# Building to Learn:

A decade of innovation at the
Columbia University Center for New Media Teaching & Learning

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National Conference for the Development of Study Plans,
Teaching and Learning and Scientific Research
Le Royal Hotel, June 15-17, 2010
Ministry of Higher Education and Scientific Research
Columbia University Middle East Research Centre

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**SUMMARY**

The Columbia Center for New Media Teaching and Learning (CCNMTL) was founded in 1999 as a response to the recommendations of a university-wide faculty and administration committee charged to examine the state of digital technology on the campus. In its short history, it has provided service to over 4,000 faculty with projects ranging from simple course management support to over 250 larger projects. CCNMTL is made up of a staff of educational technologists, web designers, programmers, and video experts who utilize a six-stage design research process. The Center has generated a decade of useful innovations and findings relevant to the educational community interested in how to most effectively employ web technologies to the improvement of higher education. Five areas are discussed in this paper:

*1) The Transition from Web 1.0 Course Management Systems to Web 2.0 Loosely Coupled Tools*
Over the last five years, CCNMTL has been experimenting with Web 2.0 tools and integrating them together in various combinations that we have come to refer to as *Loosely Coupled Tools*, including collaborative tools such as blogs, wikis, and podcasting services.

*2) Simulations*
Computer simulations built specifically for teaching and learning have evolved to allow for the possibility of dynamic discovery-oriented learning. CCNMTL has created several simulations in the areas of sustainable development, medicine, humanitarian relief, and environmental science.

*3) Annotation*
Faculty want students to move past *reading-to-summarize* to a more active engagement with the content that we sometimes describe as *close reading* with a range of media types. CCNMTL has created a series of tools and techniques for annotating text, image, and video.

*4) The Triangle Initiative: The Intersection of Research, Education, and Community Service*
Digital media provides a unique means to bring the often disparate goals of a University - research, education and service to the community - in much closer harmony. The creation of multimedia tools can simultaneously contribute in direct and significant ways to advancing the applied research of faculty and exploring the potential of new media in a more generic sense to provide unique support for community service efforts. Furthermore, these tools and specific elements within them have the potential to enrich the classrooms of students throughout the university.

*5) Global Learning*
Research universities, Columbia among them, have committed themselves to a new level of global engagement. This commitment has taken the form of creating more courses, programs of study, satellites of the university in other countries, research institutes, and events focused on global issues. CCNMTL's Global Learning projects are active demonstrations of distributed learning that mobilize the power of a diverse set of learners in different locations who can explore the multidisciplinary problems of our interconnected world. Instead of seeing distance as a barrier, these projects embrace diversity of location and culture to inform and enrich both individual and collective educational experience.

## INTRODUCTION TO CCNMTL AND ITS METHODS[1]

The Columbia Center for New Media Teaching and Learning (CCNMTL) was founded in 1999 as a response to the recommendations of a university-wide faculty and administration committee charged to examine the state of digital technology on the campus. The committee's primary recommendation was to create a service organization whose mission would be to support faculty in their use of digital technologies within the University's matriculated degree programs. The Center works to provide faculty with a broad range of new media services, including: workshops, forums, and individual consultations, as well as ongoing and sustaining support in the development of more advanced projects. In partnership with faculty as content experts, the Center is committed to advancing the purposeful use of new media and digital technologies in the educational programs of Columbia University.

Since 1999, CCNMTL's original staff of three has grown to approximately 40. In its short history, it has provided service to over 4,000 faculty with projects ranging from simple course management support to over 250 larger projects. CCNMTL employs a number of professional web designers, programmers, and video experts but the core team of Educational Technologists is the frontline for engaging and working with faculty in project conceptualization and execution. The Center, funded in large part through the University's operating budget, has received over $5 million dollars in grants and $10 million in gifts.

The notion of design experiments, or a design perspective in educational research, means shifting the focus of research from the laboratory to the classroom. The traditional gap between theory and practice was understood by researchers as the problem of a de-contextualized notion of how learning occurs in real schools, and how teachers foster it. This move from one setting to another implied the development of new ways of conceptualizing and addressing research problems in education [1]. Some of these problems were still framed as advancing what was known about students learning process. But these problems were also related to an agenda of educational innovation and change. More recently, the notion of design began to be utilized as a very appropriate heuristic to describe what it takes to develop technologies that support different teaching and learning activities. Edelson [2] explains that within a design research approach, development and research merge into a process of iterative cycles of design, implementation, and assessment. The notion of design, then, is more than a methodological perspective in educational research. It is also an epistemological frame for producing knowledge about teaching and learning. By addressing the research enterprise as a design effort, one assumes that knowledge gets articulated through a series

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[1] This section is adapted from Moretti, Frank, Ryan Kelsey and J. Rob Garfield. "Mobilizing Design Research to Extend the Global Power of Digital Media in Education: The MacArthur Commission's Global Classroom Project on Sustainable Development and the Millennium Village Simulation." Proceedings of the International Mobile and Computer Aided Learning Conference (2008).

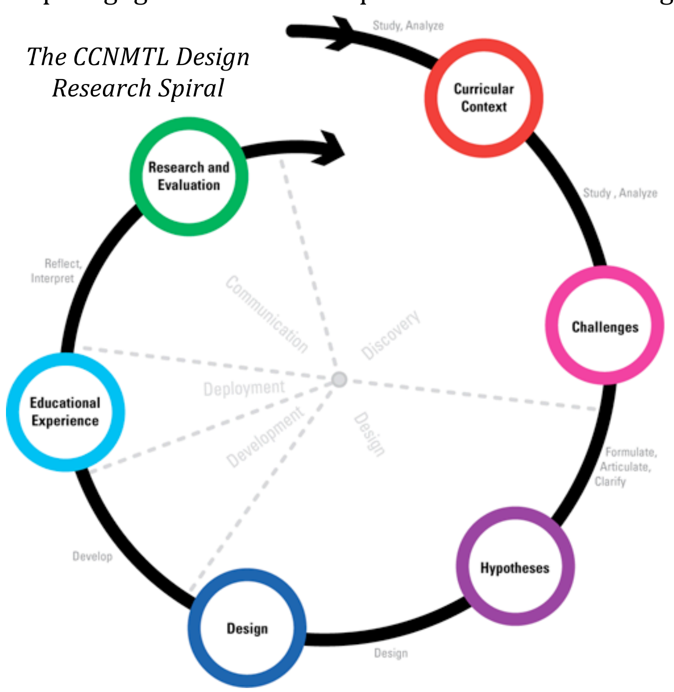
of provisional understandings, through a refinement of appreciations, and through making the whole process public to others. This is actually one of the main methodological tenets of a design approach in educational research, namely the need for a systematic documentation of the overall design process. This demand for rich, comprehensive documentation is related to two main purposes: analysis and communication.

One of the most salient features of the design approach is that it allows researchers not only to focus on analyzing the outcomes of a designed educational experience, but also on analyzing its very design processes. The process of designing an educational learning environment is full of pedagogical decisions. A design research framework attempts to capture and articulate this set of decisions and the way they play out in the actual educational experience of students and instructors [2]. Documents provide records that represent all these decisions and articulate a framework for research and assessment.

In order for design experiments to contribute to the advancement of knowledge about teaching and learning, researchers have to communicate and share their experiences to make them public and available for the study of other researchers and practitioners. A rich documentation of the experience provides this community of colleagues with better opportunities to understand and represent the nature of the activities and processes that took place [3].

This approach to thinking about the production of knowledge about teaching has some important implications for understanding how pedagogical reflections can take place through the design of educational technology projects.

Firstly, identifying challenges or problematic areas in one's own teaching, and thinking about how technology could help address them, invites instructors to make explicit their pedagogical content knowledge [4]. Shulman defines this concept as the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction. Secondly, the pedagogical reflection required to undertake design experiences entails collaboration. It is assumed that different professionals provide different expertise and points-of-view to the design and understanding of the experience [5].




*The CCNMTL Design Research Spiral*

In August 2002, the Columbia Center for New Media Teaching and Learning began to develop a design research framework that would accommodate the needs of its daily services and design practices. The Design Research process for developing classroom innovations begins by partnering with faculty members to discuss their teaching practices. This conversation unfolds in a series of discussions around the following stages.

1. **Initial Understanding of Curriculum:** What are the content, purposes, and activities involved in this course?

2. **Challenges and Opportunities:** What challenges or obstacles have faculty and students faced in the course? What new resources, teaching techniques, learning opportunities, and communication strategies would improve the educational process? What possibilities for the construction of new learning spaces begin to come into view, learning spaces impossible before the advent of digital technologies?
3. **Design Hypothesis:** What digital technologies would support the best solutions to these challenges? What learning experiences will technology enable that had not been possible before? How will students and instructors work within the redesigned learning environment? What principles and activities will best utilize these technologies to address the identified challenges?
4. **Design of Educational Experience:** How will these digital and pedagogical solutions be designed? These decisions determine the content, activities, and interactions that make up the learning environment.
5. **Educational Experience:** What facilities, orientation and/or training will be required to initiate the educational experience? Faculty, with CCNMTL support, implement the project within the course and closely monitor its use.
6. **Evaluation and Discussion of Findings:** What worked? What didn't? Together with our faculty partners, we evaluate the educational intervention, as well as our design process, and assess our hypotheses. We articulate recommendations for improving the project. The continuous documentation throughout the process enables this discussion and evaluation.

The primary notion that the cycle represents is symbolized by a helix-like quality of the image intending to indicate the recursive character of the process. The end is the beginning of a new gyre of the process now informed by the assessment of the first version of the project.

The following sections represent a limited cross-section of the discoveries and best practices derived by CCNMTL using this process over the last decade.

**FROM COURSE MANAGEMENT SYSTEMS TO THE LOOSELY COUPLED TOOLS OF THE POST-CMS WORLD[2]**

Over the past fifteen years, nearly every university in the developed world has committed itself to implementing what is known as a Course Management System (CMS). This system is/was intended to house the contents of each university's individual course curriculum and study materials and to facilitate class communication between and among students and faculty. Columbia has been running a system known as CourseWorks since 2001. At the time it was implemented, many CMSs were homegrown and developed as an alternative to custom HTML-based home pages for individual courses. CourseWorks is based on one of those homegrown systems, Prometheus, originally developed by George Washington University.[3]

These first-generation course managements systems reinforce traditional hierarchies and norms in

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[2] Portions of this section are adapted from internal CCNMTL documentation written by A. Maurice Matiz, Vice-Director of CCNMTL and the services team of CCNMTL led by Daniel Beeby.

[3] The Prometheus code was released as a shared-source model, which allowed Columbia and other institutions to participate in the development of the application, a primary reason for its selection. Soon after signing up with Prometheus, it was purchased by Blackboard, Inc., who initially promised a continuing development cycle to improve the software, but that was short-lived as the company focused on its flagship product. This has been the status of Prometheus since then, with most of the enhancements performed internally by Columbia's IT staff. There has not been a major upgrade to the software by the vendor since 2002 and Columbia is the only major university using this platform.

higher education. Courses are at the top of the food chain, organized conveniently for the institution to feed in the authorized students and faculty and for faculty to transmit course content to students. Students are the receivers at the bottom of the chain, with a menu of isolated courses to move between in any one academic term. In any subsequent academic term, previous work is subordinated to a new menu of courses.

## Insert Web 2.0

The Web is now a more interactive place with a focus on "user-created" content, a change identified as Web 2.0 in the popular press. The transformative technologies loosely categorized as social software combined with web services are having a profound impact on teaching and learning. The first generation course management systems described in the previous section are too rigid. Web 2.0 can manifest itself in a shift away from a traditional teacher-student hierarchy and allows the teacher to become a facilitator to student learning. Additionally, devices used to participate in this space are evolving away from desktop computers to laptops and hand-held units, with increasing focus on media, leaving open a gap in asset and media management services accessible via most first generation course management systems.

Unlike services offered by traditional on-campus technology-based systems, teachers and students have commercial and open-source options that they can (and do) elect to use. Google Groups and Apps[4], Blogger[5], and Ning[6] are some of the external services that are in use by many courses and groups of learners today throughout the world. While there is a strong desire to remain "on campus" on the part of most instructors, there is also an inclination among faculty and students to abandon tools such as CourseWorks if the tools that they really want are available elsewhere. This balkanization of teaching and learning spaces has strong implications in the areas of intellectual property, security, privacy and copyright. It also impacts students since they must master many systems. Without effective infrastructure to host these kinds of services or to effectively integrate accepted external web services could lead to universities forfeiting the online space to numerous vendors ad-hoc, keeping in mind that this online space is as much a place as the classroom or the library.

## A Post-CMS World

Since its inception in 2001, CourseWorks has facilitated changes in curriculum and classroom interactions in many CU courses. However, the slowing pace of change of systems like CourseWorks relative to the Web-at-large underscores the need for a new, dynamic and extensible CMS solution that will grow and adapt to the changing needs of its users, while at the same time providing an impetus for change among those very users. To remain on the forefront of higher education, universities such as Columbia must find a method that fosters innovation among faculty and students and within the curricula of the institution.

Over the last five years, CCNMTL has been experimenting with methods for moving beyond the limits of a traditional CMS integrating Web 2.0 tools together in various combinations that we have come to refer to as *Loosely Coupled Tools*. For example, collaborative tools like weblogs (blogs) and wikis were not generally known in 2001, but are now commonplace at most campuses; services

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[4] http://groups.google.com and http://www.google.com/apps/
[5] http://www.blogger.com
[6] http://www.ning.com/

supporting podcasts are now readily available in most CMSs, but obviously not included in first-generation systems. The following are a few examples of CCNMTL's results to date:

## Wikis

Wikis (Hawaiian for "fast") are collaborative websites that enable users to quickly add, edit, and share multimedia content using basic word-processor-style tools. Columbia Wikispaces provides a wiki to every active registered course at Columbia University.

A course wiki allows you to:


*Columbia Wikispaces*

- Easily create, link, and revise pages in your course wiki.
- Use familiar editing tools that make it easy to add and edit text and images.
- Integrate Web 2.0 features and services, including RSS feeds, slideshows, maps, bookmarks, Google Docs, and YouTube videos.
- Add links to useful online resources to enhance your curriculum and promote group interaction.

Columbia Wikispaces can be used in a variety of ways to enhance teaching and learning. The simple, web-based wiki platform makes group activities and course management easy and efficient. Wikispaces is notably different from a course management system because of its ability for students to contribute multimedia content and to collaborate on assignments. Wikis simplify the process of publishing to a secure course website and they make peer-to-peer learning possible.

Faculty at Columbia are actively using wiki technology to:

- Function as a course management system - with syllabus, reading list, and course materials
- Promote and facilitate group projects or papers
- Facilitate close reading and analysis
- Allow for manual translation of text, video, or audio files
- Build a repository of resources for the course
- Conduct peer reviews of student papers
- Create student project portfolios with images, videos, and text

## Blogs

The word "blog" is an abbreviation of "weblog". A blog is a web publication that consists of a series of message posts (possibly with comments by visitors). Blogs archive each post chronologically, with the most recent posts showing up at the top of the main page.

For better or worse, blogs have become a significant part of our mainstream culture and public discourse. Since the first one was started in 1997, blogs have rapidly become the instrument of grassroots organizers and citizen-journalists, a PR tool for corporations and politicians, and the romping ground of juvenile exhibitionists and their voyeuristic visitors.

EdBlogs@Columbia is an environment that provides a blog for any course offered at Columbia University upon the course instructor's request. EdBlogs make it easy to share course content and create an online community using a blogging format. EdBlogs uses familiar, word-processor-style editing tools for adding and editing text and images, so it is easy to create, update, and revise posts in EdBlogs. Faculty and instructors may also customize their blog design and structure so that it meets their specific curricular goals. EdBlogs is powered by the popular Wordpress blogging service and each blog can be restricted to students and faculty registered in their respective course.

**A course blog allows you to**:

- promote classroom discussion
- conduct student journaling and reflective writing assignments
- create online portfolios


*Columbia EdBlogs*

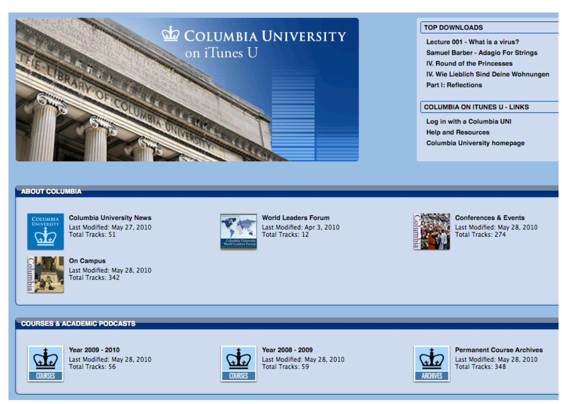
CCNMTL also runs its own blog, known as EnhancED at http://ccnmtl.columbia.edu/enhanced/ to provide faculty and instructors information about new technologies and hot topics surrounding education and technology, and to share expertise about these technologies and approaches to teaching with technology.

**Podcasting and Media Distribution**

Podcasting and Media focuses on the creation of audio, enhanced audio, and video for classroom use. The word "podcast" was born out of the concatenation of the words "iPod" and "broadcast", speaking directly to a method in which media files are offered via download to personal computers and that can be synced with portable devices. It has now become a term that is used to describe audio and video media that is syndicated on the Web via real simple syndication (RSS) technology. Podcasts can be distributed through Courseworks or other related platforms, such as Wikispaces and iTunes U.

At Columbia, faculty and students make use of podcasts in order to:

- provide students with a study aid they can review after lecture
- enable students to review the lecture before class to prepare for discussion and debate
- use on an ongoing basis as a reference for students
- demonstrate a task, procedure, or complex concept that would benefit from multimedia presentation and/or the ability to watch repeatedly




*Columbia's iTunesU Home*

## SIMULATIONS[7]

Computer-based simulations have a history as long as the development of the computer itself, dating back to the days of the Manhattan Project. One could argue that the technique of using simulations for teaching and learning (without technology) has been around for as long as students have been solving problems through role-play and the use of data, which in the United States could mean at least as far back as John Dewey's Laboratory Schools around the start of the 20th Century.

Taken together, computer simulations built specifically for teaching and learning have evolved over the past two to three decades to allow for the possibility of dynamic discovery-oriented learning.

### What is a computer-based educational simulation?

From CCNMTL's point-of-view, a simulation is a teaching tool with three components:

*1) A data model or set of algorithms that can be manipulated by the learner and provides dynamic feedback based on those manipulations*
The core of a simulation is a model of some kind that attempts to replicate some aspect of reality through a system of data, algorithms, and feedback. On its own, a data model (or simulator) can be an effective teaching and learning device if the learner is prepared to directly manipulate the model's parameters and respond to feedback without any further context[8]. But in many cases, further context and structure is needed. This comes in two parts:

*2) A role for the learner to adopt*
The objective of a role is to offer a point-of-view for the learner's actions. For example, perhaps you are the manager of a humanitarian assistance crisis or you are the investigator of a potential environmental contamination event[9].

*3) An objective to achieve or set of tasks to complete using the data model*
Since the data model does not teach directly nor does it lead the learner to act in one way or another, one often needs to present a problem or goal up front for the learner to target. Perhaps you are a farmer in a poverty-stricken village and your goal is to simply stay alive for 50 years (see the case example of the Millennium Village simulation to follow).

These three components together make up a simulation experience that can be a very engaging way to learn.

### When should you consider using a simulation?

Over the years, CCNMTL has elaborated five tenets for considering simulations as a strategy to enhance learning:

*1) Integrating seemingly disparate topics that have definable relationships*
It is very common in college programs today for there to be introductory courses that attempt to cover a wide range of seemingly disparate topics that nonetheless have some connection between them or that combine into some system of dynamic parts. In environmental science, this might be

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[7] This section is adapted from a blog post written in August, 2009 by the author on the CCNMTL EnhancED site found here: http://ccnmtl.columbia.edu/enhanced/primers/simulation_primer.html.
[8] For an example, see CCNMTL's Heart Simulator: http://ccnmtl.columbia.edu/projects/heart/.
[9] See CCNMTL and Barnard College's award-winning Brownfield Action simulation: http://www.brownfieldaction.org.

the relationships between human health, geology, and toxins. In public health, it might be the challenge of prioritizing disease vaccinations versus sanitation facilities versus food and water assistance with limited resources. In both examples, traditional courses might be organized into a series of lectures by different experts each with their own case studies or problem sets tied to his or her own specialty.

A frequent complaint from students and faculty in courses organized in this way is that students fail to see connections between topics and do not get a sense of the *big picture*. Because the content is siloed into isolated disciplines with the traditional approach, it is quite natural for this problem to occur. Using a simulation creates the possibility for a multi-disciplinary or multi-concept experience where the challenge might be to try different prioritization strategies in a public health emergency or to explore a simulated geological contamination where human health is at risk. In both cases, identifying the system relationships is necessary to solve the problem or to optimize the system's performance.

Simulations are tailor-made to address this integration problem, as they are in their most basic form a system of related dynamic parts that are meant to adjust and adapt to changing conditions.

*2) Learning a system or model of concepts through experimentation*
Some instructors have clear goals for teaching a system of concepts or a model, but they attempt to convey these concepts through didactic methods where students simply have to reproduce the model without really demonstrating any expertise in it.

As one might expect, most students are quite capable of this regurgitation, but when faced with a problem, they fail to show an ability to apply the model or set of concepts appropriately. This suggests that students will not be able to transfer the concepts to anything analogous they encounter in future courses or in their everyday experience. Furthermore, even if they are able to solve a problem using the model, students of more didactic methods will be unable to cope with new information or subtle changes to the model, suggesting an inability to generalize the skill to new situations.

Using a simulation with a deliberate discovery approach allows a learner to learn the model through experimentation with it. Rather than memorizing the relationships of a model as a given, students can be tasked with deriving the relationships through manipulating parameters in the model, thus creating their own mental model which they can more readily apply and adapt to new problems and situations.

*3) Practicing difficult, rare, or dangerous tasks*
There are situations where learners need practice at tasks that are especially difficult, rarely available, or dangerous. Imagine flying an airplane without a flight simulator experience or being asked to perform a rare surgical procedure without a trial run on a dummy patient. Simulations allow a learner to practice a string of difficult maneuvers many times over. They allow a person to have a virtual experience that otherwise might not be available to them based on space or time constraints.

*4) Decision-making and prioritizing*
Many college courses aim to teach good judgment - which ends up being translated into decision-making and prioritizing tasks where a learner is asked to operate with some combination of incomplete information and time or resource constraints. Case studies often are meant to address these same goals, and in certain instances, especially with a good instructor, they can be very

effective. What is sometimes missing, though, is the sense of the drama, perhaps in part because traditional case studies have a 20/20 hindsight element to them.

Simulations are a good way to create drama because they place you in situ and ask you to take action in the moment:

> *You are the Managing Director of the XYZ Mutual Fund. The Fed has just changed regulations that will have a major effect on how you currently operate. Every minute you don't respond, more of your shareholders are dumping their stocks and calling for your ouster. What do you do?*

Many simulation participants, both instructors and students, will tell you that acting in the moment feels more authentic and the in situ feeling adds to the learning experience by creating more motivation, heightened awareness, and a sense of immersion that helps block out distractions and stay focused on the learning experience. For many, their experience with simulation-style video games is similar. For example, some are not only willing but enthusiastic about spending many, many hours working at these kinds of games, losing track of time because of the immersion.

*5) Working with ambiguity*
A final piece often missing in college classrooms is a requirement for students to work with the unknown and find a way to move forward in the face of ambiguity. All too often, a student can simply ask (or wait) for the answer and plod forward in lockstep with their classmates. Then, when faced with a real-world job or a problem with a set of undefined objectives and no one to follow, that person is frozen, unable to move without that spoon that was feeding them everything they needed to move ahead.

By not directing the user, simulations require one to engage and decide what action to take, what parameter to adjust, and what option or strategy to explore. Many students are resistant to having to direct their own learning, perhaps because their prior schooling did not expose them to it very much, if at all. With the proper open-ended guidance from an instructor, students can learn to explore and create meaning for themselves using a simulation and walk away with the benefit of learning how not to be stymied in the face of ambiguity.

**Challenges of Simulations**
Simulations are not without their limits. Here are some of the most prominent challenges we've encountered to date:

*Inherently reductionist - You can't model everything*
Because simulations require one to reduce reality down to a set of data and equations, using them as a teaching and learning tool is inherently reductionist. Therefore, every simulation is subject to a critique of omission of a key component of any reality it tries to represent. For example, in the Millennium Village Simulation, the project team did not take cultural issues into account when creating the model. This was done because (1) culture was not part of the system being taught in the course it was designed for and (2) culture is very difficult to quantify into a set of algorithms. For simulations to be effective, designers and faculty have to make choices about what to represent and what to leave out of a model in order to reasonably reduce reality down to something that can be modeled for the purposes of teaching a particular set of concepts.

CCNMTL's approach is to deliberate carefully up front about which elements are of the highest priority and which will make the biggest educational impact for the given course objectives, and to design models that can incorporate changes and additions in future iterations.

*Require a commitment to discovery-oriented learning and related support*
Simulations will fail to reach their potential if the project team is unable to follow through with a student-centered discovery approach to learning. Occasionally, after building a simulation and implementing it in a course, faculty will fall back on traditional methods of dictating student work or conveying information at the first sign of student resistance (see previous points about learning through experimentation and working with ambiguity), removing two of the major rationales for choosing this kind of teaching strategy. In other cases, faculty will leave students entirely to their own devices, expecting students to learn on their own. This will also fail. Faculty need to take on a guiding role, which requires patience and a bit of a tough skin in the face of students not familiar with learning this way.

CCNMTL's approach here is to devote time to planning the classroom implementation strategy for the use of the simulation and providing consultation on how to assist students in a manner that encourages discovery, which could include working with lab instructors and TAs.

*More work to create than most other types of educational technology projects*
Because simulations rely on the creation of a model, they typically take a larger time investment up front before one can see the project's potential. Additionally, simulations require more testing than many other projects to ensure a balanced experience for the learner that will not reward mindless trial and error strategies or other "gaming" of the system to achieve the objective.

*More difficult to evaluate what students learn than many other types of educational technology projects*
Finally, because a simulation's learning objective is often problem solving skills, the capacity for good judgment, or a more affective emotional connection or awareness of course concepts, it can be especially challenging to develop assessments that demonstrate the learning that took place because of the use of the simulation. It is sometimes difficult to isolate these types of learnings down to the simulation experience and, therefore, one is often left having to be satisfied with correlating new skills gained by students to the use of the tool without being able to say that the simulation caused the learning.

CCNMTL continues to evolve its evaluation methods in effort to capture the experiences of students' use of simulations and is committed to working with its partners to demonstrate their effectiveness.

## CASE EXAMPLE: MILLENNIUM VILLAGE SIMULATION[10]

Dr. Jeffrey Sachs, Director of the Earth Institute of Columbia University and a global leader on issues in sustainable development (including development of the United Nations Millennium Development Goals[11]), has taught Challenges of Sustainable Development, an introductory undergraduate course, since 2005. It has no prerequisites and is required to fulfill the current special sustainable

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[10] This section was written in collaboration with J. Rob Garfield, Educational Technologist at CCNMTL.
[11] http://www.un.org/millenniumgoals/.

development concentration and upcoming sustainable development major. Enrollment is usually around 150 students who meet together in a large lecture hall twice a week and divide into sections (about 30 students each) for discussion once a week.

Sachs created the course as part of his extended efforts to demonstrate that extreme poverty is an understandable and solvable problem. In so doing he found that while, as an economist, he relies heavily on mathematical models that describe dynamics behind economic success or failure of a village in extreme poverty, students, although capable of mastering the mechanics of these models, often have difficulty drawing the connection between the economic models and real-world situations. Curriculum in the course was delivered in discrete "units" on economic growth and poverty, human demography, ecological topics (such as fisheries, climate change, biodiversity), environmental economics, and public health. Problem sets were also divided by topic: one problem set on economic growth and poverty traps, another on environmental economics and ecology, a third on epidemiology. Since the students usually had no prior experience in any of these fields, the problem sets needed to remain within a single discipline so that students could learn to manipulate each model individually.

Unfortunately, this approach did not effectively teach the students to solve problems across disciplines, a critical objective of the course. Sachs saw that undergraduates could solve a math problem based on an abstract economic or epidemiological model, but struggled to apply the solution to a descriptive narrative- based problem that required a more integrated understanding of all the influences affecting sustainable development. Since study in this field is not intended to stop at the theoretical dimensions of the mechanisms of poverty, Sachs felt it was of utmost importance that students develop the capacity to apply their knowledge when confronted with problems qualitatively similar to those awaiting them in the real world.

To address this concern, Sachs and CCNMTL developed the Millennium Village Simulation (MV Sim), a simulation tool and pedagogical approach modeled on CCNMTL's previous work in creating complex semester-long activities that require students to integrate their knowledge from different "units" of a course. The well-documented capacity of simulations to 1) increase student motivation and subject engagement, 2) serve a learner community of wide-ranging academic backgrounds, 3) provide individual control over the pace and direction of learning and thus increase student participation in large lecture hall classroom situations, 4) effectively represent complex subject matter in an integrated environment, 5) help students apply book knowledge to realistic situations, and 6) provide intelligible consistent narratives for complex ideas, made a simulation the most attractive solution for solving these particular curricular challenges. Further, while a simulation tool could provide an arena in which students could pursue the *integrated problem set* absent in the curriculum at that time, the lectures, materials, and discussion already part of the course could encourage them to look at the Millennium Villages work of the Earth Institute for real-world application of problem-solving both in these contexts and as models for other contexts involving similar trans-sector inputs.

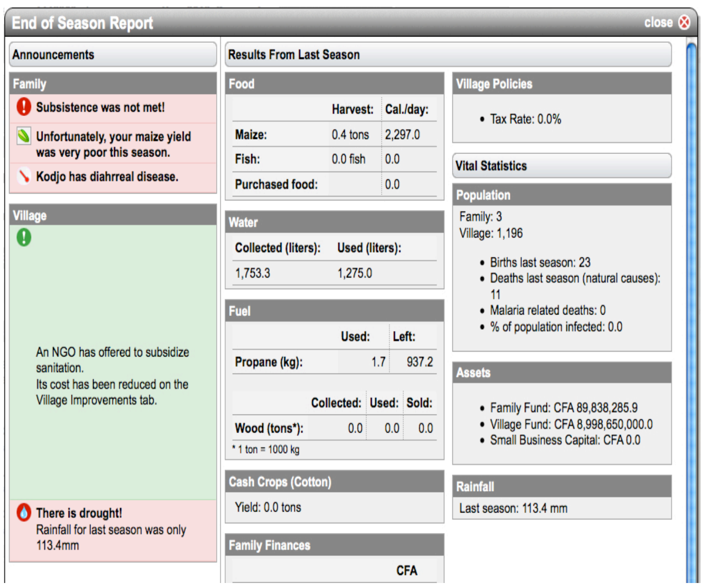
As implemented in Sachs' class since 2008, the MV Sim experience places the student in the role of two-person family in a small sub-Saharan village stuck in a poverty trap, where the savings rate is below the depreciation rate of their capital, and the assumptions of traditional economics models do not hold due to a demographic trap, a savings trap, or a capital threshold trap. The initial situation relates to the village itself and how an infusion of capital might break them out of the trap, but without it, the best resource optimization will only get a family through a 50-year cycle 90% of the time. The village can fish from the lake, and the students can apply their new knowledge of fisheries and the logistic curve to study whether the village is overfishing. Similarly, the villagers deforest because they need fuel wood, which process relates to the lectures and readings on deforestation. Villagers are susceptible to malaria, and during an epidemic the students can model the disease dynamics using the S-I-R (Susceptible-Infected-Recovering) model learned in lecture. Other health concerns are infused in the simulation, including water-borne and respiratory diseases along with "normal" illnesses like flu. Family interventions are conceived to either increase productivity or protect against catastrophes such as the aforementioned diseases, epidemics, soil depletion, and droughts. Village-wide interventions are also provided (for a labor/capital price) to give students a flavor for making decisions on a larger scale; these, too, address economic, agronomic, epidemiological, and educational issues. Within this framework, students are asked to make decisions about how to allocate their family's time to various activities, when to purchase improvements or interventions, when to borrow money, what kind of crops to farm, when/if to raise a family, and how to balance education and productivity. While making these decisions, students learn how to optimize resource management and understand the complex relationships amongst systems while, hopefully, developing a social consciousness of challenging and alien survival situations. This allows them to see, for example, the connections between the logistic growth model and its importance for the productivity, health, and economic capacity of a community.

Students enter the context of the MV Sim through the curriculum where core problems of sustainable development are represented to them through lectures, reading materials, and discussion sections. They are given supplementary assignments that require them to adopt a meaningful role and then to attempt to address these core problems within a simulation model's environment. The model, in turn, reacts to their input through a complex set of interdependent algorithms and reflects the results of their input through the feedback mechanisms of its interface. Through short written assignments, students then analyze their directed explorations within the simulated environment, tying them back into the context of the real-world problems delivered through the course curriculum. They are assessed on the quality and completeness of their analyses rather than their performance within the simulated environment.

Given the large size of the student population in the course, implementation strategies have initially focused on students using the simulation outside of lecture and discussing their results within their sections. A basic scaffolded approach that encourages experimentation is implemented in the design of the curriculum in which students are given basic information such as their role and goals, instruction on how to make decisions within the environment, and how to progress through the simulation. Students are then asked to answer questions about various real-world problems from the perspective of their experiences within the simulation and then apply them to what they were learning in lectures and readings, constructing critical arguments with regards to approaches currently being used in the field. Discussion section instructors can then focus on discussion of the issues of sustainable development as a discipline in itself without having to spend as much time clarifying connections between its constituent sub-disciplines.


*The MV Sim Interface*

The MV Sim is both a pedagogical approach and web-based simulation environment. The simulation experience places the student in the role of two-person family in a small sub-Saharan village stuck in a poverty trap. The center of the MV Sim environment is an interactive graphical area where students load sessions and engage with the systems of simulated models, making decisions for their families and for their villages while receiving visual and numerical feedback on the results of their actions. Decision-making is punctuated by the concept of "turns," where the student forward controls each movement of time.




*The End of Turn Report*

The student moves time forward in 6-month increments and receives an "End of Turn Report" of the results of decisions. Basic success criteria *within* a session are met when the student's family survives through the term of its assignments. Other goals are prescribed by assignment specifics and reinforced through the socio economic growth and stability of family and village. In addition to the report, feedback mechanisms within the tool include an achievement point system rewarding the health and financial growth of the family and village, histories of the results of every turn, and graphing tools for tracking critical variables over time to understand longer-term impact trajectories.

The rhythm of decision making and reviewing results supports experimental attitudes towards engaging with the simulation. Indeed, as students grow more familiar with the system through repeated play-throughs (i.e., completing the narrative arc of the simulation) and progressive exposure to the underlying concepts through readings and lectures, students become better able to deal with and plan for crises (such as epidemics, droughts, and resource stock failures) and grow in their understanding of the necessity of all the related factors. This concept of improvement with scaffolded practice is at the heart of the interdisciplinary character and the holistic approach to addressing the problem of extreme poverty in the developing world.

The models that "determine" results within MV Sim include logistic growth models for renewable resources and models of infectious disease, agronomic functions for determining crop yields, economic growth, and precipitation models, among many others. These, in turn, are interrelated such that repeated exposure to the simulation has the potential to promote deeper student understanding of the aforementioned models and how they interact to form a complex system that can react to inputs in both predictable and emergent ways. Finally, each model also includes a controlled dose of random variability, which adds realism by creating greater variance at emergent levels of complexity and by representing the critical element of chance in a fragilely balanced system. The tool itself includes user management, facilities for creating and managing sessions/games, links to outside resources, and general descriptions of the environment and its purpose.

One of the simulation's key resources, linked to within the tool's environment, is a complementary web site which houses player manuals, links to related simulation literature and, most importantly, a comprehensive encyclopedia of information related to each conceptual element simulated (with entries such as "Fertilizer," "Malaria Bednets," and "Latrines"). Each element contains background information and statistics, an explanation of its role in the dynamics of the MV Sim, an explanation of the element's significance in actual Millennium Villages, and links to readings for further information.

The simulation thus surpasses what can be achieved through traditional "pencil-and-paper" assignments by representing society as an interrelated set of social and natural systems. Whereas the traditional assignments serve to hone a student's skill at manipulating a particular model, they fail to drive home the lesson that the most interesting problems in the world involve several systems simultaneously and across academic disciplines. The justification for teaching sustainable development as its own field is to develop a unique cadre of students who will be comfortable working across disciplinary lines and who can think holistically about a situation such as a village in extreme poverty. The MV Sim, then, serves as the "multi-system and interdisciplinary assignment" and justifies to the student the need to study in an interdisciplinary fashion in order to adequately analyze and solve a sustainable development problem.

## ANNOTATION[12]

At CCNMTL, we see faculty wanting students to move past *reading-to-summarize* to a more active engagement with the content that we sometimes describe as *close reading*. Close reading emphasizes a search for meaning within important sub-elements of an object of study, such as a specific sentence of a poem or pigment in a tapestry, as a path to understanding the whole, such as an author's message, an historical event, or an entire culture.

Close reading, then, is not limited to text "reading" but can include video and images. The reading of non-textual sources is accomplished in different ways, and new media technology has enabled their study to occur in ways that traditionally have been limited to text. Regardless of the medium, the basic premise behind analysis of this kind is that all objects of human creation carry layers of meaning, each open to discernment and interpretation if closely examined, and each adding to the educational value of studying the object as a whole.

When students are given the task of close reading, they must decide what parts of an object are worthy of deeper study. This requires investigating early perceptions and scrutinizing possible significances. When they go on to research and describe interesting segments that they have identified, they begin to perceive significances that might otherwise have been hidden. As they test those perceived meanings against other observations, their engagement with the material increases and, in theory, the larger whole comes into focus.

### Annotation Defined

Annotations might appear as descriptive labels attached to parts of images, handwritten notes in the margin of an undergraduate textbook, or sticky notes containing comments stuck to a presentation poster. They amount to descriptions of some element, however small and fragmented from a whole, as interpreted by an observer. They can be created either for the benefit of the

[12] This section was adapted from the work of Tucker Harding, Educational Technologist at CCNMTL, whose blog post written in May 2010 on EnhancED can be found here: http://ccnmtl.columbia.edu/enhanced/primers/annotations_close_reading.html.

annotator as "notes to self", or serve as commentary for others, such as the editorial markings left by one student on the draft of a term paper for another.

Some would describe annotations as distinct from other forms of description because of their connectedness to the thing being described. For instance, an essay about a book exists separately from the book itself. Were someone to attempt to understand the essay in full, they would necessarily have to obtain a copy of the book, read it, and then attempt to connect the critic's thoughts and interpretations back to the source. An annotation, by contrast, exists upon the object being described. Its *embeddedness* allows the description to remain within the explicit context of the source. No reconnection needs to take place, and there is little room for doubt about what part of the object is being described, or its context.

Loosely defined, one might consider an annotation a form of commenting, something students do on their friends' blogs or Facebook pages in a social context (but perhaps with less scholarly focus). Bringing annotations into a course assignment can engage students in the material by employing familiar communication modes with an unfamiliar level of academic scholarship.

### How Annotations Improve Student Engagement With Content

Annotations can improve student engagement with content in a few ways. First, when students leave a comment on a specific word, sentence, or part of an object, their ideas or comments stay grounded in the object, preventing the description from shifting towards a student's prior knowledge, as is frequently seen when students quote text in a descriptive essay. Annotating text directly requires close attention to what the author has really said and the conversation remains grounded within the object being analyzed.

Second, students are led to consider carefully not just how they describe something, but prior to that, what should be described. This kind of descriptive decision-making requires awareness of the whole, which often requires that students read the text more than once and necessitates an active, investigatory approach.

Third, when an annotation is left on an object that serves to challenge the author/creator, the student must read the surrounding lines and pages carefully to make sure that A) she understands the author's intent, B) she understands the context of the problematic sentence, and C) the author has not addressed her challenge elsewhere in the text.

### Means of Effective Annotation

Annotations exist as a natural method of engagement with content, the most obvious example being the highlighted and marked lines of student textbooks--work that students do of their own accord, for themselves alone. Technology, however, has transformed the educational potential of annotations for teaching and learning. First, it enables the use of annotation to be applied to non-textual content. Second, it enables annotations to become more easily shared among students, and between students and instructors. Both have opened doors to new kinds of assignments, new dialogues among students and instructors, and improved and enhanced student projects.
There are three main media types that are amenable to technology-enhanced annotation.

## Text

Text can be annotated in many ways, largely because the format varies so much in the digital arena:

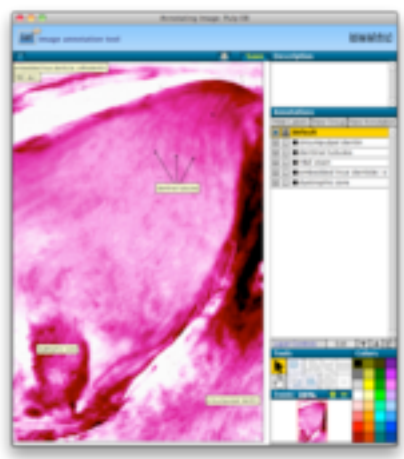
- static documents such as PDFs and office documents can be annotated with notes using "track changes" features or via "sticky notes";
- collaborative, dynamic documents, as found in a wiki, can be annotated with text embedded within the original, perhaps given a different font type, and also with hyperlinks leading from the source text to descriptions, such as seen in this example wiki;
- textual discourse and conversation, such as threaded discussion and forum spaces, can be annotated by the addition of comments and posts.

*Using a Wiki with sticky notes*

## Images

Using images as objects of study can be a powerful way of engaging students in course content. It is easy to imagine the benefits of annotating and describing parts of old maps in a history course, blueprints in an architecture course, or dig sites in an archeology course. Images can also be used to study larger phenomena--the macrocosms described earlier. For example, an ancient farming tool can become an important window into the culture and history of the people who used it when annotated and described with as much detail as possible. Evolving image annotation technologies can help students too:

- label parts of images with titles/names as a way of understanding a structure or constituency as might be found in a biology unit on cell structure, using tools such as CCNMTL's Image Annotation Tool[13];
- mark parts of images with brief or long descriptions of their meaning, or with questions about possible meanings as might be found in an art or material history courses, such done in the Engaging Digital Tibet[14] project;
- inter-relate two elements to highlight similarities or differences in an image (or across images) in an ancient cultures course;
- cut and paste pieces of images for use in textual or multimedia arguments, strengthened by direct visual evidence of the thing being described.



*Annotating an anatomy slide online*

## Video

Video can be an important educational resource in a variety of courses, and this has been the case for decades. Until recently, however, use of video in education was limited to "read-only" activities. Various new technologies encourage more active engagement with video content, maximizing their educational value. Using annotations for teaching and learning from video can be considered a method of perception education: training a student eye to perceive like that of an expert. Assignments that require students to perform close reading by using annotations help students ''do something'' with content, allowing them to perform closer analysis and craft stronger arguments.

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[13] http://ccnmtl.columbia.edu/portfolio/medicine_and_health/image_annotation_too.html

[14] http://ccnmtl.columbia.edu/portfolio/arts/digital_tibet.html

Video annotation assignments also help faculty understand what their students are seeing and thinking as they study video, and enable them to better accomplish teaching objectives.
Video annotation can take a few different forms:

- quoting video by creating clips and using them within multimedia essays using tools such as CCNMTL's VITAL (see the case example to follow);
- taking a "director's pen" to clips of video as might be found in a film class, using tools such as the web-based VoiceThread[15];
- freezing a frame via screenshot for deeper analysis, and then annotating the frames as described above in images.

CCNMTL has developed many techniques for interacting with course materials in ways that enrich the student experience, and improve and enhance learning. Annotation technology has been a major source of these enhancements to courses at Columbia. Over time, some key factors have emerged that lead to successful use of annotation assignments:

- If the goal is close reading, the more focused the assignment the better. It can sometimes be the case that having students spend four hours explicating a single paragraph will yield more important learning than if they were assigned the entire book.
- Faculty must frame the skill being developed (close reading/annotation) in a way that engages the students as active partners in knowledge development.
- Carefully consider the key teaching and learning objectives of the course and whether close reading is appropriate. If the goal is for students to get a general idea of a particular text or texts, then incorporating an annotation assignment might be the wrong way to go.

## CASE EXAMPLE: VIDEO INTERACTIONS FOR TEACHING AND LEARNING (VITAL)[16]

CCNMTL created a web-based system to help students manipulate video and use their selected clips as evidence to support arguments in a multimedia essay space. The VITAL software was designed as a mechanism to provide students with ready access to a collection of videos on course topics to help them bridge theoretical information in the readings with authentic (video) examples, and regular web-based opportunities to practice close viewing as a means of developing skills of observation, interpretation, and decision-making [6,7].

The VITAL web-based software was originally created specifically to support Herbert Ginsburg's graduate level course at Teachers College, Columbia University on early childhood math education entitled "The Development of Mathematical Thinking." Students in this course are typically working toward New York State certification in early childhood education (birth through age 8). Subject areas taught align with national recommendations and include coverage of everyday math, early number, shape, space, pattern and measurement, as well as written, symbolic math in the first few years of school. Students also learn methods of assessment, and are introduced to the cognitive processes involved in understanding, problem solving and metacognition. They consider issues of pedagogy and curriculum, including teaching with manipulatives and textbooks, and they learn to understand and analyze the complex strategies and knowledge involved in teaching (for example, pedagogical content knowledge, formative assessment, and creating a synthesis between the formal

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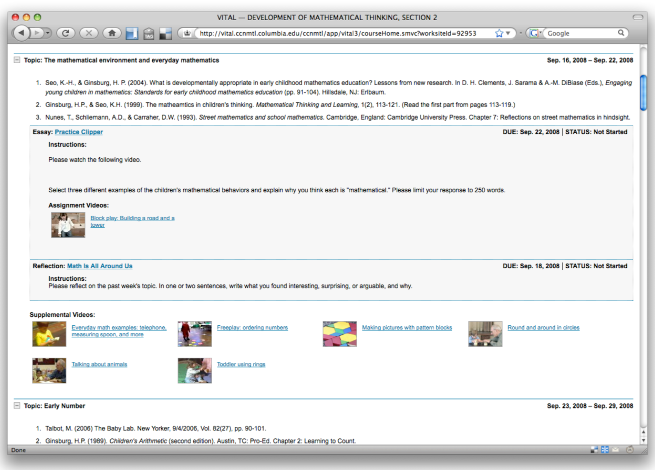
[15] http://voicethread.com
[16] This section was written in collaboration with Michael Preston, Educational Technologist at CCNMTL.

and the informal.) Each assignment in the syllabus is accompanied by videos of teachers working with young children to illustrate the concepts. The original VITAL software enables students to access the video content outside of lecture, and gives them opportunities to practice their skills of observation, interpretation, and decision-making with respect to teaching and assessment. These techniques are explicitly taught as well as modeled in class by Ginsburg.

VITAL allows the development of courses in which students can increase their understanding of under controlled conditions. Research on student learning in VITAL has covered a wide range of topics, including observation as a context for interpretation and critical thinking, extending psychological theories into context-specific case analyses, manipulating video in order to improve the use of evidence in interpretation, adaptations of classroom pedagogy to accommodate online learning experiences, and creating new measures of student learning for rich multimedia contexts. The VITAL software has been disseminated throughout Columbia University and deployed by a wide range of schools and departments, including teacher education, social work, clinical psychology, film studies, communications, and others, and beyond Columbia to our partners in the VITAL early childhood math project.

## Ginsburg's Use of VITAL

The course syllabus in VITAL tracks the syllabus of Ginsburg's Development of Mathematical Thinking course. Students in the course are taught to use VITAL regularly, in conjunction with readings and lectures, to view videotaped examples of children engaging in mathematical activities, and to complete analytical assignments that require them to interpret the videos and develop and defend hypotheses about children's mathematical thinking and learning.

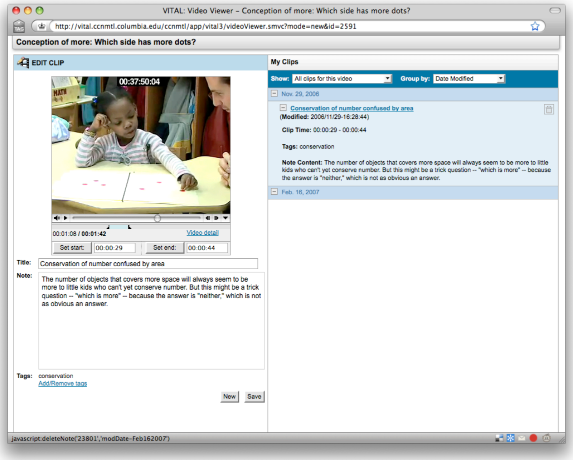



*One session in a VITAL course syllabus.*

*A course syllabus page in VITAL looks like a conventional syllabus, with a list of topics, readings, and assignments, but it also includes a selection of videos for each topic that can be viewed by clicking on the links embedded in the page. Videos open in an interactive viewer.*

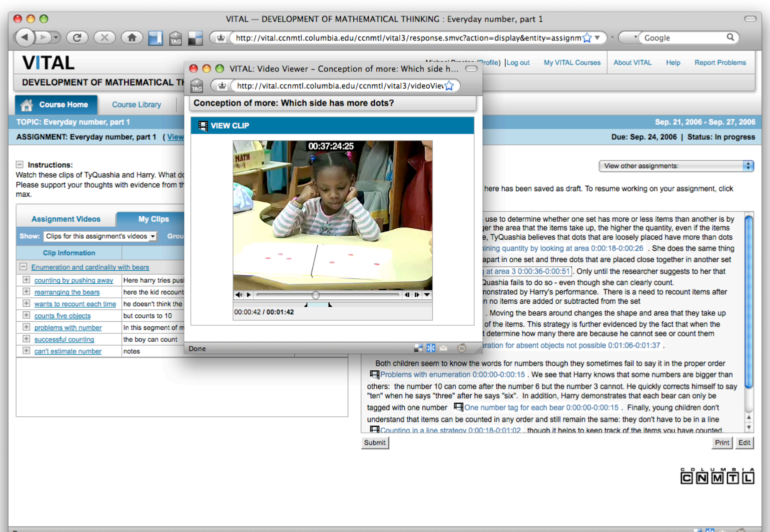
*VITAL video viewer.*

*The video viewer provides tools for clipping and taking notes on specific segments of video. These clips and notes are collected in the right-hand column, similar to writing notes in the margin of a text.*




VITAL's video viewer enables students to select and clip segments from the videos, and attach a note to each clip to help them remember the significance of the content. Clips and notes are saved in a personal workspace where they can be accessed later and used to support an essay.

In the multimedia essay space students integrate their clips of teachers working with children into their text. In a typical course, students write essays of 350 words or fewer in response to questions such as, "What does this child understand about cardinality? Please cite from the videos and the readings." Assignments encourage students to develop their own hypotheses and select evidence from the course material that supports their argument. Completed essays are "published" within the VITAL environment to be read by the instructor and other students. The instructor can also leave feedback for the student.




*VITAL multimedia essay space.*

*In the multimedia essay space, clips collected in the video viewer appear on the left, from which they can be integrated into the essay text area on the right. Faculty reading a "published" essay in VITAL can view a student's selections of video-based evidence while reading the text-based argument.*

Students complete a series of guided lessons in clinical interviewing. Assignments are designed to simulate an interview by stepping students through videotaped interviews and prompting them to interpret the child's behavior and the interviewer's technique, to anticipate what the child will do next, and to make recommendations for subsequent questions.

Students write a weekly reflection in VITAL within 24 hours of class, which is the concluding event for the week and serves as an opportunity to express what they learned, pose questions, and dispute ideas discussed in class.

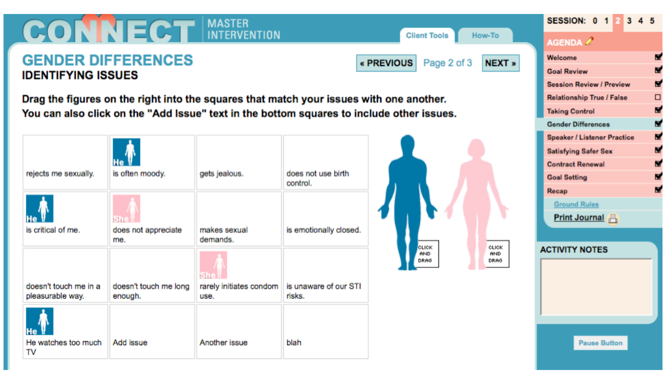
In the final month of the course, students design a mathematical lesson or activity, try it out with a child, and interview the child afterward to find out what he or she learned. The student records these events, submits the tape for inclusion in the VITAL library, and writes a research paper, in the form of an extended multimedia essay that details the literature, methods employed, and results obtained. The final project integrates the math content learned in the course with the assessment skills associated with clinical interviewing. The report submitted in VITAL also serves as a demonstration of the students' ability to think critically about the work they are doing as teachers and what a child might be learning as a result. An evaluation rubric meeting national teacher accreditation requirements is used to assess student work.

The VITAL code base has been released as an open-source software project via the Google Code repository (http://tiny.cc/vitalcode) both as a mechanism for disseminating our work and for inviting collaboration from other software developers interested in extending or adapting our code and contributing to the VITAL project.

## THE TRIANGLE INITIATIVE: THE INTERSECTION OF RESEARCH, EDUCATION, AND COMMUNITY SERVICE

Professors Nabila El-Bassel and Susan Witte, and Louisa Gilbert, senior researchers of the Social Intervention Group (SIG)[17] at the Columbia University School of Social Work, developed and tested Project Connect, an HIV prevention intervention for couples, beginning in 1997. Once they proved the effectiveness of Connect's six-session program, however, they found two substantial barriers to wide dissemination: implementation required a box-load of peripheral materials and the skills of an advanced clinician. When they met CCNMTL in 2005, the SIG researchers were looking for ways to both enhance and streamline their intervention.

Engaging in CCNMTL's Design Research methodology, the SIG/CCNMTL team embarked on an extended discovery phase. SIG learned about the range of possibilities digital media could support while CCNMTL became conversant with the content, process, and theoretical underpinnings of the intervention as well as the materials that accompanied each session: videos, anatomical models, condoms and other prophylactics, and charts.




*The Multimedia Connect Interface*

Multimedia Connect[18], as the new project is known, is now a unified, web-based environment enriched with images, custom video and interactive games replaces the box of physical objects and the hefty paper-based intervention and training materials. The sessions are organized within the environment as a roadmap that is used both to train facilitators and perform the intervention itself. As a result, the training can be more consistently delivered to a

[17] http://www.columbia.edu/cu/ssw/sig/

[18] http://ccnmtl.columbia.edu/portfolio/training/sig_project_connect.html

broader base of community health workers who, in turn, use the same environment in their actual delivery of the intervention. The computer environment also includes extensive resources on general knowledge and practice skills as well as "how-to" instructions for each session.

One of the unforeseen benefits of conceptualizing and designing Multimedia Connect was the realization that digital media provides a unique means to bring the often disparate goals of Columbia University - research, education and service to the community - in much closer harmony. In reflecting on what had been accomplished, it is apparent that the creation of Multimedia Connect simultaneously contributed in direct and significant ways to (1) advancing the research SIG pioneered by positioning the group to study a large- scale dissemination of their proven intervention and (2) exploring the potential of new media in a more generic sense to provide unique support for community public health and human services efforts. Furthermore, Multimedia Connect and specific elements within it (such as a social support network mapping tool) enrich the classrooms of social work and public health programs among others. Most obviously, Multimedia Connect has a direct and positive effect on the community, which is the target audience to begin with. In other words, a single media product maintaining its constructed identity without significant modification directly contributes to research, education and the welfare of the community.

These realizations inspired CCNMTL to create the Triangle Initiative (http://ccnmtl.columbia.edu/triangle/) to look for other opportunities to accomplish the same three-part research-education-community combination.

## CASE EXAMPLE: MASIVUKENI[19]

CCNMTL and Dr. Robert Remien, a research scientist at the HIV Center for Clinical and Behavioral Studies and associate professor of clinical psychology (in psychiatry), received a grant from the National Institute of Mental Health (NIMH) to create and pilot Masivukeni, a multimedia version of an HIV-treatment adherence program, SMART Couples, that has been effective in New York City HIV care clinics. The grant allows the program to extend its reach to South Africa, which has one of the highest rates of HIV in the world. Originally named SMART+SA, Masivukeni also aims to enrich Columbia courses at the Mailman School of Public Health and other programs focused on health disparities.


*An adherence exercise in Masivukeni*

Masivukeni, which loosely translates to "let's wake up" in Xhosa[20], is a computer-assisted program that supports counselors at health clinics in Cape Town, South Africa in assisting HIV-positive adults to adhere to their antiretroviral drug regimens through a combination of education and support. The program uses enhanced text, imagery, animations, audio, and video to teach the basics of how HIV and antiretroviral medication affect health, and to build problem solving and social support skills that patients can use to overcome barriers to treatment

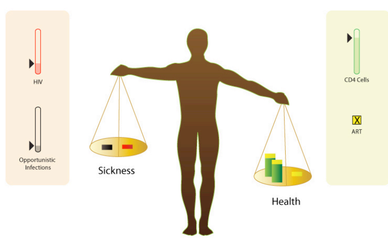
[19] This section was written in collaboration with Jessica Rowe, Senior Program Specialist for the Triangle Initiative at CCNMTL

[20] Xhosa is one of the official languages of South Africa and is commonly spoken in the area where this project was implemented.

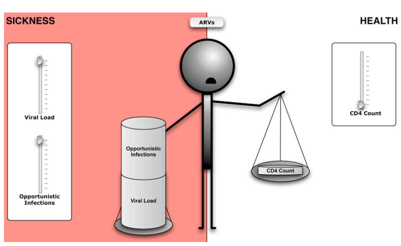
adherence. Research partners and community stakeholders from Cape Town provided guidance on Masivukeni's design, language, and skill-building activities to ensure that the program incorporated culturally relevant themes.

The CCNMTL team worked with Dr. Remien's team, researchers from the University of Cape Town, and counselors and nurses at the Hout Bay clinic over a period of six months. The research period kicked off with a two-week visit to Cape Town and the Hout Bay clinic to learn about the systems already in place and interview representative counselors, patients and nurses. After returning to the U.S., CCNMTL and Dr. Remien's team remained in close contact with the Hout Bay clinic staff and developed the intervention content collaboratively with them.

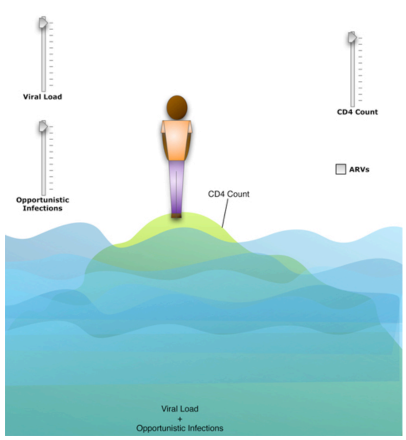
The intervention consists of several interactive activities that counselors, patients, and support partners do together over the course of several sessions. To give you a more granular sense of how CCNMTL does its design work, the example to follow lays out how one activity in the intervention was developed. These illustrations represent the development of a metaphor to explain the relationship between viral load, opportunistic infections and CD4 count and how the relationship between these factors affects the body.



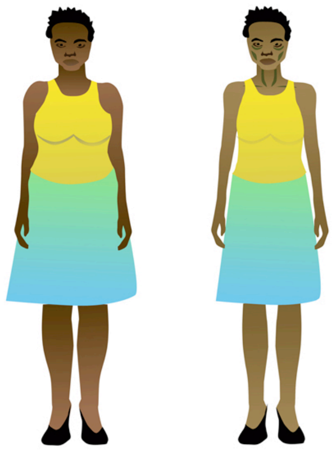

*The team started with the metaphor of a scale, placing health-improving factors on one side and illness-increasing factors on the other.*



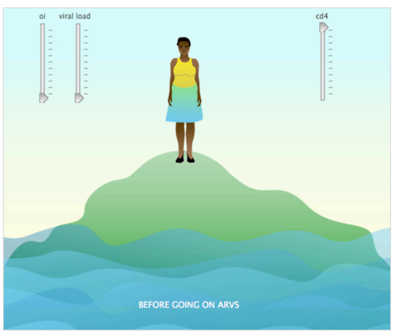

*Based on responses from the Hout Bay clinic team, color was used to emphasize which side of the scale was 'winning.'*



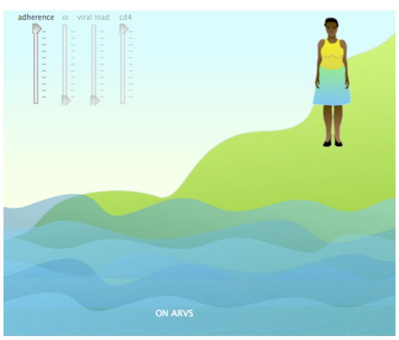

*Based on more feedback from Hout Bay, the scale metaphor was dismissed as too confusing, and the team moved to the idea of rising water.*



*The Hout Bay staff collaborators found that comparing the progression of HIV/AIDS with illustrations of a sickening body to be a useful conversational aid with patients....*




*So, more realistic illustrations were added, including a body that reflects the health state represented by the water height.*




*Finally, designers also give the figure at the water's edge agency. When the patient is on treatment, controlling adherence controls the negative health factors, allowing the figure to 'climb up the mountain.'*

The above exercise is just one of several contained within the six-session intervention, but the collaborative nature of the entire design phase of the project has led to multiple positive outcomes for the project as a whole.

In March 2009, a team from CCNMTL and the HIV Center for Clinical and Behavioral Studies trained two adherence counselors at the Hout Bay clinic to deliver Masivukeni to thirty patients who are experiencing challenges adhering to their HIV treatment. Based on results from this pilot project, CCNMTL and the HIV Center will research and explore ways to implement a broader study of Masivukeni. The clinic staff and peer counselor volunteers are invested in seeing the project though and have carved out space and time for the pilot test to take place. When the test is completed, the clinic looks forward to using elements of the intervention with future patients.

## GLOBAL LEARNING

CCNMTL's Global Learning Initiative begins with Columbia's commitment to a new level of global engagement and marries it to the power of network technology, creating new opportunities for collaborations that enrich the university's educational programs.

Globalization is most often associated with the increasing economic and cultural dominance of a very narrow cast of commercial interests and individuals. The ubiquity of American fast food, music and movies are the most obvious symbols, meanwhile the environmental repercussions of unregulated globalization are intensifying. Digital technologies are among the most important tools used to enhance and consolidate the power of the few. In the teaching and learning arena, the use of these technologies most often follows a commercial logic where the primary interest is to increase revenue by extending one institution's reach and access to additional students. The most creative, imaginative and transformative potentialities of these technologies have, heretofore, mostly remained untapped.

At the same time research universities, Columbia among them, have committed themselves to a new level of global engagement. This commitment has taken the form of creating more courses, programs of study, satellites of the university in other countries, research institutes, and events focused on global issues. Meanwhile, advances in networked communications are giving rise to new possibilities for teaching and learning.

CCNMTL's Global Learning projects are active demonstrations of distributed learning that mobilize the power of a diverse set of learners in different locations who can explore the multidisciplinary problems of our interconnected world. Instead of seeing distance as a barrier, these projects embrace diversity of location and culture to inform and enrich both individual and collective educational experience. Global Learning projects also have as their goal the development of new professional cultures and/or communities of practice. Areas of human concern such as health, the environment, education, and economic development become the natural subjects of the initiative.

### CASE EXAMPLE: GLOBAL CLASSROOM AND MASTER'S DEGREE IN DEVELOPMENT PRACTICE[21]

In January of 2008, Columbia's Center for New Media Teaching and Learning (CCNMTL) worked with faculty partner and Earth Institute director Jeffrey Sachs to launch an entirely new way to offer a graduate-level course in sustainable development. The semester-long course, "Integrated Approaches to Sustainable Development Practice," aimed to provide students with a general introduction of the basic core competencies and practical skills required of a generalist development practitioner. While the challenge of the course, content-wise, was to bridge key content areas in the health sciences, natural sciences, social sciences, and management, the challenge of the course's delivery was perhaps even more ambitious – it was to be offered simultaneously at more than twelve different institutions around the globe, including locations in China, France, India, Nigeria, Malaysia, and the U.K., among others.

The challenges related purely to subject matter are to provide students with functional knowledge of the core technical skills required to solve professional problems within the field of sustainable

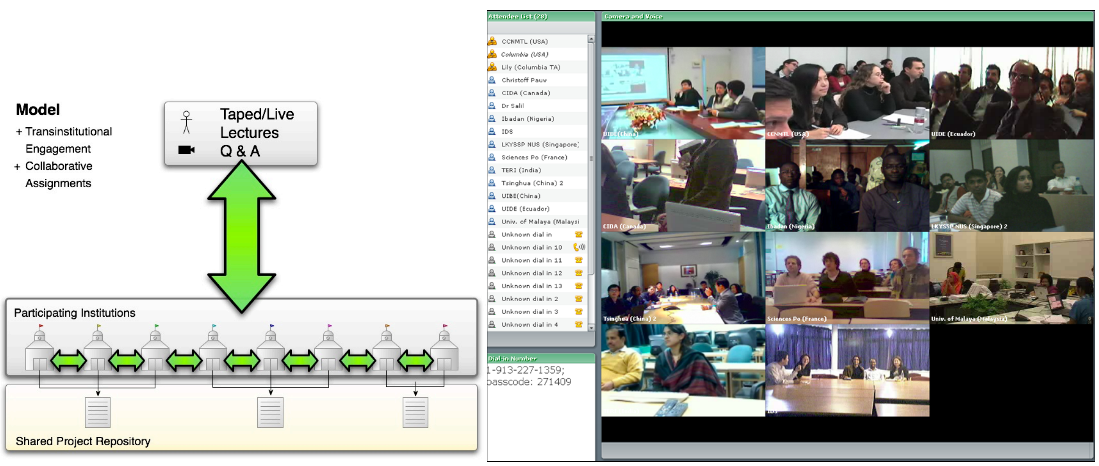
[21] This section was written in collaboration with Ashlinn Quinn, Senior Program Specialist of the Global Learning Initiative at CCNMTL, and uses excerpts from Moretti, Frank, Ryan Kelsey and J. Rob Garfield. "Mobilizing Design Research to Extend the Global Power of Digital Media in Education: The MacArthur Commission's Global Classroom Project on Sustainable Development and the Millennium Village Simulation." Proceedings of the International Mobile and Computer Aided Learning Conference (2008).

development; to construct new understandings of the work of sustainable development through a demonstrated awareness of cross-cultural, multi-disciplinary, multinational dimensions of the field; to have students demonstrate functional knowledge through the analysis and diagnosis of real-world problems; and to enable students to determine an appropriate course of action when faced with a complex development challenge.

An equally challenging part of the course relates to the fact that the course is being offered as a common experience on five continents. The challenge is to balance the desire to see a common global educational culture take shape focused on the issues of sustainable development, with awareness that local difference can be extreme in the way that it drives priorities. The larger opportunity is to take a step in defining the parameters of what the global learning environments of the future will be.

If the design of the course is able to balance the technology-facilitated distance and globally cooperative dimensions of the learning experience with focused local activities and instruction, students will receive the necessary knowledge drawn from the range of necessary disciplines, develop problem-solving skills by addressing problems of sustainability in their local areas, while, at the same time developing an awareness of the global character of the problems and issues, and the necessity for collaboration and cooperation.

The figures below represent an early visualization of the project during the discovery part of the process that has survived scrutiny and approximates our effort to balance the focused local work with the global sharing and community building and a screen capture of one of the global videoconference sessions[22].




*Global Classroom Model and an image of the synchronous online videoconference.*

By Spring of 2010, this Global Classroom course has now been offered three times, and has become a core component of a newly-launched Master's program in Sustainable Development Practice (MDP), a degree to be offered by 10 universities in 2010-11 and expanding up to 20 universities by 2011-2012. Over time, the technological framework for the Global Classroom course has been iteratively refined, adjusted, and re-deployed based on experience and evaluation, and the Global Classroom model is now poised to expand to other areas of the Columbia teaching community, for any implementation that shares a similar "distributed learning" model of collaborative learning. At

[22] Videoconferencing was done using Adobe Acrobat Connect Pro: http://www.adobe.com/products/acrobatconnectpro/.

the same time, a dedicated web platform has been launched to support networking and knowledge sharing among participants in the global MDP community.

The characteristics of the model, supported by a mixture of custom and enterprise technologies, include the following:

- Shared syllabus implemented locally at each institution
- Class sessions held as live global discussions, using web conferencing technology to enable global participation
- Shared course content, including videotaped lectures from expert practitioners, complementary readings, shared assignments
- Course management site accessible to all participants, including global discussion forums for students and instructors
- Custom social network to extend engagement beyond the classroom
- Ongoing development of myriad educational resources (video case studies, stand-along modules, et cetera) to form the basis for a repository of educational content.

CCNMTL will be actively evaluating the effectiveness of the above model in the coming years as more universities join the network and the design and use of the various tools are customized based on the goals of the global network of participating institutions.

CCNMTL is also actively engaged in seeking new projects under this same rubric of Global Learning (http://ccnmtl.columbia.edu/globallearning/).

**LOOKING AHEAD**

CCNMTL is committed to continuing to build on the above-mentioned projects and services as well as a host of others beyond the scope of this paper, but there are always new emerging areas. Here is one:

CCNMTL believes the means by which people will learn and engage with the world will more and be augmented by a small network-connected device they will carry with them at all times – in other words, a mobile phone. Many people already carry around something with more computing power than many desktop computers from the 1990s, and these devices and the networks that connect them are improving at such a rapid rate that it is possible to imagine a not-too-distant future where your geographic coordinates will no longer be a limiting factor in your ability to learn. The challenge is how to make the most of this emerging opportunity with effective pedagogical strategies and active curriculum for the always-connected global citizen.

Over the next decade, CCNMTL expects to expend significant energy towards imagining how people can best leverage these mobile tools towards educational practices from scientific data collection and analysis to urban exploration of historical sites to healthcare delivery in remote areas, among others.

In other words, stay tuned. The next decade has only just begun.

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Ryan Kelsey is the Associate Director for Education and Research at CCNMTL. Since 1999, Dr. Kelsey has directed a wide assortment of projects, including simulations, annotation tools, health and community-based projects and global programs. He wrote his doctoral dissertation on and was the co-creator of *Brownfield Action*, an environmental site assessment simulation that was funded twice under the NSF's Course, Curriculum, and Laboratory Improvement program and was winner of a Science Education for New Civic Engagements and Responsibilities (SENCER) award for outstanding undergraduate curriculum from the Association of American Colleges and Universities. He is also an Adjunct Assistant Professor for the department of Mathematics, Science, and Technology in Education at Teachers College. He received his M.A. and Ed.D. from Teachers College, Columbia University and his B.S. in biology from Santa Clara University.

## ACKNOWLEDGEMENTS

All the project and service work and the ideas discussed in this article are a collaborative effort between an extraordinary team of nearly forty CCNMTL professionals and the faculty and researchers of Columbia University, of which there are too many to mention. It is a great privilege to be able to represent a sampling of the work that has been done over the last ten years by so many dedicated educators and specialists.