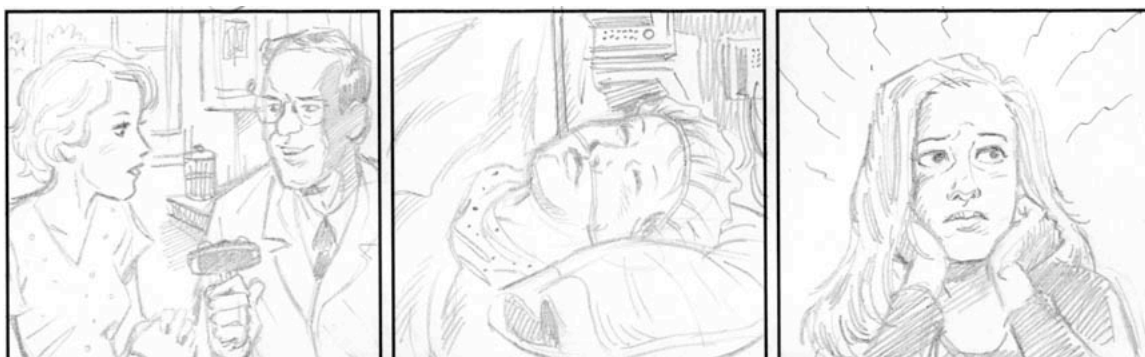




Users understood the scenario in this early storyboard but did not find the topic of satellite tracking compelling.



All users expressed concern about the idea of commercial pilots using alcohol but were torn about government regulation (last panel).



Users reported an emotional connection with the issue medical testing and health.

Figure 1 Storyboards used to test ethical scenarios.

## Comics

LHS adapted the most successful scenarios into a series of comics. The main purpose of the comics was to develop a fun and interesting way to present scenarios on nanotechnology ethics for public discussion. The six panel comics portrayed situations pertaining to ethical issues in nanotechnology.

LHS presented the comics on [powerofsmall.org](http://powerofsmall.org) alongside various mechanisms designed to test various methods for promoting discourse about nanotechnology. For example, questions positioned under a comic invited users to respond in an online forum, slider bars measured users' degree of agreement or disagreement with a given statement, and radio buttons recorded Yes or No answers.

The comics underwent user testing over a one-year period. Again, user testing was a critical component to developing functional new media.

### *About Webcomics*

Webcomics are independent comic strips that are distributed for free online. Most are self-published.

In the late 1990s the independent comic format bloomed into an Internet genre that currently consists of well over 16,000 strips that are updated on a daily, weekly, or monthly basis.<sup>1</sup>

Educational webcomics have to compete with the wealth of materials available for free. Readers expect a high, consistent and professional level of quality. Most readers judge a work based on a combination of the perceived quality of dialog, artwork, and narrative coherency. Typical readers expect a very high level of quality in all three categories.

The bulk of webcomic readers are in their teens, twenties, or early to mid thirties.

### *Sample Comics*

The following page shows two comics that LHS used in an early version of [powerofsmall.org](http://powerofsmall.org). The topics were Privacy and Health. After reading a comic visitors could enter their opinion by responding to a question in a feedback mechanism or by leaving a comment in an online forum.

LHS eventually chose not to use web comics in favor of video.

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<sup>1</sup> Retrieved from:  
[http://www.vbulletin.com/forum/faq.php?faq=vb3\\_board\\_usage#faq\\_vb3\\_forums\\_threads\\_posts](http://www.vbulletin.com/forum/faq.php?faq=vb3_board_usage#faq_vb3_forums_threads_posts). June 15, 2010.

SECURITY AND PRIVACY



HEALTH

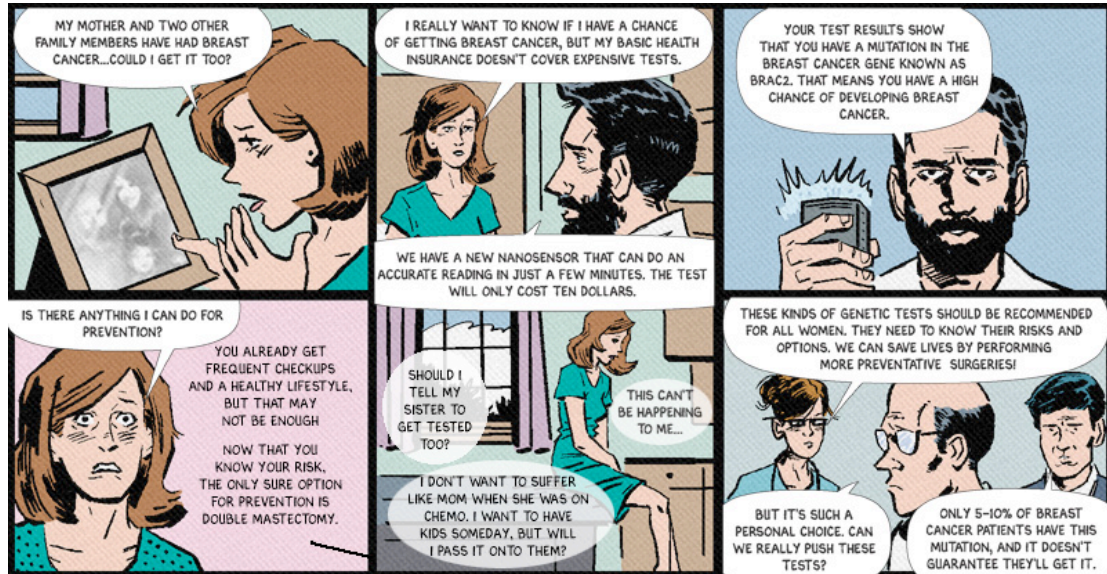


Figure 2 Web comics presenting ethical scenarios, circa 2007.

## Feedback Mechanisms

LHS faced two major challenges while building scenarios: determining how to best present them to testers, and obtaining useful feedback. Development and refinement of effective feedback mechanisms was an ongoing process. LHS undertook multiple rounds of user testing to address the problems

WHAT DO YOU THINK? Use the following sliders to express your opinion.

I like it.  Strongly Disagree  Strongly Agree

I fear it.

This should be regulated.

WHO ARE YOU? Tell us more about yourself.

I am  Male  Female    Age     Education  High School  College  Phd

Figure 3 Prototype feedback mechanisms, circa 2007.

Through user testing sessions LHS experimented with several methodologies to elicit useful feedback and opinions about the scenarios from users. LHS tried a wide variety of techniques to elicit feedback, ranging from voting on simple Yes/No questions, more granular five-point Likert scales, sliders and free-form text comments. A persistent issue was polar opposite answers (Yes/No or Agree/Disagree) or even graded opinions were insufficient to address the complex ethical questions that the scenarios posed. A second challenge was how to obtain free form qualitative data while also producing quantitative metrics.

The feedback form below from 2010 lets visitors post a text comment, add images and share using social media.

### VIEWER COMMENTS

Environment: Clean, Green, and Unseen

23 Shared Thoughts

M [Log Out](#) ✕

[Add another site](#) ▾

Share ▾ [This Page](#)

What's on your mind...

[Add Images](#) ▾ [Follow](#) ▾

Figure 4 Comment form using social media, circa 2010.

## Forums

An Internet forum, or message board, is an online discussion site often devoted to a specific area of interest. The LHS team embedded a forum within [powerofsmall.org](http://powerofsmall.org) to present ethical topics and elicit discussion.

The objective was to develop a sense of virtual community among regular users who would frequently visit the Power of Small forum. People participating in the forum would cultivate social bonds and interest groups while participating in discussions about ethical topics related to nanotechnology.

Over several months a community of repeat users began to congregate on the forum and discuss issues. LHS ultimately abandoned the online forums when spammers, utilizing a number of illicit techniques including botnets and other malicious software, began to autonomously post unrelated and offensive content at too great a rate to effectively police.

Successful Internet forums are a product of interested participants and dedicated administrators. Without a large user community limited discussion discourages new members from participating. Without effective administrators and moderators spammers, inflammatory posters (or trolls) often come to dominate the forum, making it an unpleasant place for interested participants to have discussions.

## YouTube Contest

Beginning in Fall 2008 the Nano Ethics project prototyped and tested a third technique to promote continued discourse between the public and experts in issues pertaining to ethics in nanotechnology. The objective was to build a continuing media presence via the Internet as the airing of the PBS series waned.

The project proposed a pilot study to test the efficacy of using its YouTube channel to distribute original two-minute videos created by graduate student scientists and engineers working in nanotechnology.

The idea – sponsor a YouTube contest which encouraged experts to create videos that communicated current nanotechnology research in their labs to the public. The project would distribute videos via blogosphere and emerging social media and elicit public feedback through YouTube comments or video responses, and then ask experts to respond.

The take away for NSF was a new catalog of nano-science content, as well as the opportunity to prototype and test a grass roots model for encouraging two-way dialogue between nano-science content experts and Internet users.

After a period of feasibility testing the concept using video presentations to explain and highlight research activities was found to be innovative but unsustainable. Without continuous funding to create incentives for video production by busy scientists and graduate students, and to hire staff to collect and organize the videos, production of recordings would cease.

## The Kiosk

From August 2009 through April 2010 the project conducted a highly successful prototyping and evaluation of an interactive portable kiosk as an input device designed to extend the reach and interactivity of ethical scenarios from [powerofsmall.org](http://powerofsmall.org).

The kiosk—affectionately dubbed the ‘Nano Confessional’—uses PVC plastic pipes, fabric curtains, portable lighting, a laptop computer and a microphone to build a small booth – a private space in a public place. People enter the ‘Confessional’, watch a one-minute scenario on a laptop computer, and use a webcam to record their video response to a question provided by the scenario. For example “Would you implant a nano tracking system in your aging relative?”

The outcome of the kiosk project was to determine the efficacy of a public kiosk as a tool for presenting information to engage the public and to promote discourse on ethics and nanotechnology.

Public response to the kiosk was positive. Formative evaluation showed that, with compelling scenarios, the kiosk is an effective strategy to engage the public and a proof of concept for an input device to gather public feedback on complex issues.

Evaluation provided further evidence that the kiosk has significant utility as a social science input device to spark discourse and catalogue results.

## Formative Evaluation of the Kiosk

The kiosk went through five rounds of formative testing between September 2009 and April 2010. Edu, Inc., the external evaluator, and Lawrence Hall of Science jointly developed the evaluation protocol. Staff from Lawrence Hall of Science conducted the evaluations and Edu, Inc. reviewed the results. During formative evaluation 91 people tested the kiosk and 87 people recorded videos in the kiosk.

Following primarily positive feedback from preliminary testing with 32 people at the NISE Network meeting in September 2009 the team made small changes to the user interface and improvements to the audio, video camera, and microphone.

During the first-round of testing at NISE Network evaluators tracked 18 users. Fifteen people (83%) felt the interface was easy to use. Sixteen (89%) felt the video length was good. Regarding video length test users said: “Nice and short.” “It was long enough to make me wonder more and make me want to learn more.” “Couldn’t have been any longer.” One tester said “Very short – made it hard to understand.”

When asked ‘How could the questions be more compelling?’ eight users (62%) found questions acceptable for example: “Pretty compelling – related to real life situations”, “drew me in”, and “Great, it made me think.”. Five people (38%) wanted questions to have more detail. This finding suggests that eliciting quality video responses depends on realistic and relevant scenarios that users can identify with followed by well-written compelling questions.



Figure 5 The Kiosk invited people to record video responses, circa 2009.

## Evaluation Debrief

Date	Event	Location	Videos Recorded
Sep. 14 to Sep. 16, 2009	Nanoscale Informal Science Education Network (NISE) Annual Meeting	San Francisco, CA	32
Oct. 31 to Nov. 1, 2009	ASTC Convention	Fort Worth, TX	20
Nov. 30, 2009	Materials Research Society Student Mixer at MRS Fall Meeting	Boston, MA	11
Nov. 31 to Dec 1, 2009	Materials Research Society Fall Meeting	Boston, MA	14
Apr. 6, 2010	Materials Research Society Student Mixer at MRS Spring Meeting	San Francisco, CA	10

Table 2 Formative Evaluation of Kiosk - Dates and Venues

While debriefing with Edu, Inc. LHS evaluators made several observations.

“Some of the venues...could be noisy due to locating in high traffic areas or in a social event.”

“We need a microphone that’s more unidirectional and short range to cut out the crowd noise.”

“Social events can be a great gathering for these videos because people were more outgoing and willing to share.”

“Incorporate into the interface a simple inline waiver to lower inhibition to and ease signing photo and video release.”

Finally the kiosk booth “should be a sit down experience to increase accessibility for a variety of heights and abilities”. (And wheelchairs.)

One test user suggested closed captioning because it was hard to hear the video.

Designers discussed the kiosk as part of a multi-platform strategy to engage many publics – kiosk, website, video conference calls, and in person interviews recorded on a smart phone.

In summary, LHS conducted formative evaluation with many publics including educators, technologists, scientists and the general public. The kiosk was not tested with children or teens. A test user commented “I have high school kids that are used to Skype and MySpace, so they would love [the kiosk].



## Online Kiosk

In spring 2010 following the success of the video-recording kiosk to gather input, LHS finished construction of a set of web-based tools to gather feedback and encourage discourse through an 'online kiosk' at the [powerofsmall.org](http://www.powerofsmall.org) topic pages. (e.g. <http://www.powerofsmall.org/topicpages/health.php>).

### Soliciting Feedback and Promoting Discourse Online

Visitors to the topic pages at [powerofsmall.org](http://www.powerofsmall.org) website can enter input with three online tools: a polling utility (*Your Turn*), a text commentary section (*Leave a Comment*), and self-submitted video commentaries (*Join the Conversation*).

Visitors to the topic pages are asked to provide feedback after viewing videos about current ethical issues in nanotechnology in three topics: privacy, health, and environment. Users can interact with the topics in three ways: (1) lodging their opinion by voting in a *Your Turn* poll centered around ethical dilemmas presented in each topic; (2) leaving a text comment in *Leave a Comment* to register their opinion or respond to other comments posted by prior users; and (3) *Join the Conversation* by recording and submitting a video comment that is uploaded to YouTube and can be viewed by other users.

*Your Turn*, the polling activity, asks users to respond to a single question about an ethical dilemma posed by a video of experts discussing an ethical issue. After they finish viewing video, users are invited to register their assent or dissent to the dilemma, after which they may see what percentage of other users agreed or disagreed with the same proposition.

*Leave a Comment*, the commentary, discourse and sharing section, lets users enter text comments to register their opinion. Users can read prior comments posted by other users, and discourse is established through discussion and debate by entering text responses in the comment field. Optionally, contributors can use an embedded form to log into one of several social networking sites and link their posted response to their accounts.

*Join the Conversation*, the video upload option, allows users to record a short video of themselves responding to the question posed by the scenario, essentially a video comment. Users can record videos using a digital camera or a video camera or can record directly to YouTube using their YouTube account and the YouTube WebCam service. Current users can also view video comments made by prior visitors to the site.

### Online Kiosk - Usability Testing

Developing an 'online kiosk' to solicit discussion about a difficult topic that many people do not know about is a challenge. Recognizing this LHS asked Edu, Inc. to conduct a usability review of the polling, commenting, and video upload features of [powerofsmall.org](http://www.powerofsmall.org).

To support usability testing Edu, Inc. maintains a large network of media usability testers (Media Testers). Media Testers range in skill from novice to expert web users. They are screened and rated on their ability to clearly articulate their experiences.

Edu, Inc. conducted exploratory user research using talk aloud protocols and mediated interviews. Edu, Inc. invited five testers to use the three interactive online tools on topic pages. Testers included two expert users, two intermediate users and one novice user. The panel was intended to provide a general critique of the interactive features in order to guide LHS developers in the absence of a fully funded round of user testing.

### Summary of Test Results

*Your Turn*, the polling activity was easily understood and used by all testers. The novice and intermediate users found the instructions understandable, the questions clear, and “enjoyed the quick feedback.” Expert users instantly knew how to vote, found the questions “well written” and complimented the progress bar that showed the status of the system as it loaded their vote into the total votes.

*Leave a Comment*, the commentary and sharing section, allowed all testers to leave a comment. The novice user understood none of the social media features, the intermediate users understood some social media features and the expert user understood all social media features. Two testers said they might share their comments through social media, one was unlikely to share and one would not share.

*Join the Conversation*, the video upload option was “is the most interesting and fun but is the hardest to use” according to the novice user. The novice user did not have a YouTube account. The intermediate users “easily figured how to upload my video response to YouTube”. One said “I have a YouTube account but wouldn’t want to use it for this feature.” Both expert users understood how to upload a video comment and both had YouTube accounts. One expert was likely to upload a video response. The other expert would not upload a video response. All testers said that they “really enjoyed” and “strongly recommended” watching videos from other users.

### Motivation

One expert tester was motivated to interact with the site and planned to return to the site and share comments. The novice tester said “I really enjoy seeing the vote totals, reading people’s comments and watching video responses but I’m not a social media person.”

Three testers saw no reason to interact with the site. One said “I felt like I didn’t get any real value or satisfaction by providing feedback.” An intermediate tester commented, “For me the process of uploading a video seems time-consuming and a little frustrating.” A third tester said, “Without any motivation unexcited users are likely to enjoy viewing other comments but unlikely to create any of their own.” One expert user said, “I get how to use the site but have no interest in the topic.” The second was “very excited” and planned to return to the site on her own.

### **Solid Technology**

Expert users felt that the technology used to implement the powerofsmall.org online feedback section – partially based on Google services – is solid, robust, and reliable. The choice to develop the commenting and video upload system on a commercial grade, scalable service allows developers to take a flexible and open-ended approach to the design of future web applications.

### **User Interface**

While the video feedback system is built on solid technology and information architecture, there is potential to refine the user interface. The evaluators understand that the user interface for the video response feature is in an early beta phase. The issues to address are simple and surface level such as potential changes to labels, the need to add some missing video prompts, and a small number of broken links that need to be repaired.

### **Analytics**

LHS has implemented Google Analytics, a free service offered by Google that generates detailed statistics about how visitors interact with a website. Google Analytics tracks use of video, social networking features, and web-based applications allowing the LHS team to make informed site design improvements.

The final build of the online kiosk is functional, but is still an early beta. A general lack of traffic on the site made it difficult to gather analytics. LHS is well positioned to gather quantitative evidence to track the use, impact, and efficacy of the video and social networking features of the online kiosk.

## **What was Learned**

The Center for Technology Innovation at LHS contracted with the external evaluator, Edu, Inc., to provide expertise and experience in user testing and evaluation of public outreach using new media. LHS asked Edu, Inc. to act as coach, critical friend, and advisor to the web development project.

In their role as advisor Edu, Inc. observed that LHS successfully satisfied the project goal of producing and testing five new models of interactive media and several feedback mechanisms to allow the public to register personal opinions on ethical scenarios regarding nanotechnology. The evaluators suggest that there is significant anecdotal evidence to recommend four practices tested by the LHS:

- 1) The potential of web comics as a media to present ethical scenarios
- 2) The use of video as a media to present ethical scenarios
- 3) Use of the physical kiosk to gather video responses to ethical scenarios
- 4) Use of three tools for online feedback: voting, text commenting, and video upload

The evaluators recommend that NSF consider future funding for continued development and testing of an online video service that will allow the public to view ethical scenarios, see other peoples' responses, and upload their own.

The design and implementation of innovative multimedia learning resources is essential to growing the NSF Informal Science Education (ISE) portfolio.

Edu, Inc. proposes eight lessons learned and questions to ask that can guide and inform NSF ISE as it considers new projects to engage large numbers of people in ethical discourse through interactive new media. The suggestions are based on challenges and successes experienced by LHS over the four-year project.

1. Topic Neutral Platform – The multimedia resource should present ethical scenarios and allow public feedback across STEM topics and disciplines.

- Works equally well with nanotechnology, bioengineering, or cybernetic architecture?

2. Technology and Team – Build a team who can use scalable commercial services (Google, Amazon, etc.) to develop, host, administer, and grow web applications.

- The team has experience to easily build, maintain, and scale hosted web-based applications?

3. Compelling Scenarios – New media requires effort from users. Design and test engaging scenarios that make it easy for users to provide quality feedback.

- Project understands how to engage, motivate, and immerse users across age and culture?

4. User Testing – Unrelenting contact with users is essential for user-centric cyber-learning.

- Clear plan, budget, and expertise to consult with users early, often, and ongoing?

5. Combine Physical and Virtual – Consider options for presenting ethical situations in person to allow face-to-face discussion and online to promote virtual sharing.

- If appropriate, is there an option to present ethical situations in person and online?

6. Build Community – Integrate existing and emerging social media to help users connect, share, and interact. Track the paradata to learn the impact of social media.

- Is there an intelligent strategy to leverage, monitor, and measure the impact of social media?

7. Mobile Devices – Design content and feedback mechanisms to promote instantaneous, location aware, user-generated content from mobile devices.

- Articulate proposal for two-way, real time interaction using mobile technologies?

8. Efficacy Indicators – New media is promising. Develop standards to measure and describe the benefits delivered to the users and the funding agency.

- Evaluation plan has clear strategy to monitor, evaluate, and measure impact of new media?