

THE FUTURE OF CONTENT

MARCH 2013

RESEARCH THEME UPDATE

**mediaX
STANFORD UNIVERSITY**



mediaX at Stanford University connects businesses with Stanford University's world-renowned faculty to study new ways for people and technology to intersect.

We are the industry affiliate program to Stanford's H-STAR Institute. We help our members explore how the thoughtful use of technology can impact a range of fields, from entertainment to learning to commerce. Together, we're researching innovative ways for people to collaborate, communicate and interact with the information, products, and industries of tomorrow.

The Future of Content: Creation, Consumption and Curation of Media Content in K-12 Contexts

Research Theme Update

March, 2013

Acknowledgements

The research-in-process reported here is underway at Stanford University under sponsorship by a mediaX Themed Research initiative, made possible by a gift from mediaX strategic partner, Konica Minolta. This research initiative began with a question from the business community, and a small group conversation that grew to include an international business community and an interdisciplinary group of researchers. Building on a firm grounding in fundamental science from previous research, Stanford's world-class expertise has been brought to bear on a real-world challenge.

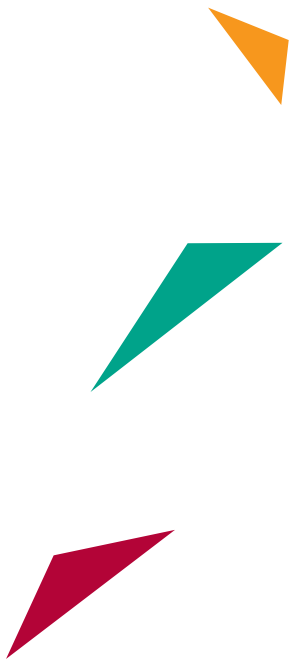


TABLE OF CONTENTS



The Future of Content: Human Sciences and Technologies for the Creation, Consumption and Curation of Media Content in K-12 Contexts

Background and Introduction

<i>1. Prospects for Scientific Advances in Work on Learning From the Perspective of Work in Education and Technology</i>	<i>5</i>
<i>2. Contests as a Catalyst for Content Creation Contrasting Cases to Advance Theory and Practice</i>	<i>9</i>
<i>3. A New Generation of Hybrid Tangible Interfaces for STEM Learning in K-12 Environments</i>	<i>21</i>
<i>4. Physical Media as Active Social Learning Agents</i>	<i>23</i>
<i>5. The Stanford Clinical Anatomy Scans (SCANs) Library for STEM Learning in K-12 Environments</i>	<i>27</i>





Introduction: Future of Content

Human Sciences and Technologies for the Creation, Consumption and Curation of Media Content in K-12 Contexts

In today's media environment, creation and consumption are two sides of the same coin. Some have called this the era of "Liquid Media"; others have called it the "Creator Economy." By entering terms into a search engine, users of all ages contribute the data on which the search engine runs. By enabling location-aware functions on mobile devices, users build the capacity of the location-aware devices they use in many different contexts. At the same time, new services that enable learning, provide personalization, and assure integrity - trust, security and authenticity – are being developed for individuals and organizations. These changes impact media content in learning environments of all types – higher education, K-12, continued education, and workplace education. These changes impact the way individuals and organizations create and consume media content for learning purposes. They expand the meaning and opportunities for curation as well.

Across the entire innovation ecosystem of media, new technologies and new uses of them are creating a sea change in educational contexts, including:

- o **Creation** – Whether by individuals, sensors, or algorithms; whether new, unbundled or re-bundled; and whether for administrative, pedagogical or entertainment purposes.
- o **Consumption** – As random, targeted, rogue, authenticated, protected, and/or sharable objects move fluidly through the environments in which education occurs.
- o **Curation** – Whether ephemeral, dynamically updated, or archived by an individual an organization, or a data-driven, automated service.

This mediaX Research Theme Update provides a mid-year window into four Stanford research projects framed in the context of **The Future of Content in K-12**. Each project is unique to this theme, yet nests into other portfolios of research activities underway at Stanford and beyond. At its core, each project builds on prior research and is intended to serve as a foundation for future research. The projects included in this report were launched in September 2012 (for the 2013 academic year).

Roy Pea's contextualization of the *National Research Council's Grand Challenges for Education for Life and Work* identifies two major opportunities for scientific advances in work on learning for education. Both are relevant to this mediaX Research Theme and its continuation:

- o The vision reflected in personalized learning at scale suggests an always-on networked world of educational opportunities that optimize learning at many levels of difficulty and assistance. Research is needed to understand the requirements for learning maps of dependency relationships, metadata tagging and recommendation engines, digital assessment and feedback systems, deep understanding of how to match learner modalities to learning resources, and the meaning of identity and relationships in the technology-enhanced learning process.
- o To fully leverage multi-modal learning interaction science and technology, research is needed to

understand the complex multi-sensory experience of embodied semiotic interactions, meaning in context and sensory modalities. Technologies and methodologies for integrating diverse types of data (from sensor streams, workbench streams and human-coded data) are needed for pattern detection and sense-making, which will analyze and adapt in-situ experiences for rich interaction with data stream inter-relationships.

The goals of the mediaX Future of Content Research Theme span the creation, consumption and curation of media content in K-12 contexts, across the wide range of organizations, people and technologies involved; they span formal and informal learning environments, as well as in-school and out-of-school contexts that include teachers, administrators, students and families. Four projects are exploring new insights about the intersection of people, media and technologies based on asking new questions, new ways of studying those questions, and new ways of combining observation and judgment about media content.

The Contests as Catalysts project (led by Brigid Barron) is studying ways to foster the creation of content by students. The research team is investigating differences among three types of engagement motivations and participation incentives for student contests for online content creation: chance, competition and altruism. Using quantitative and qualitative methods, the research team is also exploring student behaviors, roles and opportunities for community participation with formal academic programs, specifically those that leverage interactive programs to create new educational content.

The Hybrid Tangible Interfaces project (co-led by Paulo Blikstein and Ingmar Riedel-Kruse) explores the requirements for personal, web-enabled science labs. In a use case experiment, they address the urgent need in many fields for access to “wet lab” and real lab experiences to promote deep learning in areas in which empirical work is crucial, such as the STEM disciplines (science, technology, engineering and math). Implementing a bimodal learning model, learners build a model of a device or phenomenon in the real world and attach sensors to it; then they build a virtual model (on the computer) of the same device or phenomenon using one of several computational modeling platforms. Learners run both models, and explore and investigate the function and behavior of the device or phenomenon. These projects build and test novel “bimodal interfaces” for high school biology and chemistry classes.

The Physical Media as Active Social Learning Agents project (led by Clifford Nass) is exploring how learning motivation can be influenced by social back-channeling in mechatronic media. This team has built interactive mechatronic learning components for high school students. Experimental protocols vary methods of integrating a social agent and an empathic response into the learning device, as students complete a tutorial and then work in a self-guided exercise. Using video recorded observations of the tutorial, as well as pre and post tests, the research team is studying how engagement and information retention are influenced by the presence of a personalized social agent with emotional response.

The Stanford Clinical Anatomy Scans project (led by Professor Sakti Srivastava) is testing the requirements for use by high school and middle school students of an online library of educational CT scans

(the Stanford Clinical Anatomy Scans Library– SCAnS). The team is investigating how media consumption experiences impact learning for a teaching methodology that uses layered, augmented media content to support instruction. They are also identifying user interface and delivery technology requirements for media distribution to a range of devices geared to individual and to group instruction.

These four projects initiate the **mediaX Future of Content Research Theme** and its broad insight agenda on the question: *What insights are needed for people to thrive in the new media content and technology environments of K-12 contexts?*

Other exploratory questions include:

- How can requirements for fluid administrative and pedagogical content ecosystems (multi-mode, cross-media, multi-screen, and multi-owner) be articulated for new tools, platforms and operating systems? What are the new roles and opportunities in educational content (formal and informal hubs of influence)?
- How will new technologies - sensors, scanners, visualization tools, time-based user experiences, and others - transform the creation of blended, layered, augmented media? How will users navigate this content?
- How can the multidimensional flow of media objects be enabled, tracked with usage analytics, and monetized to recognize and encourage creation, appropriate consumption and curation?

Martha G Russell

martha.russell@stanford.edu

Executive Director

mediaX Team

Susana Montes

susanam@stanford.edu

Communications Manager

Adelaide Dawes

adelaide@stanford.edu

Program Manager

Prospects for Scientific Advances in Work on Learning

*From the Perspective of Work in Education and Technology*¹

Roy Pea, Faculty Director mediaX at Stanford University; David Jacks Professor of Education and Learning Sciences Director, H-STAR Institute.

This paper begins with a clarifying framework for the aims of education synthesized in a recent NRC report on Education for Life and Work—what it is that people should be able to know and to do, in terms of three broad areas of competencies: cognitive, intrapersonal (such as intellectual openness, initiative, metacognition) and interpersonal (such as teamwork, collaboration, leadership, responsibility). A central implication of this framework is that we need a science of learning for education that examines conditions for developing complex performances and competencies, not only memory and problem-solving and solo learning.

Furthermore, how learning occurs and affordances for its design change in a fundamental way when everyone everywhere has immediate access to the hyperconnected world of smart phones tapping into cloud computing, social media, broadband wireless networks, rich media conferencing, and big data informed apps. Many predict jobs will be far more rapidly transformed in this hyperconnected world. Lifelong learning and re-tooling for new jobs is a persistent fact of life, as necessary knowledge and tools for work and life undergo waves of disruption and re-invention.

This tripartite emphasis is important for broadening STEM participation. More than cognitive processes and strategies are at stake in educational participation. Interpersonal issues such as stereotype threat, difficulties in communication and collaboration and intrapersonal issues such as disciplinary identity and self-evaluation are consequential for selecting and maintaining STEM learning pathways.

It is valuable to contextualize several overarching challenges and opportunities for research, design, tool and theory development in relation to this framing. Each surfaces substantial needs for scientific advances in work on learning for education.

Challenge #1: Personalized Learning at Scale

The 2010 National Education Technology Plan presents a Grand Challenge Problem of personalized learning in an always-on networked world of educational opportunities (p. 78): “Design and validate an integrated system that provides real-time access to learning experiences tuned to the levels of difficulty and assistance that optimize learning for all learners, and that incorporates self-improving features that enable it to become increasingly effective through interaction with learners.” *Grand challenge problems*

¹ Prepared by request for the National Science Foundation.

are important problems that require establishing a community of scientists and researchers to work with measurable progress toward their solution.

This vision requires open learning maps of dependency relationships among learning standards such as the K-12 Common Core State Standards in mathematics and English Language Arts that are to be achieved during educational processes. Learning resources also require tagging with metadata to learning standards and learning maps. Digital assessments are needed to determine where the learner is in those maps, and a computational model of the learner needs to be continuously informed by data about their performances and choices. The concept of recommendation engines familiar from Amazon, iTunes, and Netflix for books, music and movies is also applicable in this personalized learning vision—but with greater complexities involved for learning resources, given the interdependencies of learning progressions as referenced to learning maps. Open source software has been created to enable broad experimentation in the issues involved in making such a K-12 learning technology ecosystem functional, and public-private partnerships will be valuable. Deeper inquiries are needed to unpack the nature of learner preferences for the modality or modalities of their experiences of learning resources, and how learner’s interests can be matched to appropriate learning resources.

There has been substantial progress in establishing a common vocabulary for tagging learning resources by the Learning Resource Metadata Initiative, building on the semantic web, and as supporting alignment to Common Core Standards. Yet we need far more inquiry to establish empirically warranted learning progressions for other K-12 STEM domains than mathematics (such as the Next Generation Science Standards), for courses of study at the college level, and for intrapersonal and interpersonal competencies, not only the cognitive. Intertwined relationships during human development and learning between these three categories of competencies are also likely. For example, personal identification with mathematics or with science domains - what some call 'disciplinary identity'- build in significant measure from interests that the learner develops, but these interests themselves can be socially constructed, as in when a learner aspires to develop the capabilities that an adult model manifests. How is learning such competencies mediated by technologies, and how could such learning be better supported?

Challenge #2: Multi-modal Learning Interaction Science and Technology

An important frontier for developments is to capture, integrate and make systematic inquiries into large-scale, multimodal data streams of learning interactions in-situ, such as learners with their teacher in a classroom, collaborators in a project-based learning environment after-school, distributed students in a college-level MOOC, learning interactions of children with ‘social robots’.

There is increasing recognition that human learning is a complex multi-sensory affair of embodied semi-otic interactions, and that the production and perception of meaning in context engages the full range of sensory modalities. This is important because there are many challenges associated with inquiry into better understanding how learning is occurring within and across formal and informal settings. Learners and educational systems exploit increasingly pervasive mobile learning devices, online educational applications and resources such as MOOCs, OER, Wikipedia, web search, digital curricula, games, and simulations. Yet most research on learning in education has minimal sensing of the contexts in which

learning processes are being enacted, and in which learning outcomes are developed, since classroom studies dominate. A variety of technologies makes possible new inquiries for advances on these issues.

Increasing accessibility of environmental and personal sensors is now enabling ready capture and review of rich data streams of human interactions in learning contexts, such as audio/video (including panoramic systems), GSR/Heart Rate, breath-rate, body motion, GPS, gesture, EEG, and emotional states. Increasingly such sensors are embedded in mobile phones. “Sensing” of learning contexts and recognition of the people, gestures, discourse patterns, and activities in them will be an important complement to “learning analytics” and “educational data-mining.” Emerging and closely related multidisciplinary fields that have been focusing principally on clickstream data from online educational activities and related administrative data.

Less advanced but much needed are technologies and associated methodologies for integrating diverse data types from sensor streams and human-coded data, and multimodal data stream ‘workbenches’, incorporating analytic tools for sense-making and pattern detection with rich interactive data visualization capabilities for examining data stream inter-relationships. How can multi-modal analytical techniques from computer vision, speech recognition, gesture recognition, and machine learning be used to deepen our understanding of in-situ experiences of learning and teaching in education? Research on the behaviors underlying differential performance of collaborative groups has already exploited these multi-modal sensing opportunities. Multidisciplinary research teams will be needed to tackle these big data challenges, engaging social scientists, learning scientists, computer scientists, statisticians, neuroscientists, and disciplinary domain experts.

Contests as a Catalyst for Content Creation

Contrasting Cases to Advance Theory and Practice

Research and Design Team: Brigid Barron, Associate Professor of Education; Caitlin K. Martin, Stanford YouthLab Research Program Director; Sarah Morrisseau, Vital Signs Program Coordinator; Christine Voyer, Vital Signs Community Specialist; Sarah Kirn, Vital Signs Program Manager.

Technical Team: Liem Khuu, Vital Signs Software Developer; Sarah Morrisseau, Vital Signs Program Coordinator; Caitlin K. Martin; YouthLab Research Program Director.

Background

New generative platforms and increasing accessibility are changing the nature of who is contributing content to the Web and how they do so. Networked learning communities offer young people opportunities to pursue interests and hobbies on their own time while also giving them a chance to contribute to the learning of others by producing content, engaging in discussion, and providing feedback. Qualitative research offers rich portraits of how actively contributing content to online communities can develop social networks, a sense of agency, technical skills, content knowledge, and confidence in one's ability to create (Ito et al., 2009; Barron, Gomez, Pinkard, Martin, forthcoming, Jenkins, 2006). More quantitative studies, however, suggest that those who contribute content are in the minority and that content creation is linked to parents' level of education (Hargittai & Walejko, 2008; Barron, Walter, Martin, Schatz, 2010).

Given the benefits of content creation to both the creator and the community, the team believes it is essential to understand the conditions that might serve as a catalyst to content creation. In the team's proposal to mediaX an approach was outlined to contribute to this research and theory building agenda by carrying out an experimental study that contrasts ways to invite the creation of content. The project's prospective contributors are middle school students and already participating in a learning-oriented Internet community called Vital Signs. The Vital Signs contribution to this project consists of the use of the online platform as a Research Environment for this work and collaboration with personnel for the contest design and the recruitment of teachers and students to participate in the research. The research team created the Contest around which this research is based and provided Contest Incentives.

The Research Environment is a citizen science networked system located in the state of Maine, linked statewide to schools and accessible not only to the focal participants (teachers and students in seventh and eighth grade classrooms), but to anyone who wants to learn and contribute. Contributors take on missions to document invasive species and submit their observations and evidence to a public Website. Trained teachers use GPS devices and digital cameras with their students along with cyber-enabled research tools, such as Google Maps. To date, more than 170 teachers and classrooms across Maine are

participants within the Research Environment. Because the state has a longstanding laptop program started in 2002, all middle school students have access to their own MacBook, which they use at home and at school and can keep with them during vacations, thus making Maine a potential “window to the future” for the time when 1:1 computer: learner ratios can be taken for granted (see Chen et al., 2006).

Although the Research Environment enables teachers and their students to contribute species observations, students and teachers do not often contribute original content that would help others learn. And, there is much that students might have to offer. The team’s ongoing research project, funded by the NSF, has allowed the creation of detailed case portraits of learners as they experience the work out in the field, and the process of formalizing and uploading their observations. The team has found that students have varied interests and skills that might be useful to the vital signs community, if they were inspired to share them online. This prior funding has also allowed the team to study the kinds and quantities of contributions students and teachers have made to the site since 2009. This existing data will the project a solid baseline for comparison.

The team’s vision is to use this already robust Research Environment as a living lab to generate insights about how to amplify the potential of cyber-learning for all students by creating a more participatory community. The statewide laptop program is unique in the United States and it creates a powerful opportunity to understand how communities who vary in their economic profile, sources of livelihood and technological immersion choose to engage in content creation and what barriers they face. The team’s goal is to provide data that is generalizable to all academic learning hubs that use networked tools to build community, collect data, and advance knowledge.

Project Work to Date

In the fall of 2012 we designed a contest inviting youth to create and submit original media projects around STEM-related content and implemented three models of introduction to the event: (1) Competitive model: Contest with a material prize for best contributions; (2) Lottery model: Contest with prize based on random selection; (3) Altruistic Model: Need for learning resources described, with model of resources and invitation to contribute.

Three condition groups were created by stratified randomization, an online tracking approach was developed to look at what the three groups were doing online in the Research Environment, and paper-based and email invitations were distributed to educators within each condition group. These focal activities are described in more detail below.

Designing the Contest

In October 2012, the entire team met to discuss contest specifics, including scope, dates, content, and

learning resources. Content ideas were guided by both groups' expertise in designing learning opportunities for youth and built on the team's ongoing ethnographic and web generated data collected during our two year NSF funded project. These ideas were further informed and iterated on using feedback received from the November 2012 meeting with project PI Brigid Barron and mediaX executive director, Martha Russell, and representatives from mediaX strategic partner, Konica Minolta. The result is the Creative Kid Invasion Contest. The final structure offers youth participants two content topic options (to tell the story of a native or nonnative species found in Maine or to create a how-to guide for a skill necessary to citizen science investigations or cyberlearning) and a selection of three presentation media (video, audio podcast, digital book layout).

During an October visit to Maine, the team held face-to-face collaborative design workshop with 18 eighth-grade research participants and led them through an activity to help us select learning resources to embed in the contest site. The team showed the students a variety of potential resources, including exemplar video projects made by youth around similar content, learning videos and paper-based resources around technical (how to create a video in iMovie) and planning (how to storyboard your video) activities. Students rated the resources and indicated what they liked and did not like about them.

Using this information, the team created a contest web page (see Appendix A) for the Research Environment that included the details of the contest as well as links to the contest submission page and to the 14 learning resources (three how-to project examples, three species story project examples, four resources for media production and four resources for digital storytelling and planning, see Appendix B). The team also created a banner (see Figure 1) on the Research Environment home page to highlight the contest and lead users to the main contest page. Both the banner and the contest page are neutral in terms of condition (i.e. no mention of prizes).



Figure 1. Creative Kid Invasion Contest banner on the Website home page.

Creating Condition Groups

Schools or organizations that had participated in the Research Environment were identified (N=92;

including 89 schools and three organizations). The team used stratified randomization¹ to split the 92 institutions into three condition groups (altruism N=31, lottery N=29, and prize N=32), each with similar proportions of institutions with evidence of higher and lower socio-economic status² and program engagement.

Developing Ways to Track Results

Working closely with the Research Environment personnel, the team created two new custom variables in the Research Environment Drupal platform, one that holds the name of the school that the user is affiliated with, and one that holds the condition that that user (i.e. that school) is affiliated with. The team enabled these custom variables to be passed to Google Analytics, which allowed them to watch behaviors by different groups of users using the segmentation feature in Google Analytics (see Figure 2a).

To ensure the most accurate results, users are required to sign in to view the contest page. The team is using Google Analytics to track (1) audience views of the contest page; (2) click events on the contest page (see Figure 2b) to see who is viewing which learning resources; and (3) entrance and exit URLs from the contest page (see Figure 3) to see where users come to the contest page from on the site, and where they are leaving it for. The team tested these variables and the reporting capabilities in Google Analytics using these variables extensively in both a test site and then in the Research Environment.

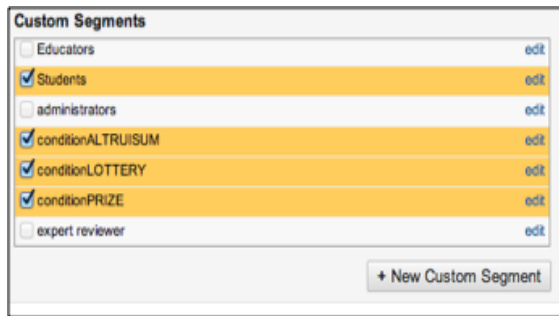


Figure 2a. Segmenting by student condition.

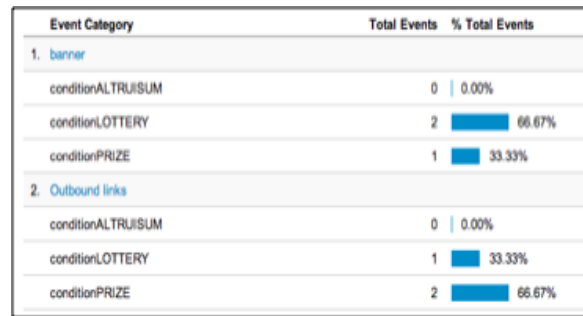


Figure 2b. Example of link click events by condition.

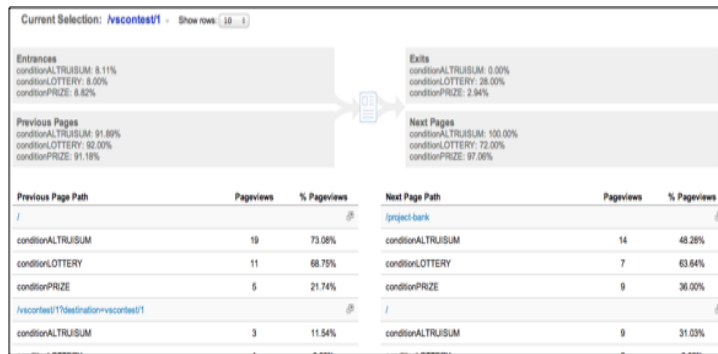


Figure 3. Example of analytics showing navigation flow into (where did people come from) and out from (where did people go) the contest page by condition.

1 Feeder schools were grouped together (assuming that teachers and siblings and graduates may be in contact). Within profile groups each entry was given a random number (Excel RAND number generator) and items were sorted from least to greatest number. Each entry was assigned a condition (repeated alphabetically, i.e. first = altruism, second=lottery, third=prize, etc.)

2 For public schools this was indicated if the percentage of students who qualified for subsidized lunch was above or below the state average (https://portal.maine.gov/sfsr/sfsrdev.ED534.ED534_report) while for private schools (N=7) and non-school organizations this was indicated by county % living in poverty (more or less than state average). Sites with metrics indicating lower SES, N=42; sites with metrics indicating higher SES, N=49.

Inviting Participants

A paper-based flyer advertising the contest was designed for teachers in order to (1) generate excitement about and knowledge of the contest at the school level and (2) to establish the conditions. Three versions of the flyer were executed, identical except for a description of the reason for entering (see Appendix C): (1) an altruistic version around submitting work for the benefit of other students, with the best options shown on the Program Website, (2) a lottery version, with entries chosen randomly to receive prizes such as an iPad, digital camera, and iTunes gift certificates, and (3) a prize version, with the entries judged to be best winning an iPad, digital camera, and iTunes gift certificates. The Stanford team also created a two-minute video invitation (neutral of condition) to encourage youth to participate.

A DVD of the invitation video and a stack of color printed flyers (for the appropriate school/organization condition) were mailed to all educators at participating institutions on February 11, 2013, along with a letter explaining the contest event. The letter asked educators to show the video in class, post the flyers around their school, and encourage their students to participate. On this same day, the banner and the contest page went live in the Research Environment. Teachers are responding positively to the invitation via emails to Research Environment staff, sharing their plans for inviting students, asking clarifying questions and offering suggestions (see challenge section below). The first student project submission was uploaded on February 28, 2013.

Challenges

The research team has run into a few technical challenges that required collaborative problem solving by various team members at Stanford and in Maine. The initial proposal for this work indicated that the team would use the Google Analytics Content Experiment tool to randomly determine how students come to the project work (assign and track different conditions, taking different users to different contest description pages based on condition). Upon further research, the team realized Google Analytics only allows random assignment to groups for a content experiment. This did not work with the design: It was important that students in the same classrooms and schools to be in the same condition (since they would often be using computers side-by-side in the classroom and hopefully talking about the contest together). The team also wanted to ensure a similar proportion in each group of variables that could affect outcomes, such as teacher/school experience/engagement with the Program and different levels of district and school SES. In short, the team needed to change the model of how people were designated as part of a group and how they were tracked. The team came up with the blended offline and online approach described here and worked closely with the Program's Website design team and technical team to iterate and test versions of the online tracking and sharing between the Drupal platform and the Google Analytics module.

The team has also run into more human-oriented challenges of the type often found in design-based research in schools, including school schedules (e.g., teachers have their own timing that works to introduce the project, a week of student vacation the week after the site went live, teachers requesting more time to allow student registration due to unforeseen barriers to sign up including school firewalls blocking authentication of individual student accounts in the Research Environment).

The team is working closely with the Research Environment staff as they work closely with teachers on an individual basis, and as we solve these problems for individuals we are finding ways to implement larger changes to the contest implementation that will help to alleviate these issues for other participants (e.g. pushing the individual registration deadline back two weeks).

Ongoing Plans

The team intends to monitor the online activity for the three conditions throughout the month of March. Students have been required to create their own individual Vital Signs account by mid March (as opposed to their team accounts) and the final due date for project submission is May 27. If by the March deadline the number of interested participants is not satisfactory, the team intends to intervene by implementing a project workshop to build videos with selected participating classrooms. The team will also send out another promotion for people to sign up in the spring.

Throughout the spring, data will be tracked online by experimental condition, both activity in the Research Environment, and project submission. In early spring, the team plans to assemble a panel of judges and develop a criteria for judging project work. The contest deadline is May 27, as a result of a possible wave of classrooms using the Research Environment in the spring suggesting more students on the site and engaged with the project work (some students will have done it in the fall only, and other students will do it in both seasons). Judging will be finalized by mid June, so that project participants can receive their notice while the schools are still in session. The team will work from the submission deadline through the summer months to analyze the data more fully including experimental conditions, website participation (i.e., viewing the contest page, time on the contest page, returning to the contest page, clicks on learning resources), project submission, and quality. A final report will be delivered at the end of August.

References

- Barron, B., Gomez, K., Pinkard, N., Martin, C.K. (in press). *Cultivating Creative Production and New Media Citizenship in Urban Communities: Digital Youth Network*. MIT Press.
- Barron, B., Walter, S., Martin, C. K., & Schatz, C. (2010). Predictors of creative computing participation and profiles of experience in two Silicon Valley middle schools. *Computers and Education*, 54 178–189.
- Glott, R., Schmidt, P., Ghosh, R. (2010). *Wikipedia Survey – Overview of Results*. Published by the UNU-MERIT Collaborative Creativity Group.
- Hargittai, E. & G. Walejko. (2008). The Participation Divide: Content Creation and Sharing in the Digital Age. *Information, Communication and Society*. 11(2): 239-256.
- Ito, M., Horst, H., Antin, J., Finn, M., Law, A., Manion, A. et al. (2009). *Hanging out, messing around, and geeking out: Kids living and learning with new media*. Cambridge, MA: The MIT Press.
- Jenkins, H. (2006). *Convergence culture: Where old and new media collide*. New York: New York University Press.
- Pew Internet and American Life Project reports: <http://www.pewinternet.org/>
- Wu, Michael (2010). *The Economics of 90–9–1: The Gini Coefficient (with Cross Sectional Analyses)*.

Appendices



Appendix A: Contest Webpage

Home

CREATIVE KID INVASION!

Contest

Make a digital video, audio, or book to share what you know and what you can do.

- ▶ Create a Vital Signs user account just for you (not a team account) by: **March 15, 2013**
- ▶ **Submit** your project by: **May 27, 2013**
- ▶ There are two topics for you to choose from (more info below):


option 1

Tell the story of a native or invasive species found in Maine.

option 2

Create a how-to guide for any skill related to Vital Signs (photography, species ID, sketching, Google Earth, etc.)

Option 1. Tell a species story!



Every species has a story! Be a nature detective and share the story of a native or invasive species found in Maine, or that may be found in Maine soon.

1. **Check out examples** of species stories in the menu bar on the right.
2. **Choose the species** that you want to be the focus of your story.
3. **Plan your storyline.** Think of some questions you want to answer about your species. How can you make it fun or interesting?
4. **Get your information.** Use different sources to make the best, evidence-based story you can.
5. **Plan out your story!** What happens first, second, third? What will people see and hear?
6. **Create your story** as a 2-3 minute digital book, video, or audio project. See production resources in the menu bar on the right.

Species Story Examples

- 1 [The Wild Carrot's Video Blog](#)
- 2 [Have a bittersweet-free holiday](#)
- 3 [Commander Ben](#)

How-to Examples

- 1 [How to ID a green crab](#)
- 2 [How to set up a tadpole habitat](#)
- 3 [How to sketch a blue crab](#)

Production Resources!

Making resources

- [Create a video in iMovie](#)
- [Create a podcast in Garageband](#)
- [Create a digital book in iPhoto](#)
- [Check out video techniques](#)

Planning resources

- [Choose your media](#)
- [Choose your content](#)
- [Write a script](#)
- [Plan your scenes](#)

Appendix B-1: Examples of Resources Included in Contest



Story Examples: A YouTube channel with video stories of a number of different non-native species in Maine.

Link: <http://bit.ly/ZoXlil>



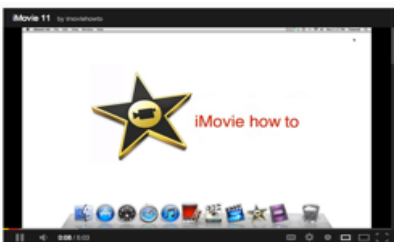
How to example: Video guide about how to set up a tadpole habitat, made by a young person.

Link: <http://bit.ly/11c6aQP>



How to Example: Video guide for how to sketch a crab.

Link: <http://bit.ly/10a6r3V>



Media Production Resource: Video tutorial for how to create and export a movie using iMovie

Link: <http://bit.ly/XWXbSG>



Storytelling and planning resource: PDF storyboarding template.

Link: <http://bit.ly/144rqbz>

Appendix B-2 Contest flyer: Lottery Condition



**Creative
Kid
Invasion**

**vital
signs**

Contest Make a digital video, audio, or book to share what you know and what you can do.

Winners will be chosen at random!
Submit a project and be entered into a raffle to win:
an iPad * a Digital camera *
iTunes gift cards and more

option 1
1. Choose a topic: Tell the story of a native or invasive species found in Maine.

or

option 2
Create a how-to guide for any skill related to Vital Signs (photography, species ID, sketching, Google Earth, etc.)

2. Go to <http://vitalsignsme.org> to see details and view resources

3. Create your own individual Vital Signs account by **March 4, 2013**

4. Post your project to the Vital Signs project bank by **May 27, 2013**

* Prizes listed represent awards for projects submitted by individuals; team submissions are also encouraged and members will receive prizes that total an equivalent amount.

 **Gulf of Maine
Research Institute**
Science. Education. Community.

Appendix B-3 Contest flyer: Prizes Condition



Contest Make a digital video, audio, or book to share what you know and what you can do.

The best projects will win great prizes!
Grand prize: iPad * Runner-up: digital camera
and 5 more winners will receive iTunes gift cards and other prizes

 option 1

Tell the story of a native or invasive species found in Maine.

or

 option 2

Create a how-to guide for any skill related to Vital Signs (photography, species ID, sketching, Google Earth, etc.)

1. Choose a topic:

2. Go to <http://vitalsignsme.org> to see details and view resources

3. Create your own individual Vital Signs account by **March 4, 2013**

4. Post your project to the Vital Signs project bank by **May 27, 2013**

* Prizes listed represent awards for projects submitted by individuals; team submissions are also encouraged and members will receive prizes that total an equivalent amount.



Appendix C-1 Contest flyer: Altruistic Condition



Contest Make a digital video, audio, or book to share what you know and what you can do.

Inspire kids across Maine to do great Vital Signs work. The best projects will be featured on the Vital Signs website!

1. Choose a topic:
 - option 1** Tell the story of a native or invasive species found in Maine.
 - or
 - option 2** Create a how-to guide for any skill related to Vital Signs (photography, species ID, sketching, Google Earth, etc.)
2. Go to <http://vitalsignsme.org> to see details and view resources
3. Create your own individual Vital Signs account by **March 4, 2013**
4. Post your project to the Vital Signs project bank by **May 27, 2013**

A New Generation of Hybrid Tangible Interfaces

For STEM Learning in K-12 Environments

Research Team: Paulo Blikstein, Assistant Professor Graduate School of Education; Ingmar Riedel-Kruse Assistant Professor Bioengineering.

Project Aims

1. Develop an HTML5 Framework for remote and local experimentation, and bifocal modeling

The team developed the data base and online interface for remote experimentation (See Figure 1 e,f). The integration of the (bifocal) modeling component is currently in progress.

2. Develop and pilot cost effective experimentation platform

The team has developed multiple hardware platforms, usable both locally and remotely. They built an ink jet based low cost / high throughput pipetor, that can be scaled up in the future into a mini-cloud server platform (see Figure 1,b). This platform allows the spatio-temporal stimulation of microbiological systems – such as a slime mold *physarum* responding to food stimuli (see Figure 1c,d). The team also developed a related system based on lego mindstorm and arduino (see Figure 2) (still in development), which enables school children to build such systems themselves.

3. Design and run a set of two bifocal modeling units in biology and chemistry for high-school

The team currently ran a test study with Stanford students in the BioE311 class, where students performed remote biology experiments, while stimulating slime mold *physarum*. The students also carried out the data analysis. If this test is successful, the team plans to take the next step to extend / test in other schools.

Other Progress

- Hired a CS students for carrying out the majority of programming work.
- Purchased consumables and hardware components.

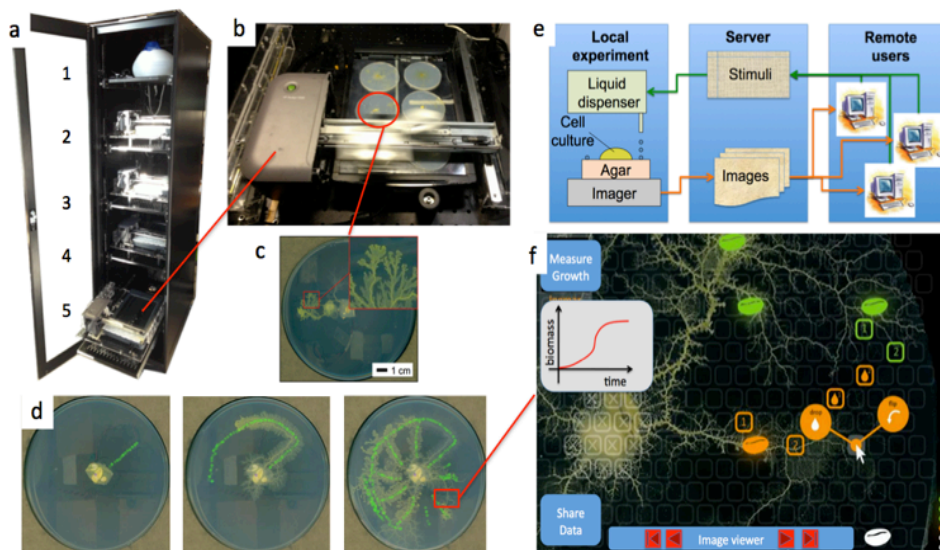


Figure 1: Biotic Processing Units (BPUs) and the interactive online platform for cloud-based biology experimentation: a) Conventional server rack filled with b) BPUs, which is made from reverse-engineered, inexpensive consumer electronics (inkjet printers and scanners), making the system scalable and cost-effective. c) 10s-100s of microbiological experiments (depending on the kind of experiment) fit onto one BPU; here a slime mold (*Physarum*) (yellow) is growing in a petri-dish. d) Time-lapse imaging of remotely instructed chemical stimulus (green) and response of the slime mold (yellow) over one day (left to right). e) Coupling one or more BPUs to the web via control servers, databases, and a web server enables remote users to f) carry out experiments and to investigate many multicellular phenomena, such as *Physarum* chemotaxis, via an interactive web interface.

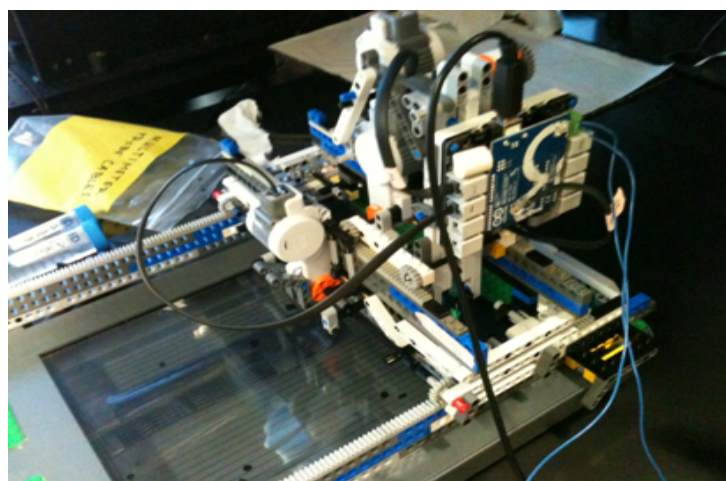


Figure 2: Pipetting an imaging platform based on lego mindstorm, arduino, and a flatbed scanner, which will enable easy reproducibility, self-building, and even further development by school children.

Physical Media as Active Social Learning Agents

Research Team: Cliff Nass, Thomas M. Storke Professor of Communication; Malte Jung, Postdoctoral Research fellow, Management Science and Engineering; Nikolas Martelaro, Graduate Student in Mechanical Engineering.

Aims and Hypotheses

What if the thing that is being created takes the role of an active social agent in the creative experience itself?

The broad, long-term objective of this study is to develop the theory and principles necessary to design new physical media that can take an active social role in creating highly motivating K-12 learning experiences. The project's specific research aim is to explore how the social behavior of mechatronic media affects a creative K-12 mechatronics learning experience. Specifically, the research team hypothesizes that a mechatronic media component exhibiting social back-channeling behavior will lead to improved learning experiences compared to standard non-social media components.

Technical Setup

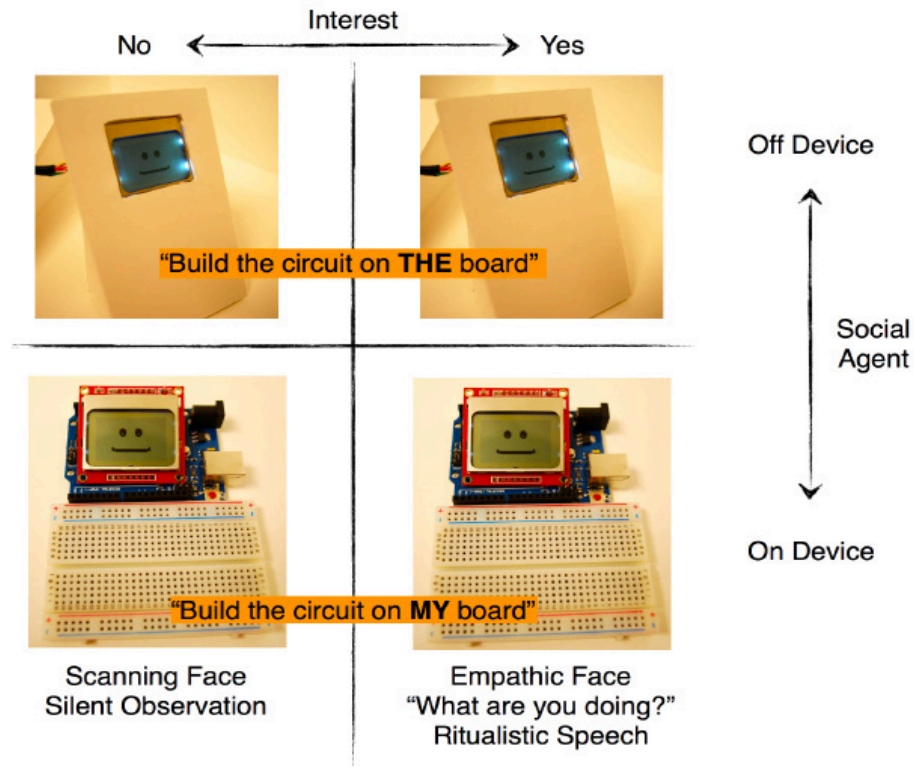


Figure 1 - 2: (social agent on/off) x 2 (device interested yes/no) study setup

This study explores the effect of social back-channeling on student learning during a mechatronics task using a 2 x 2 study design with variation axes “social agent locus” and “device interest,” shown in Figure 1.

The research team creates a social agent through the use of a digital face and verbal instructions. The social agent will either reside off the device as a small robot, or as the device itself. To strengthen the effect of social agent locus the team will alter verbal instructions to use phrases such as “build the circuit on **THE** board” (off device) vs. “build the circuit on **MY** board” (on device). On the second axis, the team manipulates the device’s interest through facial movement and verbal back-channeling.

During the interested condition, the device’s face will follow the user’s and ask questions such as: “What are you doing?” In the uninterested case, the device’s face will simply scan around programmatically and observe silently. Using these two variations, the team can explore which variable has a stronger effect on student learning.

During “interested” conditions, the social agent will be controlled by one of the experimenters via an external control unit connected to the researcher’s laptop. The researcher will control the social agent by viewing the student through a webcam angled at the student’s face.

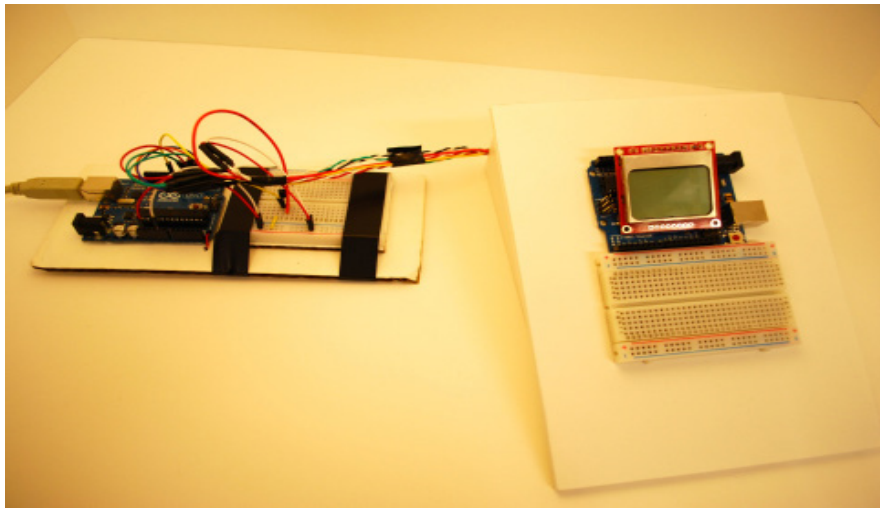


Figure 2: External Control Unit

Study Procedure

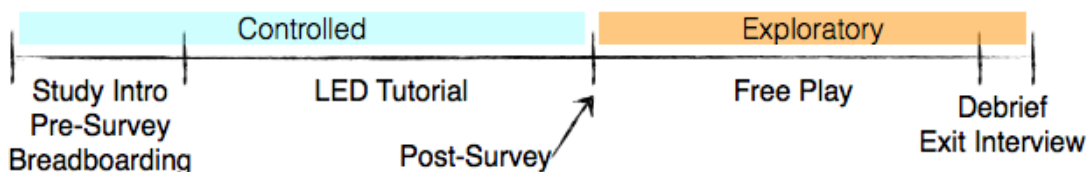


Figure 3: Study Procedure Timeline

During each study session, each student will be randomly assigned to one of the four test conditions outlined in the technical setup. The student will be given a short introduction to the study and will then take a pre-survey covering demographics information, previous experience with electronics and programming, and interest in STEM subjects. The student will then complete a tutorial on how to use a light emitting diode (LED) with one of the social agents. During all sessions, the social agent will ask the student probing questions, such as: “Would you like to know more about resistors?” The team plans to use the response to this question as a measure of student engagement.

The introduction and tutorial consist of the controlled activity of our study. After completing the tutorial, students will take a brief survey measuring aspects such as activity engagement, information retention, personal affect, and interest in mechatronics. After the post-survey, the student will then be allowed to play, making their own device using the skills they have just learned. During this time, the device will interact in the same manner as during the tutorial minus tutorial step instructions.

From this play, the team will observe similarities and differences in behaviors during a creative activity compared to a tutorial activity. In addition, this play period will allow the team to more qualitatively understand student engagement and information retention. All sessions will be videotaped and the team may use video coding to gather more qualitative data from these play sessions.

Key Milestones Achieved

- o IRB Protocol Approved (Protocol: 26278)
- o On device and off device social agent built (see Figures 1 and 2)
- o Technical setup and study procedure designed
- o Session task and tutorial material designed (shown in Figure 4)
- o Key measures defined: engagement, retention, affect, interest in mechatronics

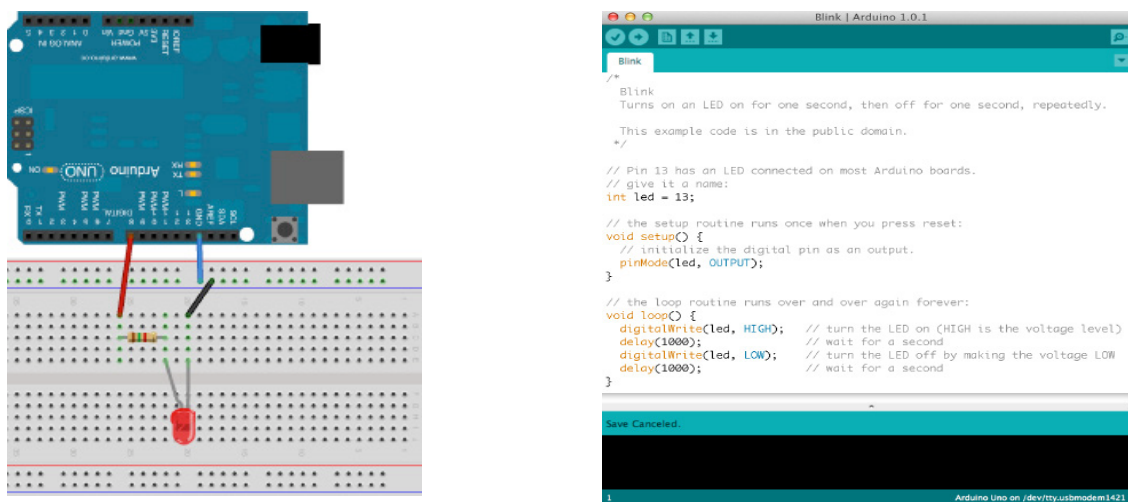


Figure 4: Sample Tutorial Materials

Moving Forward and Basic Schedule

- o Fine tune condition manipulations (i.e. exact question phrasings, exact face graphics, etc.):
March 8th
- o Recruit student participants (N = 60): March 1-22
- o Run studies: Late March - April
- o Analyze data: April - June

The Stanford Clinical Anatomy Scans (SCAnS) Library

How High School Students Can Access the Resources of an Academic Medical Center

Research Team: Sakti Srivastava, Associate Professor Surgery-Anatomy; Alan Detton, PhD, Lecturer of Surgery-Anatomy; W. Paul Brown, DDS, FACS, FICS, Consulting Associate Professor of Surgery-Anatomy; Patricia Youngblood, PhD, Consulting Associate Professor of Surgery-Anatomy; Matt Hasel, Production Manager, Division of Clinical Anatomy; Robert Cheng, Research and Development Engineer, Division of Clinical Anatomy; Matthew Stephens, Research Assistant, Division of Clinical Anatomy.

Project Work to Date

The project began with a pilot implementation of a curated collection of CT and three-dimensional scans of skeletal structures in the classroom setting of a local high school. To deliver the images in an interactive format for devices commonly available in schools, such as laptops and handheld tablets such as the iPad, the scans were prepared for the Vizua platform. This platform could effectively handle the massively large files of 2D and 3D clinical datasets via versatile interfaces. It handles the computationally intensive “back-end” tasks of manipulating and rendering the visualizations on their servers, and then streams the content through their interface to the devices of remote users (i.e., students and their teachers).

An introductory meeting with local high school teachers resulted in the selection of Menlo School as the first site. The research team selected Menlo School due to its proximity to Stanford, its robust anatomy curriculum, and their desire to implement computer-based technologies in the classroom. Planning meetings between Stanford and Menlo faculty took place to introduce and explain the anatomy content, the software and its capabilities, as well as to discuss the two primary research themes of this study. The first research theme relates to how CT-based clinical scenarios can be used appropriately in the high school classroom, taking into consideration technical and logistical constraints, as well as in-class activities and hands-on assignments. The second research theme is focused on investigating the strengths of the specific methodology being used to deliver content, supporting instructional use, and identifying the shortcomings or requirements for new features of the pedagogy, interactivity and delivery of this technology.

The research team initially selected two groups of students, both taught by the same instructor, to utilize the Stanford Clinical Anatomy Scans for a portion of the course devoted to teaching skeletal anatomy. The team also chose 10 pre-selected clinical CT cases to represent the different skeletal regions of interest. Each of the 10 cases were prepared and loaded into the Platform to offer a variety of interactive features. These features included a brief explanation of the displayed dataset, and a set of predetermined views offering traditional orientations of skeletal structures. The team also created two instructional

videos to assist students in utilizing the interface. The videos covered information about how to create an account, open a case, manipulate the model, and perform more difficult tasks within the interface. The videos were made available to the students. They were then asked to go to the Platform's home page (www.vizua3d.com), sign up for an account, and take a free 20 minute-long tour to familiarize themselves with the interface. Using these individual accounts, coordination with the Platform allowed for additional time to be given to each student after this initial trial period. Unlike other educational resources that come imbedded with all the educational data, this system lightens the load on the users' device by streaming the data from their server.

In coordination with the teaching faculty, the team determined that a labeling project would serve as the students' assignment with the SCAnS content. During the period devoted to learning skeletal anatomy, each student was allotted a one-hour block of time to use the system through provided laptop computers. At the onset of the selected class period, only eight out of 15 students were able to login initially, though eventually all of the students were able to log on. Students were asked to identify skeletal features in their assigned region, and to label them within the provided labeling system of Platform's interface. When students experienced difficulty labeling the scans due to system errors, they were instructed to take screen captures of the interface, and to use PowerPoint to label that saved image.

A similar project was conducted with students in 8th grade, which focused on an introduction to the nervous system utilizing an MRI of the brain. Unlike the high school students who were each responsible for the labeling assignment, the junior high students were divided into groups of three. These students shared their allotted one hour time increments amongst the group (giving each group three hours of time with the system). These students were assigned views, given specific structures to identify, and asked to label them only through the screen capture method. Upon completion of the assigned labeling protocol, students immediately received feedback about their accuracy by having the instructor check their work in class.

Challenges

In response to the introduction of the SCAnS content using this Platform, in both high school and junior high classes, the team received immediate feedback concerning both the strengths and limitations of the anatomy content and the Platform. Some of the limitations include concerns about the hourly allotment of time, multiple users slowing down the system, and a variety of difficulties related to the provided labeling system. These limitations demonstrate an immediate concern with this delivery Platform on a larger scale, or even at the same scale, and must be corrected prior to moving forward with an interactive distribution and visualization platform to other high schools. Despite these complications, the team received many positive reactions regarding enjoyment of the assignment from students, who qualified it as "highly informative." The team therefore considers this content, on an appropriate system, to have great potential in this setting.

Next Steps

The team plans to formalize the evaluation protocol through a standardized survey that will be sent to all participants. The survey is expected to ask students to rate their experience compared to other instructional methods, describe their interaction with the SCAnS content and the Platform, and evaluate the various capabilities of the software including their perception of its limitations, and strengths.





mediax.stanford.edu

The format of this paper is optimized for double-sided printing.